

Table of Contents

Contents	6
Chapter 01:The Child	8
Chapter 02:Child Health Scenario	10
Chapter 03:Examination of A Child:Crucial to Remember	13
Chapter 04:Growth and Development	14
Chapter 05:Infant and Young Child Feeding(IYCF)	22
Chapter 06:Integrated Management of Childhood Illness[IMCI]	27
Chapter 07:Childhood Immunization and Vaccine Preventable Diseases	34
Chapter 08:Newborn and Common Neonatal Problems	54
Chapter 09:Nutritional Disorders	80
Chapter 10:Cough and/or Difficult Breathing	97
Chapter 11:Diarrhoea	112
Chapter 12:Vomiting	118
Chapter 13:Abdominal Pain	121
Chapter 14:Constipation	124
Chapter 15:Sore Throat & Difficulty in Swallowing	126
Chapter 16:Undue Exhaustion to Normal Activities	128
Chapter 17:Joint Pain and Swelling	145
Chapter 18:Fever and Rash	155
Chapter 19:Prolonged High Fever	162
Chapter 20:Jaundice	173
Chapter 21:Blood Vomiting	179
Chapter 22:Generalized Lymphadenopathy	182
Chapter 23:Pallor or Anaemia	187
Chapter 24:Pallor,Bleeding and Fever	198
Chapter 25:Bruising and Bleeding	205
Chapter 26:Puffy Face and Scanty Urine	214
Chapter 27:Dysuria	227
Chapter 28:Sudden Paralysis	230
Chapter 29:Convulsion	237
Chapter 30:Developmental Delay	253
Chapter 31:Abnormal Behaviour	261
Chapter 32:Short Stature	265
Chapter 33:Difficulties in Movement and Posture	270
Chapter 34:Accidents and Emergencies	277
Chapter 35:Parasitic Infestations	287
Chapter 36:Common Surgical Problems of Children	293
Chapter 37:Fluid,Electrolytes and Acid-Base Homeostasis	311
Chapter 38:Instruments & Procedures in Paediatrics	319
Chapter 39:Model OSPE for Practice	328
Annexure	334
Index	359

Step on to
PAEDIATRICS

3rd Edition

Md Abid Hossain Mollah
Nazmun Nahar

THIS EDITION PROVIDES -

- **To the point symptom based discussion on the common child health problems, in accordance with the undergraduate medical curriculum**
- **Updates on managements adopted from different national and international guidelines and websites**
- **Illustrations of clinical signs through about 500 coloured photographs of patients**
- **Pictorial presentation of common surgical problems of children, birth injuries, RDS and paediatric practical procedures**
- **Inclusion of management of haemolytic diseases of newborn, Wilson disease, posterior urethral valves and dog bite**
- **Addition of 4 new chapters' e.g. short stature, abdominal pain, constipation and common behavioral abnormalities of childhood**
- **Comprehensive discussion on fluid, electrolytes & acid-base homeostasis and correction of common electrolyte abnormalities**
- **A model chapter on Objective Structured Practical Examination (OSPE)**
- **Sections on self-assessment of the students at the end of each chapter**
- **Relevant annexure on practical case management issues including neonatal jaundice, growth chart etc.**

Step on to **PAEDIATRICS**

Md Abid Hossain Mollah

MBBS, FCPS (Paediatrics), Diploma in Medical Education (UK), FACP (USA), FRCP (Edinburgh, UK)

Professor & Head, Department of Paediatrics
Dhaka Medical College, Dhaka, Bangladesh

Nazmun Nahar

MBBS, FCPS (Paediatrics), FRCP (Edinburgh, UK)

Ex-Professor & Head, Department of Paediatrics
Dhaka Medical College, Dhaka, Bangladesh

Professor of Paediatrics & Director General
BIRDEM, Dhaka, Bangladesh



JANUARY 2016

TOMORROW IS TOO LATE

We are guilty of many errors and many faults.
But our worst crime is abandoning the children,
Neglecting the fountain of life,
Many of the things we need can wait,
The child cannot.
Right now is the time his bones are being formed,
His blood is being made and his sense are being developed
To him we cannot answer 'tomorrow' .
His name is 'today'.

Gabriela Mistral

Nobel Laureate (Chile, 1889 — 1957)

CONTENTS

Chapter 01: The Child	1
Chapter 02: Child Health Scenario	3
Chapter 03: Examination of A Child: Crucial to Remember	6
Chapter 04: Growth and Development	7
Chapter 05: Infant and Young Child Feeding (IYCF)	15
Chapter 06: Integrated Management of Childhood Illness [IMCI]	20
Chapter 07: Childhood Immunization and Vaccine Preventable Diseases	26
Chapter 08: Newborn and Common Neonatal Problems	46
Chapter 09: Nutritional Disorders	72
Chapter 10: Cough and or Difficult Breathing	89
Chapter 11: Diarrhoea	104
Chapter 12: Vomiting	110
Chapter 13: Abdominal Pain	113
Chapter 14: Constipation	116
Chapter 15: Sore Throat & Difficulty in Swallowing	118
Chapter 16: Undue Exhaustion to Normal Activities	120
Chapter 17: Joint Pain and Swelling	137
Chapter 18: Fever and Rash	147
Chapter 19: Prolonged High Fever	154

Chapter 20: Jaundice	165
Chapter 21: Blood Vomiting	171
Chapter 22: Generalized Lymphadenopathy	174
Chapter 23: Pallor or Anaemia	179
Chapter 24: Pallor, Bleeding and Fever	190
Chapter 25: Bruising and Bleeding	197
Chapter 26: Puffy Face and Scanty Urine	206
Chapter 27: Dysuria	219
Chapter 28: Sudden Paralysis	222
Chapter 29: Convulsion	229
Chapter 30: Developmental Delay	245
Chapter 31: Abnormal Behaviour	253
Chapter 32: Short Stature	257
Chapter 33: Difficulties in Movement and Posture	262
Chapter 34: Accidents and Emergencies	269
Chapter 35: Parasitic Infestations	279
Chapter 36: Common Surgical Problems of Children	285
Chapter 37: Fluid, Electrolytes and Acid-Base Homeostasis	303
Chapter 38: Instruments & Procedures in Paediatrics	311
Chapter 39: Model OSPE for Practice	320
Annexure	326
Index	351

CHAPTER 01

THE CHILD

Children are the future asset and hope of a nation. They are the foundation of future development.

WHO IS A CHILD?

The United Nations Convention on the Rights of the Child defines - "A child means every human being below the age of eighteen years unless under the law applicable to the child, majority is attained earlier."



ACCORDING TO CHILD ACT 2010 GOVERNMENT OF BANGLADESH - "ANY PERSON UNDER AGE 18 IS TO BE REGARDED AS A CHILD."

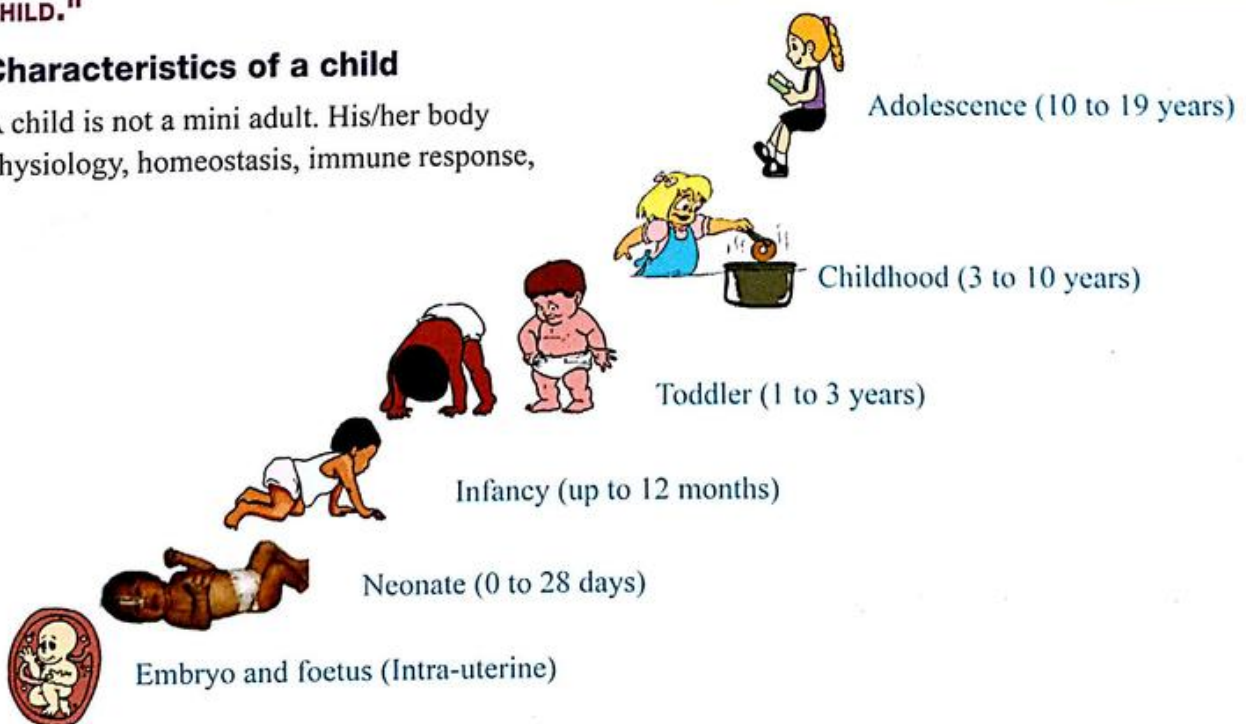
Characteristics of a child

A child is not a mini adult. His/her body physiology, homeostasis, immune response,

illness /disease pattern, his/her basic or nutritional needs etc. are different from that of an adult. He/she grows up everyday towards maturity passing through different stages of life.

Stages of a child's life

- Intrauterine period:
 - * Ovum: 0-2 weeks
 - * Embryo: 2-9 weeks
 - * Foetus: 9 weeks to birth
- Neonatal period: Birth to 4 weeks of age
- Perinatal period: 28th weeks of gestation to the 7th day after birth
- Infancy: Birth to 1 year of age
 - * Early infancy: Birth to 6 months
 - * Late infancy: 6 - 12 months
- Toddler: 1-3 years of age
- Childhood: 3-10 years of age
- Adolescence: 10-19 years of age



STAGES OF A CHILD'S LIFE

What is Paediatrics?

Paediatrics (also spelled pediatrics or pædiatrics) is the branch of medical science that deals with the medical care of infants, children, and adolescents. The word “paediatrics” means “healer of children”; and is derived from two Greek words: (pais = child) and (iatros = doctor or healer). The sole discipline is concerned with

all aspects of well being of infants, children, and adolescents, including their health, their physical, mental and psychological growth & development. A paediatrician is a child's physician who provides not only medical care for children who are acutely or chronically ill but also provides preventive health services for healthy children.

References

1. Government of the People's Republic of Bangladesh. Ministry of Women and Children Affairs. National Child Policy (Jatio Shishu Niti) 2011.
2. Office of the United Nations High Commissioner for Human Rights. “Convention on the Rights of the Child” The Policy Press.
3. Government of the People's Republic of Bangladesh. Ministry of Health and Family Welfare. Directorate General of Health Services. Health Bulletin, 2008.
4. MM Aminul Islam. Definition of Children and Age Determination. The Administration of Juvenile Justice: International standard [Internet]. Available from: http://www.bsafchild.org/save/juvenile_justice4.php.
5. United Nations. Child Rights document. 1999.
6. www.news-medical.net/health/Pediatrics-What-is-Pediatrics.
7. Bonita F. Overview of Pediatrics. In: Kliegman RM, Stanton BF, Geme III JWS, Schor NF, Behrman RE. Editors. Nelson Textbook of Pediatrics, 20th Edition. New Delhi: Elsevier; 2016.

SELF ASSESSMENT

Short answer questions [SAQ]

1. What are the stages in a child's life?
2. Who is a child?
3. What is infancy?
4. Who are adolescents?
5. What is Paediatrics?
6. What are the roles of a Paediatrician?

Multiple choice questions [MCQ]

1. Toddlers are children whose age is in between
☐ a) 1 month to 1 year ☐ b) birth to 6 month ☐ c) 1 to 3 years
☐ d) 3 to 10 years ☐ e) birth to 2 years

CHAPTER 02

CHILD HEALTH SCENARIO

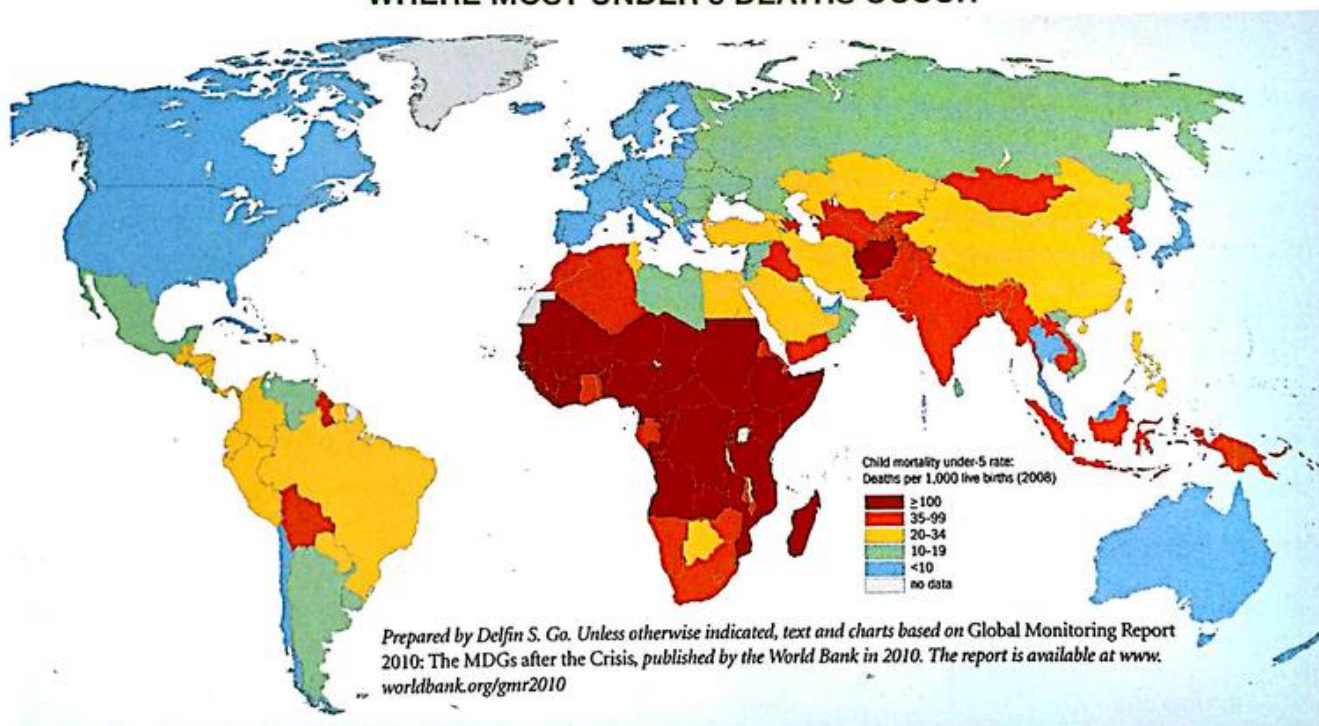
GLOBAL SCENARIO	3
BANGLADESH SCENARIO	3

GLOBAL SCENARIO

Every year about 6.3 million children below 5 years die throughout the world. The major causes of these deaths remain acute respiratory

infections (mostly pneumonia), diarrhoea, malaria, malnutrition and high perinatal deaths. **Most of these deaths occur in countries of South-East Asia, Africa and Latin America.**

WHERE MOST UNDER 5 DEATHS OCCUR



Source: Finance & Development, September' 2010

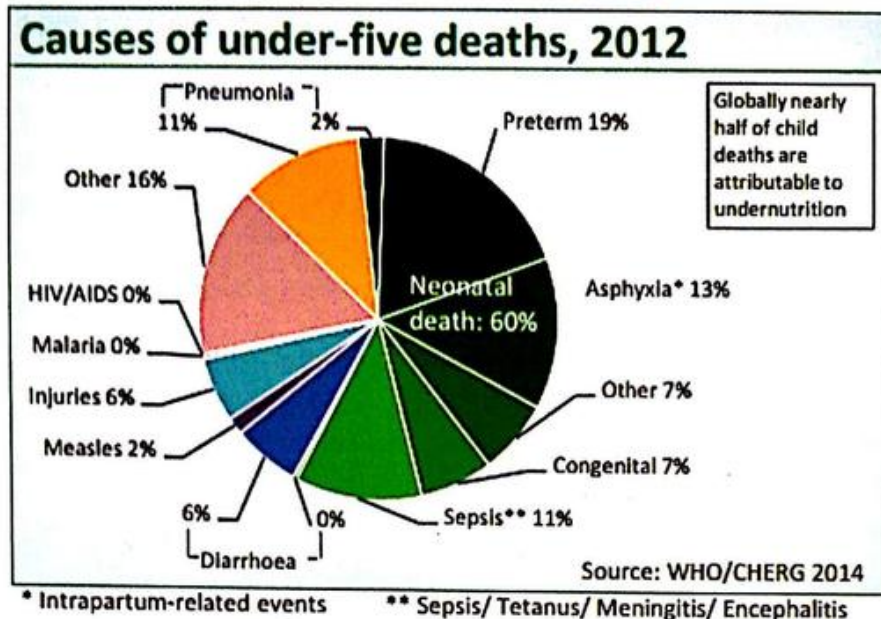
BANGLADESH SCENARIO

In Bangladesh, the major illnesses contributing to under 5 mortality are -

- | | |
|--|-----------------|
| * Neonatal illnesses <i>e.g. perinatal asphyxia, low birth weight, sepsis, congenital malformations etc.</i> | * Pneumonia |
| | * Diarrhoea and |
| | * Malnutrition |

Only **Neonatal deaths** account for about two-thirds of all infant deaths.

Major causes of under 5 child deaths in Bangladesh



Source: www.countdown2015mnch.org/countryprofile/bangladesh

The current under 5, infant and neonatal mortality rates in our country being 46, 38, 28 per thousand live births respectively which remain still very high in comparison to developed world (BDHS '2014, p35).

The UN General Assembly set **Millennium Development Goal 4 (MDG 4)** to curb these unfortunate deaths.

MDG 4: Reduce child mortality

Goal

Reduce mortality rate by 2/3rd among under five children between the years of 1990 to 2015.

Indicators

- Under-five mortality rate
- Infant mortality rate
- Proportion of 1 year-old children immunized against measles

Target versus Achievements

Bangladesh perspectives

Indicators	Base year (1990)	Status (2011)	Current status (2015)
Under-five mortality rate (Deaths/1000 live birth)	151	53	46 *
Infant mortality rate (Deaths/1000 live birth)	94	43	38 *
Proportion of 1 year-old children immunized against Measles (%)	54	84	87 **

* BDHS '2014, p35

**EPI Coverage evaluation Survey September '2015

Bangladesh is very much on the right track towards achieving the UN's target of MDG 4 by 2015. However, the major challenge to reach the desired target is the unacceptably high neonatal deaths.

To prevent these deaths and to reach MDG 4 in time, Government has set many *vertical child health programmes*. These are -

- * Integrated Management of Childhood Illness (IMCI)
- * Expanded Programme on Immunization (EPI)
- * Measles Rubella (MR) vaccination campaign
- * Helping Babies Breathe (HBB)
- * Emergency Triage Assessment & Treatment (ETAT) for neonates
- * Infant and Young Child Feeding (IYCF)
- * Vitamin A plus campaign & anthelmintic administration
- * National Immunization Day (NID)

MDG

The Millennium Development Goals (MDGs) are eight international development goals that all 193 United Nations member states and at least 23 international organizations have agreed to achieve by the year 2015. The MDGs are -

	Goal 1: Eradicate extreme poverty and hunger		Goal 5: Improve maternal health
	Goal 2: Achieve universal primary education		Goal 6: Combat HIV/AIDS, malaria and other diseases
	Goal 3: Promote gender equality and empower women		Goal 7: Ensure environmental sustainability
	Goal 4: Reduce child mortality		Goal 8: Develop a global partnership for development

References

1. National Institute of Population Research and Training, Mitra and Associates, Dhaka and MEASURE DHS, U.S.A. Bangladesh Demographic and Health Survey 2011.
2. Government of the People's Republic of Bangladesh. Ministry of Health and Family Welfare. Directorate General of Health Services. IMCI Students Handbook, 2011.
3. Robert E Black et al, Global, regional, and national causes of child mortality in 2008: a systematic analysis. Lancet 2010; 375: 1969–87.
4. Delfn S. Go. Unless otherwise indicated, text and charts based on Global Monitoring Report 2010.
5. www.countdown2015.mnch.org/country/profile/Bangladesh.
6. Bangladesh Demographic and Health Survey 2014 (published in April 2015)

SELF ASSESSMENT

Short answer questions [SAQ]

1. What are the current U-5, infant & neonatal mortality rate in Bangladesh?
2. What percentage of under five mortality is contributed by neonatal death?
3. What are the health related Millennium Development Goals?
4. What is MDG 4? What are the expected goal and Indicators of MDG 4?
5. What is the major challenge in Bangladesh to achieve MDG 4 by 2015?
6. Enumerate different national child programmes to achieve MDG 4.

Multiple choice questions [MCQ]

1. The major illnesses contributing to high under 5 mortality in Bangladesh are-
☐ a) pneumonia ☐ b) diarrhoea ☐ c) malnutrition
☐ d) thalassaemia ☐ e) neonatal illnesses
2. The indicators of MDG4 are
☐ a) neonatal mortality rate ☐ b) infant mortality rate ☐ c) maternal mortality rate
☐ d) under 5 mortality rate ☐ e) EPI coverage

EXAMINATION OF A CHILD: CRUCIAL TO REMEMBER

TIPS

6

Examining a child is an art, not similar to that of an adult. It may not follow the usual sequence that we practice while examining an adult. It requires much passion, attention and gentle handling.

EXAMINING A CHILD

- The consulting room must have a range of toys for all ages, and the child should be allowed to play & explore the room.



- Talk to the child while examining. It creates a sense of bonding with each other.
- Examination is better to be done by regions rather than by systems. It is better to auscultate heart and lungs before the child is disturbed and starts crying.
- Those parts of examination, which are unpleasant or may be painful, should be left until last.
- While talking to the mother, watch the child attentively –

- * Does the child look unwell/sick?
- * Is he/she interested in the surroundings and exploring them or apathetic?
- * Are there any obvious physical abnormalities?
- * Is breathing difficult or noisy?
- * Is the child look well nourished or wasted?
- * Watch the child running around to look for any obvious abnormality in the gait
- * Anthropometry must be done in every child

- Build rapport with the child and the mother to make them feel confident on your full attention and active support.
- Examine the child at his/her comfort. Young children should be examined sitting on their parents lap, as any attempt to get the child to lie down may result in crying.
- Offer the child to play with something while examining. Sometimes a small toy clipped on to stethoscope may be distracting enough to examine the child adequately.



Child examination area may be decorated with popular pictures or cartoons

CHAPTER 04

GROWTH AND DEVELOPMENT

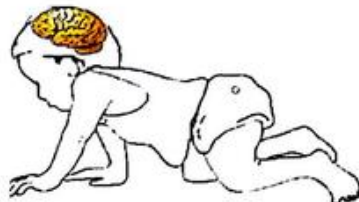
GROWTH	7
DEVELOPMENT	10
MILESTONES OF DEVELOPMENT	11

Growth and development are the commonest concern of parents and is frequently enquired to the doctors.

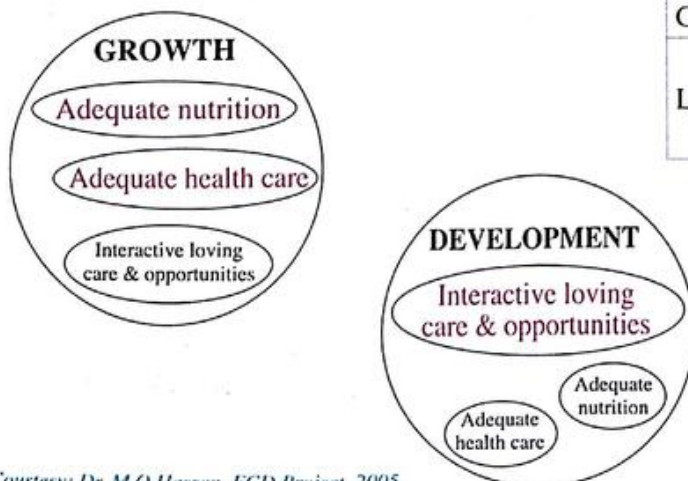
Growth refers to physical maturation and signifies an increase in size of the body parts and various organs. It occurs as a result of tissue hyperplasia, hypertrophy and differentiation.

Development refers to acquisition & maturation of skills, behaviour and values on the part of the growing child. It mostly depends on the maturation of nervous system. Through development, a child builds up a store of knowledge about his or her environment, learns motor skills, communications, behaviour etc.

A complete child is one who has both optimum physical growth and age appropriate mental development.



KEY NEEDS OF A CHILD



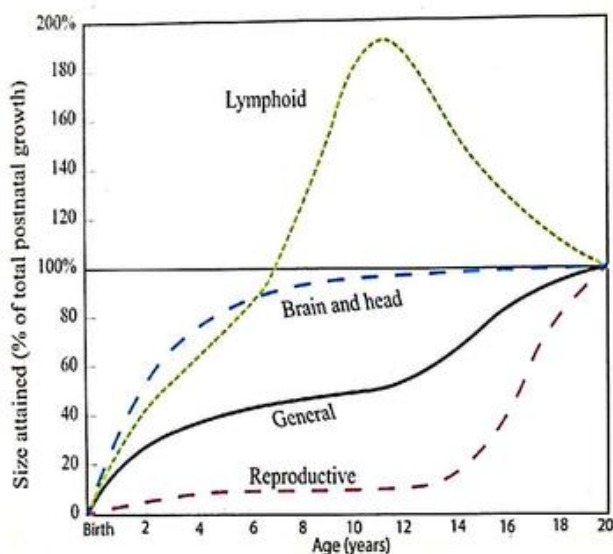
Factors influencing growth & development

- * Genetic influence *e.g. Tall parents have taller children*
- * Nutrition *e.g. optimum nutrition will ensure optimum growth*
- * Low birth weight *e.g. LBW babies may grow at a slower rate*
- * Influence of hormones *e.g. thyroxin, growth hormone, insulin*
- * Chronic illnesses *e.g. TB, heart diseases, kidney diseases etc.*
- * Chromosomal abnormalities *e.g. Down syndrome, Turner syndrome etc.*
- * Emotional deprivation *e.g. children brought up in broken families may not grow and develop normally*
- * Others *e.g. social, cultural and environmental factors*

Rate of growth & development of different organs at different ages

Growing organs	Attainment of growth	Age of maximum growth attainment by
Somatic	100%	18 years
Brain	90%	3 years
Gonads	90%	13-15 years
Lymphoid	Exceeds 100% by 7 years, then decline and becomes normal by 13-15 years	

Postnatal growth curves for General, Brain, Lymphoid and Reproduction systems (Tanner, 1962)



Normal growth velocity during childhood

Age	Growth velocity
1 st year	25 cm/year
2 nd year	12 cm/year
3-4 years	7 cm/year
5-6 years	6 cm/year
7 year till pubertal onset	5 cm/year

Ref: Agarwal et al. 2007, AAFP '2008

GROWTH

Assessment : Anthropometry

i.e. measurement of -

- * Length/Height
- * Weight
- * Occipitofrontal circumference (OFC)
- * Mid upper arm circumference (MUAC)
- * Body Mass Index (BMI)
- * Skin fold thickness

Measuring length/height

A. Recumbent or Supine length

For children who are -

- * Less than 2 years of age
- * Unable to stand or finds difficulties in standing

Instrument: Infantometer, a firm measuring board with 125 cm/50 inches marking with one head and one foot board.



Infantometer

Courtesy: Dr Mallika Alam

Procedure of measurement

- Two persons are required to measure the supine length
- Place the measuring board on a firm surface
- Lay the child on his back, on the board. One person should ensure that the head is held in contact with the headboard



Courtesy: Dr Mallika Alam

Measuring length of a child using Infantometer

- Other person should hold the ankles to ensure the child to be positioned completely aligned & flat against the board. Firm pressure may also need to be applied to keep their legs in position
- Record the length to the last complete millimeter

NB. The supine length is about 1 cm greater than standing height in children <5 years.

B. Standing height

Instrument: Stadiometer or a 6 feet measuring scale attached to a vertical surface or wall.

Procedure of measurement

- Child's body must be positioned with its -
 - * Feet together

- * Feet flat on the ground
 - * Heels touching the back plate of the stadiometer
 - * Legs must be straight
 - * Buttocks against the backboard
 - * Scapula, wherever possible, against the backboard
 - * Arms loosely at their sides
- The child's head must be positioned according to **Frankfort plane**
- Ensure the child is in the correct position
- The headboard placed carefully on the child's head
- Then place the child's head in such a way that the lower margins of the orbits will remain in the same plane with the tragi (**Frankfort plane**). The Frankfort plane will remain parallel to ground surface



Measuring height using stadiometer



Frankfort plane

- Reading is taken from the scale at eye level to the last complete millimeter

NB. Child's height doubles the value of its birth (i.e. 100 cm) by 4th year and 3 times (150 cm) by 14th year

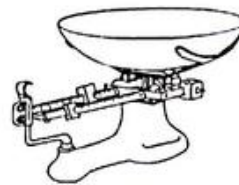
Measuring Body Weight

Instruments: Weighing scale.

- Beam balance
- Bathroom scale (spring/digital)
- Hanging scale

Weighing procedure

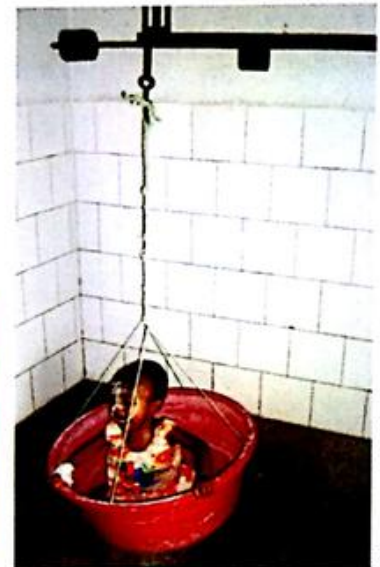
- The child should be weighed nude
- He/she should not touch any object during weighing
- The child should be off shoes or sandals



Beam balance



Bathroom scale



Hanging scale

NB. Child's weight doubles the value of its birth by 6th months and 3 times by 1st year and 4 times by 2nd year

Measuring Occipito-Frontal Circumference (OFC)

Instrument: Non-stretchable measuring tape

It is generally measured in infants and children less than 3 years of age by a flexible, non-stretchable measuring tape.



Measuring OFC by tape

Procedure of measurement

The tape is applied firmly over glabellas and superior orbital ridges anteriorly, then passed around head at same level on each side and posteriorly at the level of external occipital protuberance.

Average OFC of a child

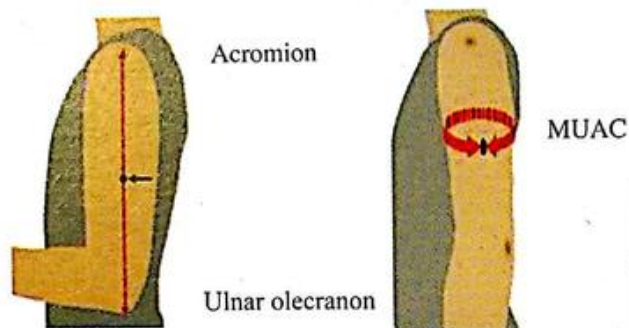
At Birth (cm)	At 3 months (cm)	At 6 months (cm)	At 1 year (cm)	At 2 years (cm)
35	41	44	47	49

Courtesy: Dr Rumi Myedull Hossain

Measuring Mid Upper Arm Circumference (MUAC)

Instrument: Shakir's tape

It is measured in children between ages 6 months to 5 years for *mass screening* of nutritional status.



Source: Internet

Procedure of measurement

It is measured at a point approximately midway between the acromion process and ulnar olecranon. The tape should touch the skin without compressing the tissue. It is traditionally recorded on left side while the arm hanging normally.

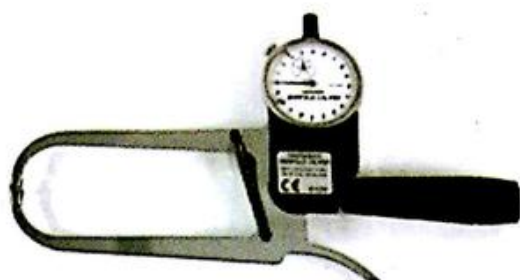


Measuring MUAC by Shakir's tape

Source: Internet

Assessment of tissue mass

- Measurement of body mass index, BMI
(Calculation: $\text{Weight (kg)} / \text{Height (m}^2\text{)}$)
- Measurement of triceps & sub-scapular skin fold thickness by Harpenden Calipers



Harpenden Calipers

Source: Internet



Measuring skinfold thickness by Harpenden Calipers

Source: Internet

DEVELOPMENT

It is already mentioned that development depends on the maturation of brain which means increase in -

- Number of neurons as well as
- Number of synapses

At birth the number of neurons are 100 billions and the number of synapses are 50 trillions.

Thereafter, through repetitive stimuli and interactions from environment, the number of synapses increases and **by 3 years**, this number reaches its maximum to 1000 trillions. However, the number of neurons remain almost similar to that, at the time of birth.

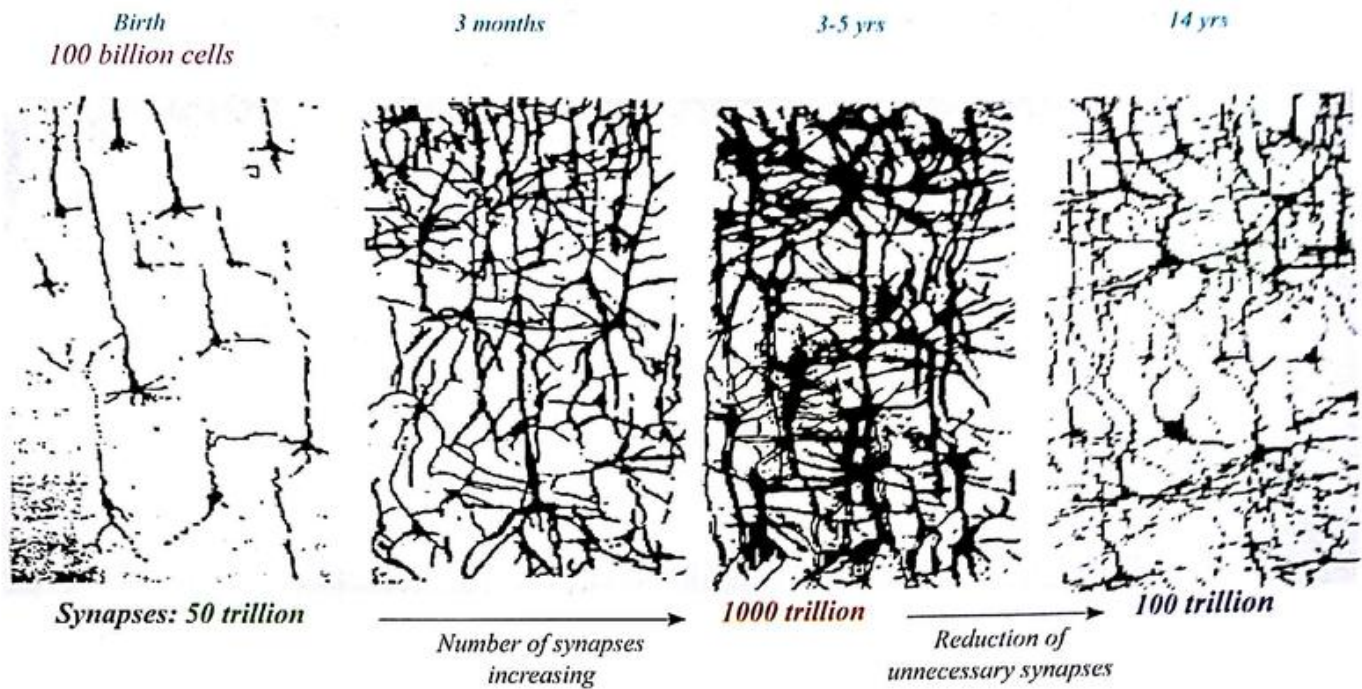
With time, the developing brain gets rid of unnecessary connections and at adulthood 100 trillions synapses persist those are essential.

Therefore, appropriate care as well as proper stimuli during the first 3 years of life is very crucial and this actually determines future neurodevelopmental outcome of children.

Early Childhood Development (ECD)

Period from conception to 5 years of age is early childhood. This period is the key determinant for subsequent growth, development and ultimate productivity. The development that a child acquires during this period is known as Early Childhood Development.

The quality of care given during this period, determines the persistence of relevant synapses and eventually what the child will become in future.



Principles of Development

- * It is a continuous process
- * It is cephalocaudal in direction
- * Sequence of development is same but the rate is different
- * Mass activities are replaced by specific responses
- * Primitive reflexes are lost before the appearance of corresponding voluntary movement

How to assess development ?

Development is assessed through assessment of its different domains (areas).

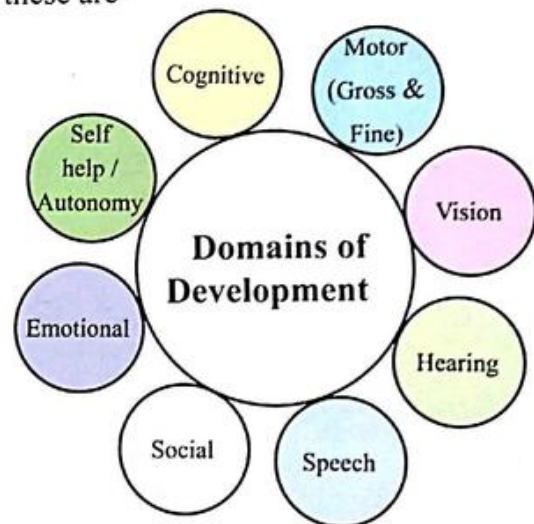
MILESTONES OF DEVELOPMENT

These are the abilities that a child will achieve within a predictable age range.

The age specific milestones of development of a normal child is given in the next pages. This chart is used at bed side as standard to compare with the developmental achievement of a child.

Domains of Development

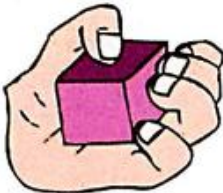
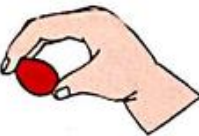
There are 8 different domains of development and these are-



However, while assessing development, these domains are grossly subdivided into 4 functional areas such as -

- Gross motor
- Fine motor & Vision
- Speech, language & hearing
- Social, emotional, behavior, self help/ autonomy

Age Specific Normal Milestones of Development

Age group	Gross motor	Fine motor & Vision	Speech, language & hearing	Social, emotional, behavior, self help/ autonomy
6 weeks	* When pulled from supine to sitting there is partial head lag * Primitive reflexes persist 	* Follows moving object or face by turning the head 	* Scared to loud noises 	* Child smiles in response to mother's smile 
3 months	* Neck control is achieved * Primitive reflexes are gone	* Reaches out for toys 	* Vocalizes alone or when spoken to coos and laughs 	* Recognize mother * Becomes excited by toys
6 - 8 months	* Sits without support * At 6 months with round back * At 8 months with straight back 	* Transfer objects from one hand to other * Palmar grasp is attained 	* Turns to soft sounds out of sight 	* Tries to feed him or herself 
9 - 10 months	* Crawls * Stands holding furniture 	* Pincer grip 	* Says bi syllable words e.g. <i>Baba, Dada, Mama</i>. * Says one word with meaning 	* Plays peek a boo * Waves bye bye 

Age Specific Normal Milestones of Development

Age group	Gross motor	Fine motor & Vision	Speech, language & hearing	Social, emotional, behavior, self help/ autonomy
12 months	* Walking unsteadily, broad gaits, hands apart 	* Throws objects * Turns pages of a book	* Says 2-3 words with meaning other than 'dada'/'mama' * Responds to own name by turning when called from behind 	* Drinks from cup 
15 - 18 months	* Walks alone steadily 	* Scribbles with pen 	* Says 12-15 words	* Asks for things by pointing 
18 - 20 months	* Walks backwards	* Builds a tower of 3 cubes 	* Points to 3 body parts on request * Begins to join 2 words together 	* Holds spoon and gets food to mouth 

Adapted from Module on Early Childhood Development for Undergraduate Medical Students, Teachers Guide
 Courtesy: Professor SM Shahnawaz Bin Tabib

Scales of Developmental Assessment

Though developmental status of a child can be assessed using the above mentioned chart, it can more accurately be assessed with the aid of

different scales like -

- The Baily Scale
- Denver Scale
- Weschsler Intelligence Scale for Children

References

1. Harris R. Children and adolescents. Hutchison's Clinical Methods. 22nd ed. Saunders; 2008. p 323-342.
2. Molla MR. Concise Textbook of Pediatrics. 2nd ed. Dhaka: 2007. Chapter 2, Physical Growth and Development; p. 5-29.
3. Khan MR, Rahman ME. Essence of Pediatrics. 4th ed. Elsevier; 2011. Chapter 4, Growth and Development; p.56-71.
4. Kabir ARML. Pediatric Practice on Parents Presentation, 1st ed. Dhaka: Asian Colour Printing; 2011.
5. Height, measuring a child. UCL Institute of child health. [Internet]. Available from: http://www.ich.ucl.ac.uk/clinical_information/clinical_guidelines/cpg_guideline_00060.
6. Bangladesh Shishu Academy, Dhaka. Modules on Early Childhood Development for Undergraduate Medical Students. 2009, ELCD Project.

SELF ASSESSMENT

Short answer questions [SAQ]

1. Define growth and development.
2. Name important factors influencing growth and development.
3. What parameters are measured to assess growth?
4. What is Frankfort line? Name the instrument used to measure length & height.
5. What are the domains of development? How do we assess development?
6. Write down the milestones of development of a 12 months old child.
7. Define ECD. Write down the name of scales used to assess development.
8. Write in short the basics of development.
9. Write short note: Growth chart.

Multiple choice questions [MCQ]

1. Normal developmental milestone of a child include -
☐ a) smiles at 6 weeks ☐ b) holds head at 3-4 months ☐ c) sits unsupported at 5 months
☐ d) crawls at 7 months ☐ e) speaks 2-3 words at 12 months
2. Motor development of a 1 year old child include -
☐ a) running ☐ b) stands independently ☐ c) walks backward
☐ d) walking unsteadily, broad gait ☐ e) transfer of objects from one hand to other
3. The following are the five motor actions
☐ a) pincer grip ☐ b) scribbles with pen ☐ c) walks backward
☐ d) turns page of a book ☐ e) sitting with support
4. Assessment of development includes assessment of
☐ a) OFC ☐ b) motor function ☐ c) speech ☐ d) vision ☐ e) BMI

INFANT AND YOUNG CHILD FEEDING (IYCF)

BREAST FEEDING	15
COMPLEMENTARY FEEDING	17

Appropriate feeding practices are essential for proper nutrition, growth, development as well as survival of infant and young children. The feeding practice which include both breast feeding as well as complementary feeding are collectively known as **Infant and Young Child Feeding (IYCF)**.



Components of IYCF

- * Promotion of early initiation of breast feeding (within first hour of birth)
- * Ensuring exclusive breast feeding for first 6 months (180 days) of life
- * Proper complementary feeding from 6 months of age (completion of 180 days) with continuation of breast feeding up to 2 years of age

BREAST FEEDING

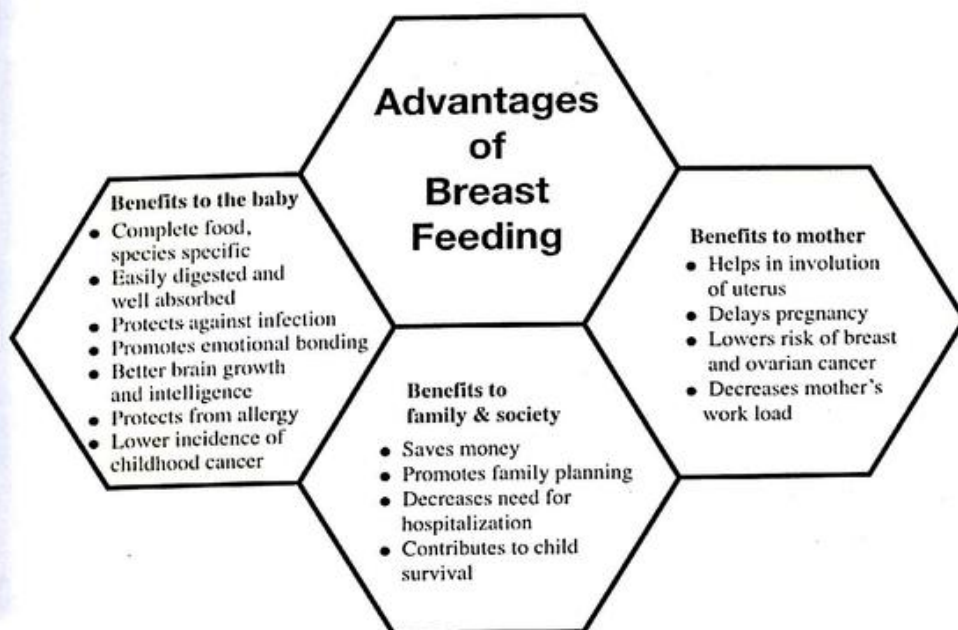
Breast feeding promotion is a key child survival strategy. Breast milk contains all the energy and nutrients that a baby needs for healthy growth, development and protection against infections.

It is estimated that about *1 million newborn deaths* could be averted globally, if breast feeding would have been initiated within first hour of birth. There is also published evidence that under five mortality rate could be reduced by 13% through exclusive breast-feeding up to 6 months. Further 6% deaths can be prevented by timely starting of proper complementary feeding with continuation of breast feeding up to 2 years of age.

Ample evidences exist which unequivocally supports that exclusively breast-fed babies have less diarrhoea, less respiratory and other infections than formula fed babies.

Colostrum

A sticky white or yellow fluid secreted by the breast during second half of pregnancy and for a few days after birth before breast milk comes in.



Anti-infective Components of Colostrum

- * Immunoglobulins *e.g. Secretory IgA, IgG, IgM*
- * Cellular elements *e.g. White blood cells.*
- * Lysozyme, Lactoferrin and transferrin
- * Complement system (opsonic & chemotactic activities of C3 and C4)
- * Oligosaccharides (prevent bacteria from attaching to mucosal surfaces)
- * Bifidus factor (help special bacteria to grow in the intestine and prevent growth of other harmful bacteria)

Prelacteal Feeding and its Hazards

Prelacteal Feeding

It is the feeding of liquids or foods other than breast milk given prior to the establishment of breast feeding. Commonly honey, water, mustard oil, sugar water, etc. are given to the newborn in our society as prelacteal feed.

Hazards of Prelacteal Feeding

- * Deprives the child of colostrum.
- * Increases the risk of illnesses such as diarrhoea and other infections and allergies
- * Satisfies a baby's hunger, making him or her less interested in breast feeding. As a result there is less stimulation of breast milk production and this ultimately leads to lactation failure
- * If a feeding bottle is used, it may interfere with the baby's learning to suck at the breast

Positioning and Attachment

For successful breast feeding, proper positioning and good attachment of the baby with mother and her breast are most important. The criteriae for these are given in the table -

Proper positioning	Good attachment
	
• The body is fully supported • Body close to the mother • Straight head and body • Facing breast, nose opposite to the nipple	• The baby's chin is touching the breast • The baby's mouth is open widely • The baby's lower lip is turned outwards • More areola is seen above than below

Signs of Effective Suckling

- * The baby takes slow, deep suckles followed by a visible or audible swallow
- * Sometimes the baby pauses for a few seconds, allowing the ducts to fill up with milk again
- * The baby's cheeks remain rounded during the feed
- * When satisfied, baby usually releases the breast spontaneously

Signs of Ineffective Sucking

- * A baby may suck quickly all the time, without swallowing
- * The cheeks may be 'drawn in' indicating that milk is not flowing well

Exclusive Breast Feeding (EBF)

Exclusive Breast Feeding means giving the baby only breast milk (*not even a drop of water or other foods*) from birth till 6 months (180 days) of age.

How to ensure successful Breast Feeding?

- Build confidence of the mother about her ability to breast-feed her child
- Ensure privacy of mother
- Explain the benefits of breast feeding and hazards of artificial feeding
- Allow extra nutritious food to the mother
- Special care to mother's health
- Demonstrate good position and attachment to the mother during feeding her child
- Motivate other family members to support breast feeding

BMS e.g. infant formula and other commercially available baby foods should not be allowed to give to children



COMPLEMENTARY FEEDING (CF)

It means giving the baby other foods in addition to



*Ideal complementary food chart
Courtesy: ICMH, UPHCP, Bangladesh*

breast milk. These other foods are called complementary foods. Appropriate CF means provision of right foods at right time in right amount, prepared and delivered hygienically to sustain optimum growth of the baby. It should be started after completion of 6 months (180 days) of age.

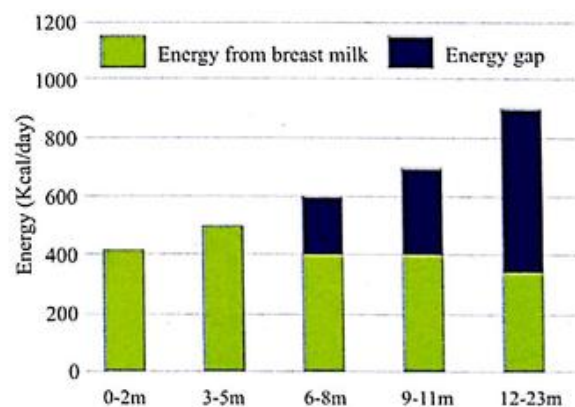
During the period of complementary feeding, a baby gradually gets accustomed to eat family foods.

Importance of Complementary Feeding

As babies grow and become more active, an age is reached when breast milk alone is inadequate to meet the child's nutritional needs.

To meet that extra need or to fill the energy gap, between the total nutritional needs of the child and the energy & nutrient provided by breast milk, complementary foods are added in the daily feeding schedule.

Energy required by age and energy provided from breast milk



Properties of Complementary Foods

- Good complementary foods should be a combination of -
 - * **Energy rich** e.g. rice, ruti, oil, noodles, potato
 - * **Body building** e.g. fish, meat, egg, pulses
 - * **Protective** e.g. vegetables, fruits and micronutrients

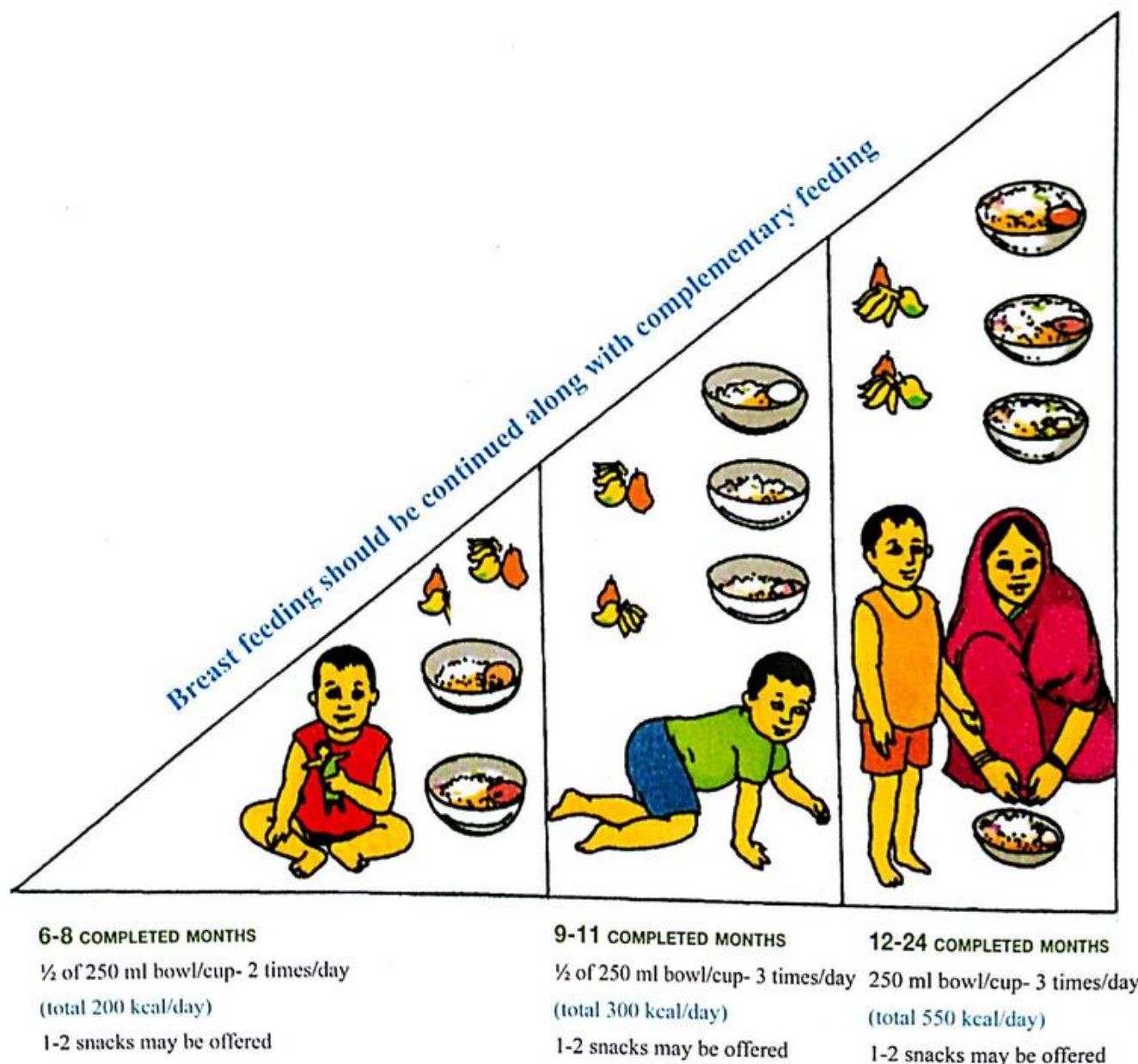
- It should not be spicy or salty, easy to eat and liked by the child
- It should be easy to prepare from locally available and affordable foods

Principles of Complementary Feeding

- Start single food at a time *e.g. mashed ripe banana with gradually increasing quantity.*
- Start 2nd weaning food *e.g. khichuri made from rice, pulses and vegetables* after some time (about 1 week)

- Introduce fish, meat, egg (begin with yolk) one after another
- Complete whole weaning process by 9 months to 1 year
- By 3rd year, accustom to family foods

Do not force the child to eat. Do not continue to feed each meal for more than 20-30 minutes.



Sources: i) Modules on IYCF, Ministry of Health, GOB, 2012. ii) Clinical guidelines on IYCF, GOB 2014

References

1. Khan MR, Rahman ME. Essence of Pediatrics. 4th ed. New Delhi: Elsevier; 2011. Chapter 3, Infant and Young Child feeding; p. 49-55.
2. Kabir ARML. Pediatric Practice on Parents Presentation, 1st ed. Dhaka: Asian Colour Printing; 2011.
3. World Health Organization. Department of Nutrition for Health and Development. Complementary feeding: Family food for breastfed children; 2000.
4. Government of the People's Republic of Bangladesh. Ministry of Health and Family Welfare. Directorate General of Health Services. National strategy for infant young child feeding in Bangladesh; April, 2007.
5. World Health Organization. Infant and young child feeding Model Chapter for textbooks for medical students and allied health professionals; 2009.
6. Government of the People's Republic of Bangladesh. Ministry of Health and Family Welfare. Directorate General of Health Services. Training Modules on IYCF; 2010.
7. Clinical guidelines on Infant and Young Child Feeding (IYCF), GOB '2014.

SELF ASSESSMENT

Short answer questions [SAQ]

1. What do you mean by exclusive breast feeding & complementary feeding?
2. What are the anti- infective properties of breast milk?
3. Write down the properties of good complementary feeding?
4. What should be the frequency of complementary feeding at 6 months & 12 months of age?
5. Write down the importance of complementary feeding.
6. What are the hazards of prelacteal feeding?
7. What is colostrum? What are the advantages of colostrum?
8. Mention 4 points suggesting good positioning and attachment.
9. Write short note: Weaning.

Multiple choice questions [MCQ]

1. Signs of good attachment during breast feeding are -
☐ a) mouth wide open ☐ b) lower lip turned inward
☐ c) more areola below than above the mouth ☐ d) facing breast, nose opposite to nipple
☐ e) chin touching breast.
2. The energy yielding foods are -
☐ a) meat ☐ b) fish ☐ c) fruits ☐ d) oil ☐ e) sugar
3. The body building foods are-
☐ a) rice ☐ b) meat ☐ c) fruits ☐ d) egg ☐ e) potatoes
4. Amount of complementary foods for children between 6-12 months include
☐ a) full 250 ml cup once daily ☐ b) half 250 ml cup twice daily
☐ c) full 250 ml cup twice daily ☐ d) full 250 ml cup thrice daily
☐ e) half 250 ml cup once & 1-2 snacks daily

CHAPTER 06

INTEGRATED MANAGEMENT OF CHILDHOOD ILLNESS [IMCI]

WHAT IS IMCI	20
RATIONALE & COMPONENTS	20
FACILITY BASED IMCI	20
COMMUNITY BASED IMCI	23

Most of the global child deaths occur in the world's poorest countries of sub-Saharan Africa and South Asia and the major causes are pneumonia, diarrhoea, neonatal illnesses, malnutrition and accidents particularly drowning. In addition malaria and HIV infections contribute in many areas of the world. To combat this challenge, WHO and UNICEF developed Integrated Management of Childhood Illness (IMCI) in mid 1990s.

WHAT IS IMCI

It is an evidence based syndromic approach that identifies and categorizes the major illnesses responsible for under 5 deaths and what actions to be taken. The approach is designed to classify the severity of the illnesses rather than making a diagnosis. In addition to curative care, the strategy also addresses aspects of nutrition, immunization and other elements of disease prevention and health promotion.

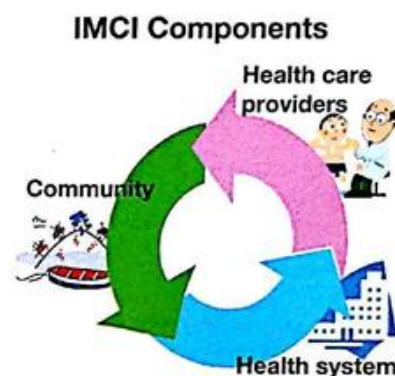
RATIONALE

Evidences revealed that most sick children present with signs and symptoms of more than one diseases and this overlap of signs & symptoms signifies the possibility of more than a single illness. Hence an integrated approach is needed that can go beyond a single disease and can address the overall health of the sick child.

COMPONENTS

IMCI has 3 components

- Improvement in case management skills of healthcare providers
- Improvement in overall health system required for effective management of childhood illnesses
- Improvement in family and community health care practices



Case Management

Management of sick children through IMCI strategy is executed -

- At Outdoors of health centers & Referral hospitals (**Facility based IMCI**)
- In the Community (**Community based IMCI**)

FACILITY BASED IMCI

(Case Management at Outdoor)

Here the following things are done -

- Assessment of the sick children (0 day upto 2 months & 2 months upto 5 years) using a limited number of selected clinical signs
- Classification of the illnesses based on severity of clinical signs & symptoms
- Identification of treatment according to classification e.g. whether to treat at the outdoor or to refer to a higher centre with a pre referral treatment

I. Assessment of the sick child

Zero day upto 2 months
Features of very severe disease * Not feeding well/unable to feed* * Convulsion* * Grunting * Fast breathing ($\geq 60/\text{min}$) * Severe chest indrawing* * <u>Fever (99.5°F or feels hot) or low body temperature ($<95^{\circ}\text{F}$ or feels cold)*</u> * Movement only when stimulated or no movement at all*
Local bacterial infection • Umbilical infection (Periumbilical redness or draining pus) • Skin pustules
Jaundice • Age of appearance (e.g. within 24 hours) and extent of jaundice (e.g. yellow palms and soles)
Diarrhoea • General condition e.g. movement, restless/irritable, sunken eyes, skin pinch
Feeding problem or Low weight ($< -3\text{SD}$) Position, attachment & frequency of breast feeding, feeding during sickness, other foods & fluid or have oral ulcers or thrush
Immunization status
Other problems

2 months upto 5 years
General danger signs • Had <u>convulsion</u> during the present illness or convulsion now • Lethargic or unconscious • Not able to drink or breastfeed • Vomits everything
Four main symptoms • Cough or difficult breathing e.g. respiratory rate, chest indrawing, stridor, wheeze • Diarrhoea e.g. duration, presence of blood, signs of dehydration e.g. general condition, sunken eyes, skin pinch, child's reaction when offered to drink • Fever e.g. duration, H/O travelling to malaria endemic area, stiff neck, features of measles/mouth or eye complications • Ear problem e.g. ear pain, discharge of pus, duration of illness, tender swelling behind the ear
Nutritional status: Malnutrition e.g. visible severe wasting, bipedal oedema, weight for age & anaemia (palmar pallor)
Immunization status
Vitamins e.g. A, multivitamin/mineral supplementation
Deworming status
Feeding assessment e.g. breast feeding, complementary feeding, feeding during illness
Other problems

Presence of any general danger sign or features of very severe disease indicates that the child is very sick and in need for immediate referral to hospital.

II. Classification & Identification of Treatment

After assessment, sick children are classified, based on the presence or absence of general danger sign and presence of any specific sign or combination of signs. The classification(s) are colour coded which indicate the severity of the illnesses and call for specific actions as in the box.

Urgent referral with pre-referral treatment
Treatment at local health facility & follow up
Home treatment and follow up

Example: A child (2 months upto 5 years) with cough and or difficult breathing

Assessment, classification and identification of treatment (IMCI, WHO '2014 adopted)

Signs	Classify as	Identify treatment
- Any general danger sign - Severe chest indrawing (<i>deep & easily visible</i>) - Stridor in clam child	SEVERE PNEUMONIA OR VERY SEVERE DISEASE	- Give first dose of an appropriate antibiotic - Treat the child to prevent low blood sugar - Refer urgently to hospital
- Chest indrawing - Fast breathing	PNEUMONIA	- Give oral Amoxycillin for 5 days - If wheezing (even if it disappears after rapidly acting bronchodilator) give an <u>inhaled bronchodilator/oral Salbutamol</u> for 5 days - Soothe the throat and relieve the cough with a safe remedy - If coughing more than 2 weeks or recurrent wheeze refer for <u>assessment for TB or asthma</u> - Advise mother when to return immediately - Follow up in 3 days
No signs of pneumonia or very severe disease	COUGH OR COLD	- If wheezing (even if it disappears after rapidly acting bronchodilator) give an <u>inhaled bronchodilator/oral Salbutamol</u> for 5 days <u>Soothe the throat</u> and relieve the cough with a safe remedy - If coughing more than 2 weeks or recurrent wheeze refer for <u>assessment for TB or asthma</u> - Advise mother when to return immediately - Follow up in 5 days if not improving

Case Management at Higher Centre

(Referral Health Facility)

- Emergency Triage Assessment and Treatment (ETAT):** Grouping the sick child on the basis of emergency signs & priority signs and ensure life saving management without delay
- Comprehensive clinical assessment and investigations to reach the diagnosis
- Appropriate treatment and follow up

TRIAGE : It is a process of rapid screening of sick children when they first arrive at hospital

and placing them in one of the following groups

- Sick children with emergency signs** - require emergency treatment to prevent death

Emergency signs

- | | |
|-------------------------------|----------------------|
| * Stridor | * Signs of shock |
| * Severe respiratory distress | * Coma |
| * Central cyanosis | * Convulsion |
| * Grunting | * Severe dehydration |

- If any one of the above emergency signs are found, appropriate emergency treatment should be given immediately
- If no emergency signs seen, **priority signs** should be looked for

Priority signs

- * Visible severe wasting
- * Oedema of both feet
- * Severe palmar pallor
- * Any sick young infant (< 2 months old)
- * Lethargy, drowsiness
- * Continually irritable and restless
- * Major burns
- * Any respiratory distress
- * Child with urgent referral note from another facility

If any of these signs are found, appropriate treatment should be given immediately. Those with neither emergency nor priority signs will get routine treatment

Cardinal Features of Certain Severe Diseases

Cardinal features	Suggestive disease/conditions
Convulsion	• Meningitis • Encephalitis • Hypoglycaemia • Hypocalcaemia
Stopped feeding well	• Septicaemia • Meningitis • Pneumonia • Other serious illness
Fast breathing and severe chest indrawing	• Pneumonia • Bronchiolitis • Acute asthma • Heart failure
Grunting	• Respiratory failure • Septicaemia
Less movement	• Septicaemia • Severe dehydration • Hypocalcaemia

Lethargy/ unconsciousness

- Birth asphyxia
- HIE
- Intracranial haemorrhage
- Septicaemia, Meningitis
- Severe dehydration

COMMUNITY BASED (C-IMCI)

Evidence has shown that up to 80% of deaths of under five children occur at home with little or no contact with health care providers. So there is a big gap between the care seekers and care providers. To minimize this gap, interventions are also planned at the community (Community IMCI). The main objectives of C-IMCI is to improve behaviour and care practices of families and communities.

The important strategies of C-IMCI are -

1. Promotion of growth & development

- * Exclusive breast feeding for first six months of age
- * From six months, give children good quality complementary foods while continue to breast feed for two years or longer (IYCF)
- * Micronutrients supplementation *e.g. vitamin A, iron and zinc*
- * Promoting mental and social development by responding to a child's needs for care and by providing a stimulating environment *e.g. playing, talking etc.*

2. Disease prevention

- * Disposal of all faeces safely, hand washing after defaecation, before preparing meals and before feeding children
- * Protect children in malaria endemic areas, by promoting them to sleep under insecticide-treated bed nets
- * Provide appropriate care for HIV affected people and to take action to prevent further HIV infections

3. Appropriate care at home

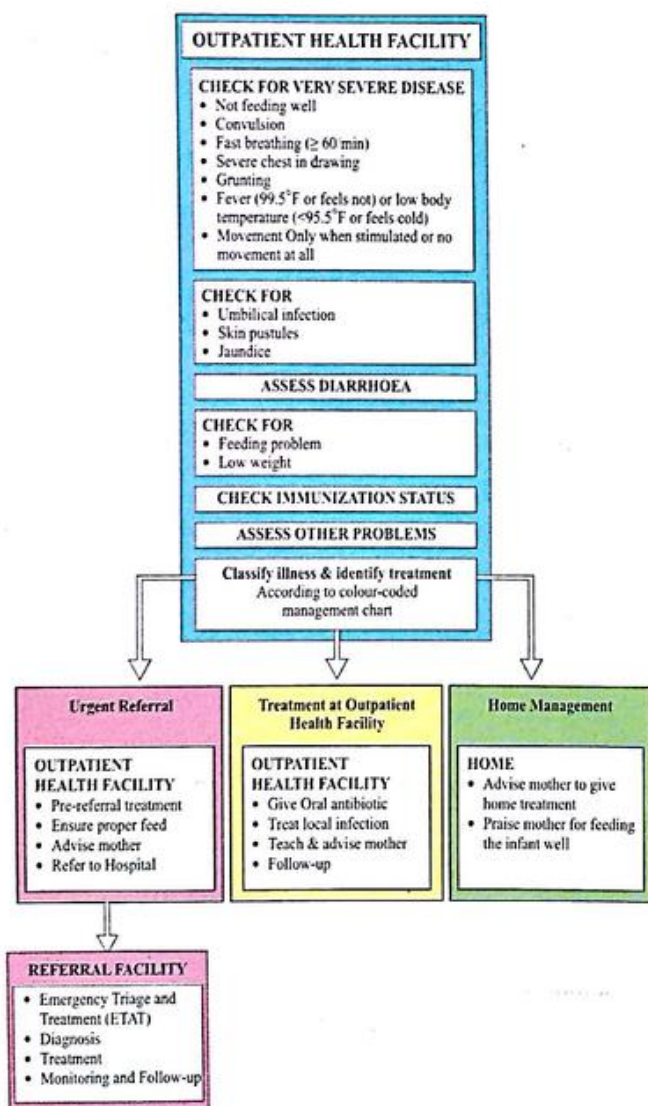
- * Continue to feed and offer more fluids including breast milk to children when they are sick
- * Give sick children appropriate home treatment for infections
- * Protect children from injury and accident and provide treatment when necessary
- * Prevent child abuse and negligence, and take action when it does occur
- * Involve fathers in the care of their children and in the reproductive health of the family

4. Care-seeking outside home

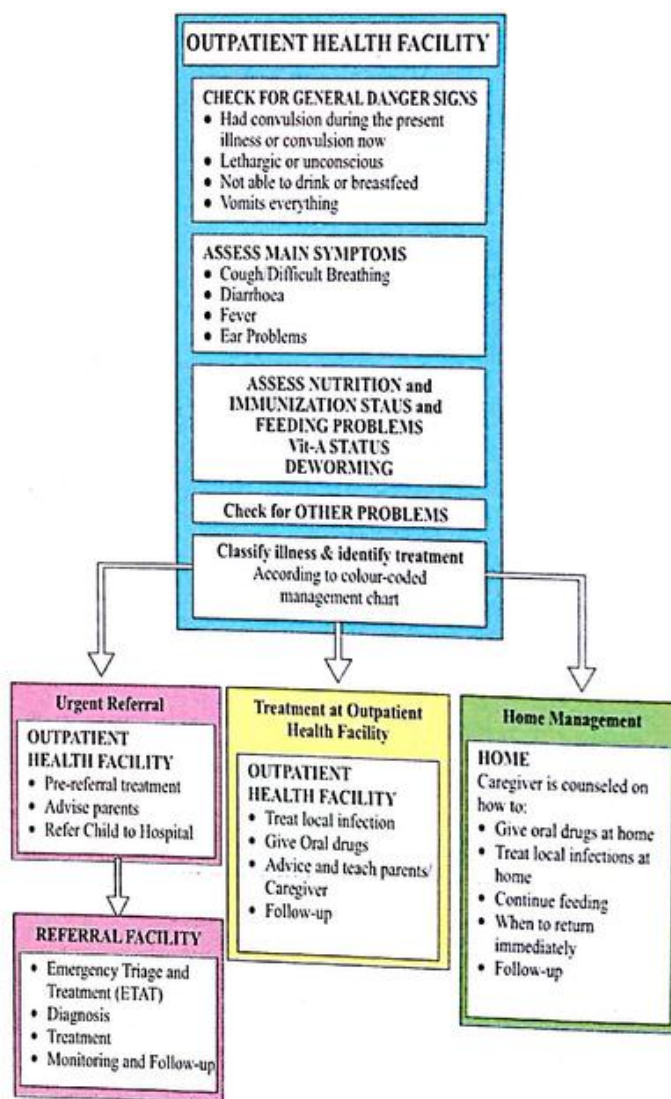
- * Recognize when sick children need treatment outside home and seek care from appropriate providers
- * Take children for complete immunization before their first birthday
- * Follow the health provider's advice on treatment, follow-up and referral
- * Ensure that every pregnant woman has adequate antenatal care (ANC) and seeks care at the time of delivery & afterwards

Summary of Stepwise Case Management

IMCI case management at a glance for children from 0 day up to 2 months



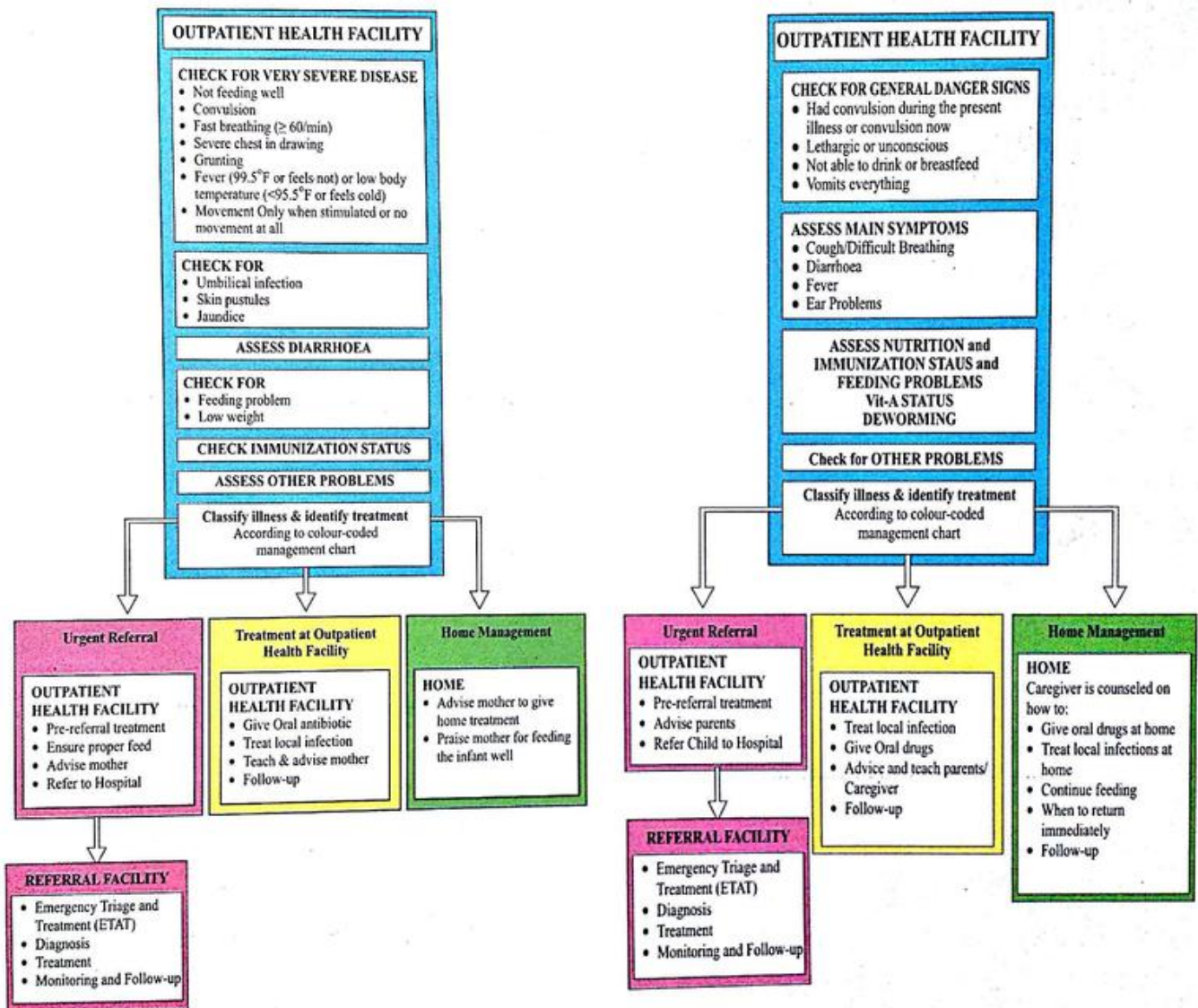
IMCI case management at a glance for children from age 2 months up to 5 years



Summary of Stepwise Case Management

IMCI case management at a glance for children from 0 day up to 2 months

IMCI case management at a glance for children from age 2 months up to 5 years



References

1. World Health Organization. World Health Report. Make every Mother and Child Count. Geneva; 2005.
2. World Health Organization. Murray CJL and Lopez AD. The Global Burden of Disease: A Comprehensive Assessment of Mortality and Disability from Diseases, Injuries and Risk Factors in 1990 and projected to 2020. Geneva; 1996.
3. Child health in the community - "Community IMCI" Briefing package for facilitators, Reference document [Internet]. Available from: (http://www.who.int/child_adolescent_health/documents/9241591951/en/index.html).
4. Government of the People's Republic of Bangladesh. Ministry of Health and Family Welfare. Directorate General of Health Services. IMCI Student's Handbook; 2011.
5. World Health Organization (WHO), IMCI chart Booklet; March 2014.

SELF ASSESSMENT

Short answer questions [SAQ]

1. What is IMCI? What childhood diseases are assessed in this strategy?
2. What are the different components of IMCI?
3. What are the main symptoms and other issues to be addressed in a sick child between 2 months to 5 years, according to IMCI?
4. What are the causes of lethargy?
5. Write down the main objectives of Community IMCI.

Multiple choice questions [MCQ]

1. The general danger signs of a sick child are-
☐ a) convulsion ☐ b) not able to drink ☐ c) wheeze ☐ d) lethargy ☐ e) stridor
2. Indications of vitamin A supplementation according to IMCI are-
☐ a) dysentery ☐ b) persistent diarrhoea ☐ c) measles ☐ d) anaemia
☐ e) very severe disease
3. The following signs are suggestive of very severe disease in young infants –
☐ a) fast breathing ☐ b) jaundice ☐ c) not able to suck
☐ d) umbilical infection ☐ e) convulsion
4. The 4 main symptoms of sick children (2 months upto 5 years) are
☐ a) convulsion ☐ b) ear problem ☐ c) vomits everything
☐ d) lethargy ☐ e) jaundice
5. The emergency signs of a sick child include -
☐ a) stridor ☐ b) grunting ☐ c) bipedal oedema
☐ d) visible severe wasting ☐ e) shock
6. Clinical signs indicating pneumonia of a 2 years old child include -
☐ a) stridor ☐ b) convulsion ☐ c) fast breathing
☐ d) chest indrawing ☐ e) runny nose

CHILDHOOD IMMUNIZATION AND VACCINE PREVENTABLE DISEASES

BASIC INFORMATION	26
EPI	27
VACCINE PREVENTABLE DISEASES	
• TUBERCULOSIS	27
• MEASLES	35
• MUMPS	37
• CHICKENPOX	38
• TETANUS	39
• PERTUSSIS	41
• DIPHTHERIA	42

IMMUNIZATION: THE BASICS

Vaccine

An Antigen used to stimulate the production of antibodies and to provide immunity against one or several diseases.

Immunization

It is the process of inducing immunity artificially by administering antigenic substances or preformed antibody. It is of 2 types -

Active	It is the process of inducing antibody production or to activate immunologically competent cells through stimulation of body's immune system by vaccines
Passive	It is the process of providing temporary protection through administration of exogenously produced antibody

Expanded programme on immunization (EPI)

It means increasing the number of vaccines in the vaccination schedule so as to provide a wider coverage against infectious diseases among the population.

Cold chain

It is a system to keep the vaccines cool so as to maintain their potency and efficacy at every stage from the time of manufacturing until their use.

Adverse Events Following Immunization (AEFI)

It is a medical incident that takes place after immunization, causes concern and believed to be caused by immunization.

Contraindications of Immunization

- Acute illnesses
- Previous severe reaction to immunization
- Immune deficiency
- Progressive or uncontrolled central nervous system diseases etc.

Major achievements of EPI in Bangladesh

- National immunization coverage 2014 -

Full immunization	81%
BCG	99%
Penta3	91%
OPV3	94%
Measles	86%

Source : EPI Office, Mohakhali, Dhaka, July 2014

- 92% babies are protected at birth against neonatal tetanus
- On 27th March 2014, WHO certified 11 countries of SEAR region including Bangladesh as polio free

EPI SCHEDULE IN BANGLADESH

At Birth	BCG, OPV ⁰
At 6 Week of age	* Penta 1, OPV 1, ** PCV 1
At 10 Week of age	* Penta 2, OPV 2, ** PCV 2
At 14 Week of age	* Penta 3, OPV 3, *** IPV
At 18 Week of age	** PCV 3

At 9 completed months	□ MR
At 15th -18th months	□ MR
* Penta includes DPT + Hib + HepB vaccines, ** PCV means Pneumococcal Conjugate Vaccine, *** IPV means Inactivated Polio Vaccine, □ MR means Measles & Rubella	

EPI schedule, Reviewed in 2015

Courtesy: Dr Tajul Islam A Bari

Apart from the above mentioned vaccines, other vaccines available in the private sector are mumps measles rubella (MMR), chicken pox, hepatitis A (HAV), typhoid, rota virus, meningococcal conjugate vaccine, cholera etc.

Another objective of EPI is to prevent deaths of mothers as well as their newborn babies from tetanus. This is ensured through vaccination of women during their reproductive age by Tetanus toxoids (TT) and the schedule is as follows

Doses	Age & Interval of vaccinations	Duration of protection
TT 1	At 15 years	Nil
TT 2	At least 1 month (4 weeks) after TT 1	3 years
TT 3	At least 6 months after TT 2	5 years
TT 4	At least 12 months after TT 3	10 years
TT 5	At least 12 months after TT 4	Life long

N.B. if 5 doses of TT are completed, no TT is required during pregnancy

In addition, vaccine against Human Papilloma Virus to the adolescent girls (at age 11 to 12 years) may be given to protect them from cervical cancer.

Congenital Rubella Syndrome (CRS) & Measles-Rubella (MR) vaccination campaign' 2013-14

The major morbidities of CRS are-

- * Deafness
- * Cataract
- * Patent ductus arteriosus

MR campaign '2013-14

To prevent the morbidity and mortality from rubella as well as from measles, a nation-wide MR vaccination campaign was held during 2013-14 in 2 rounds to cover all children from

9 months upto 15 years. The objectives of this programme was to increase the vaccination coverage rate against measles and rubella of >95% by 2016.

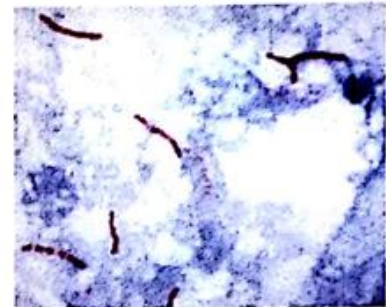
VACCINE PREVENTABLE DISEASES

In this chapter will discuss TB, measles, mumps, chickenpox, tetanus, pertussis and diphtheria. The other vaccine preventable diseases *e.g. pneumonia, typhoid, poliomyelitis and hepatitis A & B* are discussed in other sections.

TUBERCULOSIS

Organism

Mycobacterium tuberculosis hominis and occasionally *M. bovis*.



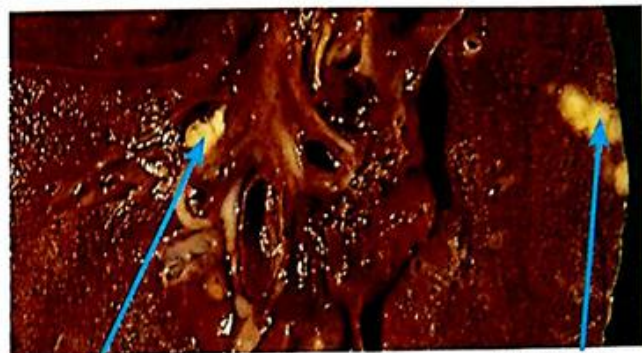
Source: Internet

Transmission

- Inhalation of airborne droplets from open adult pulmonary TB patients (*sputum smear positive for AFB*)
- Ingestion of infected cow's milk (rare)

Pathogenesis

The infectious droplets (*containing TB bacilli*) enter terminal bronchioles of lungs parenchyma through inhalation where they multiply and cause lesion to adjacent lungs tissue (**Ghon focus**).



Granuloma in a hilar LN → Ghon complex ← Sub-pleural granuloma

The bacilli are then drained through lymphatics to the hilar lymph nodes and cause their enlargement (**hilar lymphadenopathy**). The Ghon focus and hilar lymphadenopathy form the **primary complex (Ghon complex)**.

Other Sites of Primary Complex

- * Intestine with mesenteric lymph nodes
- * Skin with regional lymph nodes
- * Tonsil with cervical lymph nodes

Outcome of Primary Complex

- * Healing and calcification.
- * Hypersensitivity reactions, *e.g. erythema nodosum, phlyctenular conjunctivitis.*
- * Destruction to lungs parenchyma *e.g. progressive pulmonary TB.*
- * Invasion of pleura either directly or from a subpleural pulmonary focus or caseated lymph node giving rise to *pleural effusion.*
- * Pressure effects *e.g.*
- (i) By the enlarged hilar & mediastinal lymph

nodes over the bronchus *e.g.*

- *if complete obstruction-collapse;*
- *if partial obstruction - ball valve effect and obstructive emphysema*

(ii) Destruction of bronchial wall and entry of caseous materials within bronchus *e.g. endobronchial TB*

(iii) Pressure over other vital structures.

- * Haematogenous dissemination *e.g. miliary TB, tubercular meningitis* and dissemination to other organs (end organ tuberculosis) *e.g. kidney & genitourinary tract, bones, adrenals, skin, fallopian tube*
- * Involvement of pericardium - either from direct invasion or through lymphatic drainage from subcarinal lymph nodes *e.g. pericarditis & pericardial effusion*
- * Involvement of peritoneum from lympho-haematogenous dissemination and also by direct contact from mesenteric lymph nodes *e.g. ascites*
- * Ingestion of the infected caseous materials *e.g. intestinal TB*

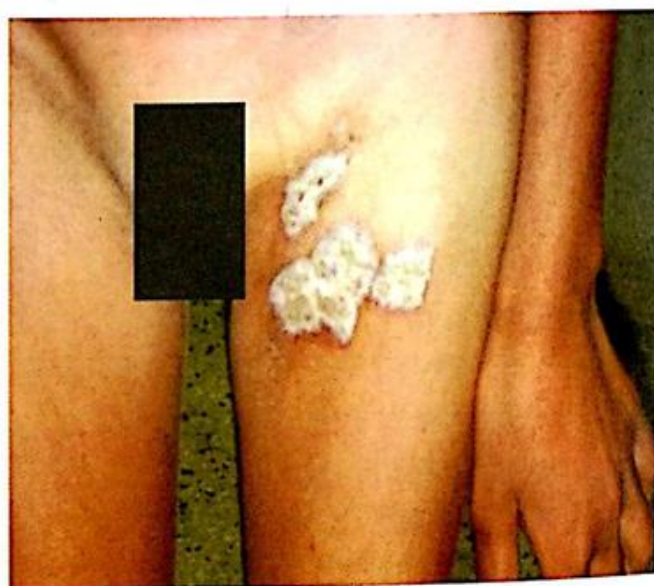
Types of tuberculosis

1. Pulmonary TB (Commonest form)
2. Extra-pulmonary TB

Photographs of different types of extra-pulmonary TB



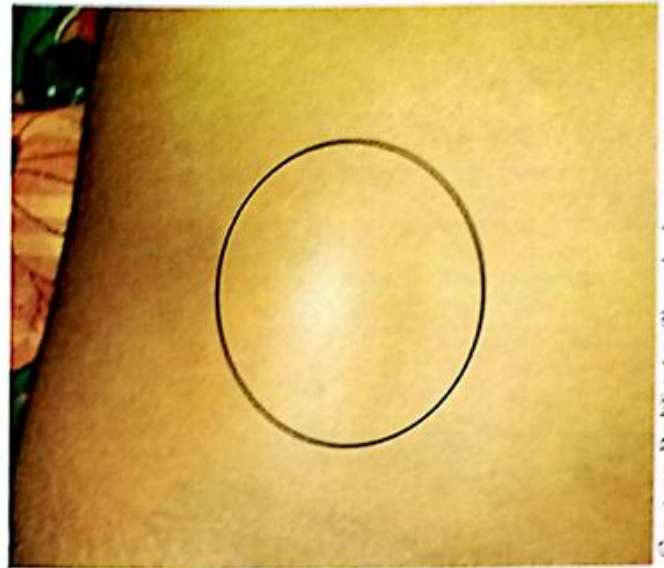
Tubercular lymphadenitis



Lupus vulgaris (skin TB)



Gibbus in spinal TB



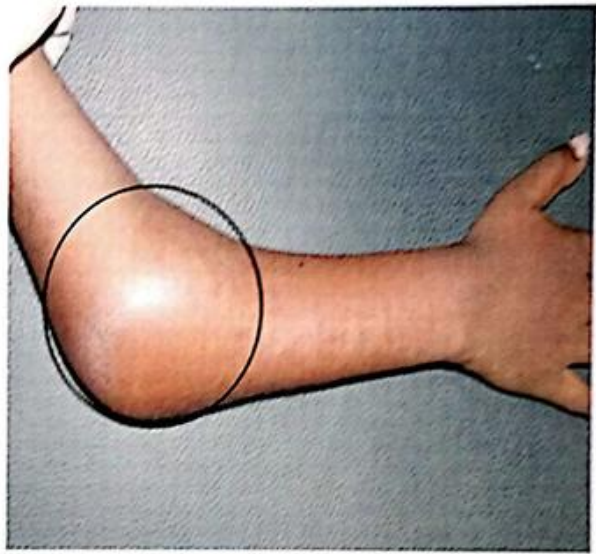
Cold abscess, paravertebral

Courtesy: Dr. Jigar Arav Shamsheer



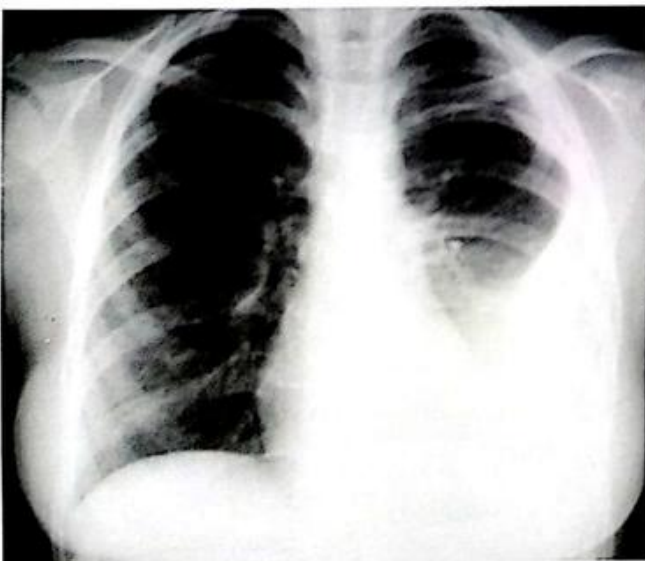
TB dactylitis with skin TB

Courtesy: Prof. Navada Ambar

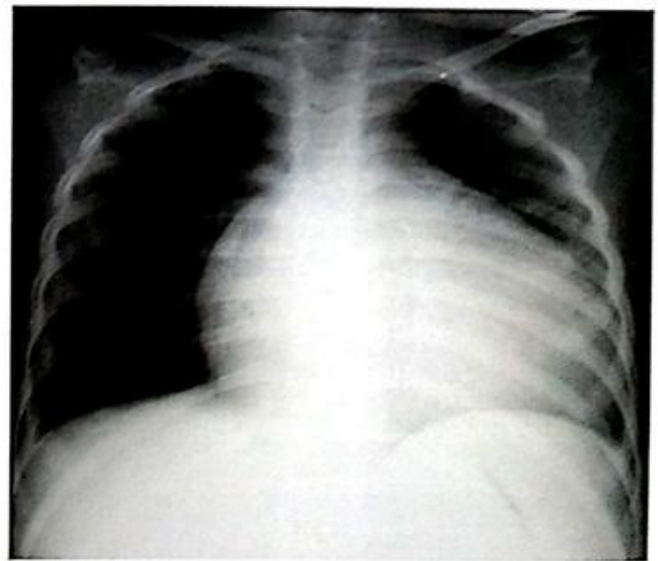


TB of elbow and wrist joint

Source: Internet



Pleural effusion



Pericardial effusion



Tuberculoma of brain



X-ray elbow (ice cream scoop" appearance of the proximal ulnar metaphysis)



Paravertebral abscess & destruction of vertebral bodies



Pott's disease

Clinical Manifestations

Symptom Criteriae suggestive of Pulmonary TB

- Persistent non-remitting cough for >2 weeks not responding to conventional antibiotics (*Amoxicillin, Co-trimoxazole or Cephalosporins*) and/or bronchodilators
- And/or
- Persistent documented fever (38°C/100°F) > 2 weeks after common case such as typhoid, malaria or pneumonia have been excluded

And/or

- Documented weight loss or not gaining weight during the past 3 months (especially if not responding to de-worming with food and/or micronutrient supplementation) OR severe malnutrition

And/or

- Fatigue and reduced playfulness

National Guideline for Tuberculosis in Children. 1st edition; March 2012

Symptoms and Signs Suggestive of Extra - pulmonary TB

Symptoms and signs	Extra pulmonary TB
• A <u>painless enlarged mass of matted lymph nodes</u> ($>2 \times 2 \text{ cm}^2$), usually in the neck, <u>not fixed to the underlying tissue</u> , may present with sinus, not responding to a course of antibiotics	TB lymphadenitis (commonly cervical)
• Cough and shortness of breath	Pleural TB, Pericardial TB
• Reduced playfulness, irritability, weight loss, headache, <u>vomiting without diarrhoea</u> , drowsiness, lethargy, convulsions, unconsciousness and meningitis of acute or sub acute onset not responding to antibiotic	TB meningitis
• Abdominal pain, altered bowel habit, mass or ascites	Abdominal TB
• Gibbus (acute angulation of the spine resulting from collapse of vertebral body)	TB spine
• Chronic pain and swelling of joint(s), usually single	TB arthritis

Diagnosis

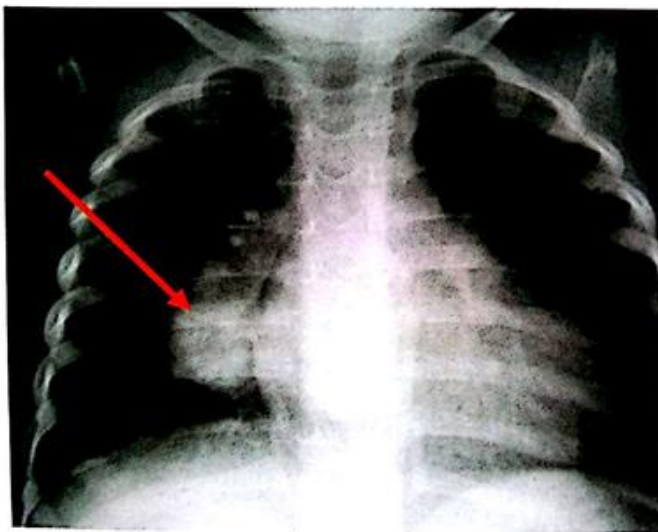
The key to the diagnosis of TB is a high index of suspicion. Bacteriological confirmation is usually not possible in children.

The presence of **3 or more of the features** given in the box strongly suggest a diagnosis of TB -

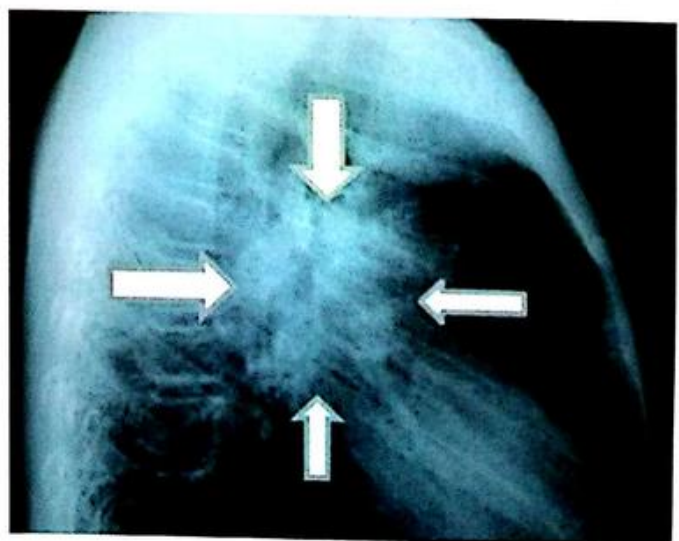
- * Symptom criteriae suggestive of TB
- * A history of recent close contact with open TB case *e.g. within past 12 months*
- * Physical signs highly suggestive of TB
- * A positive Mantoux test
- * Chest X-ray suggestive of TB *e.g. hilar lymphadenopathy*

Investigations

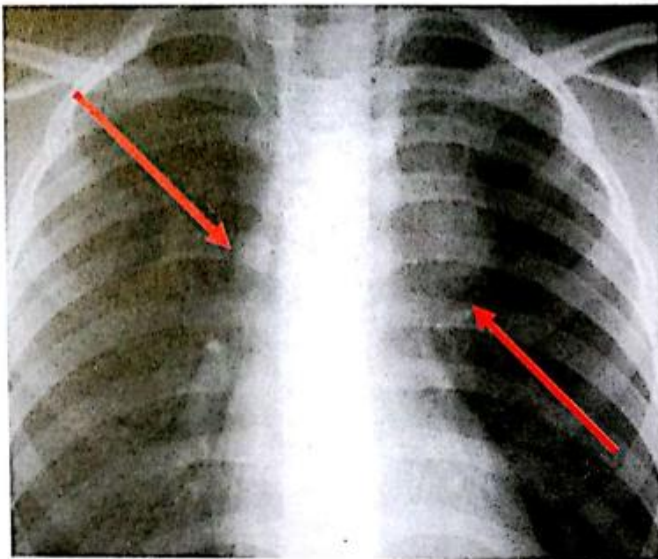
- Complete blood counts: Hb (reduced), lymphocytosis, ESR (high)
- X-ray chest: Findings suggesting pulmonary TB (shown in x-rays below)



Right hilar lymphadenopathy AP view



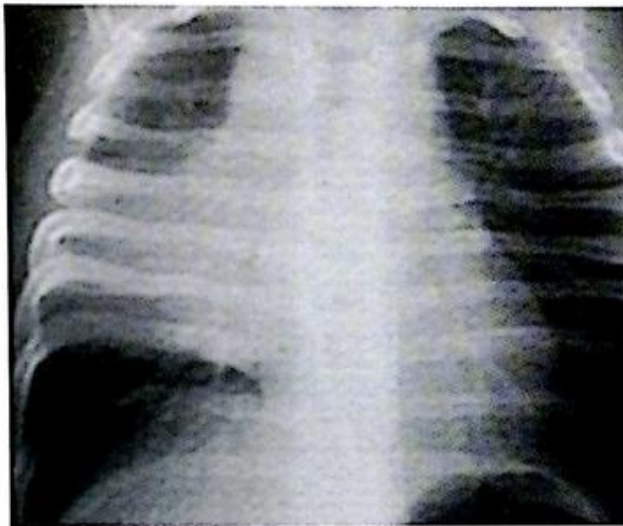
Right hilar lymphadenopathy, Lateral view



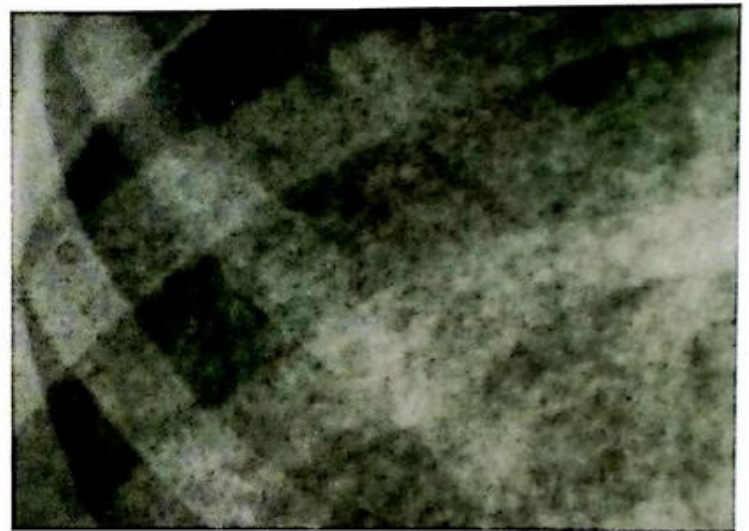
Paratracheal lymphadenopathy



Patchy opacity



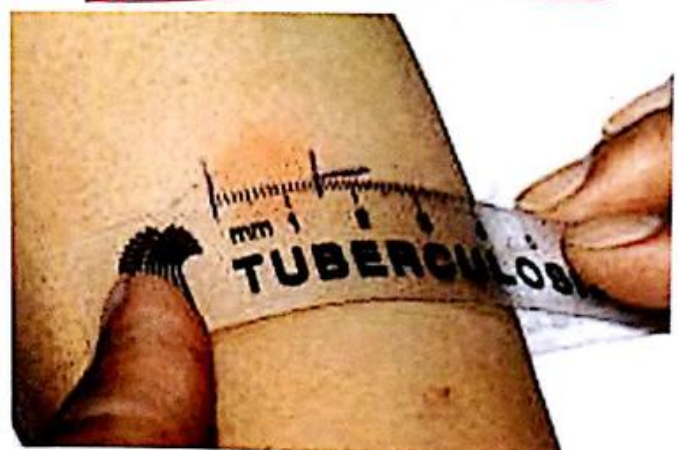
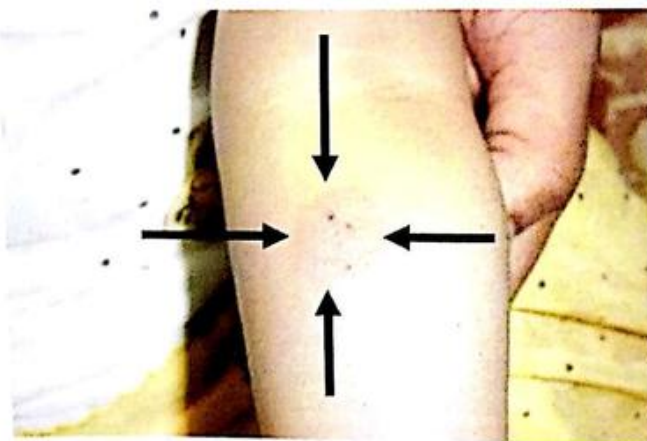
Middle lobe consolidation



Miliary mottling

- Mantoux Test (MT): Done by intradermal injection of 0.1 ml of tuberculin reagent containing 5 tuberculin unit of PPD in the skin of flexor aspect of forearm and the reaction is observed after 72 hours at the site of injection

- Test is regarded positive if induration is-
 - * >10 mm diameter
 - * >5 mm diameter will be considered positive when associated with severe malnutrition, HIV infection and immunosuppression



Mantoux test: Reaction and measurement

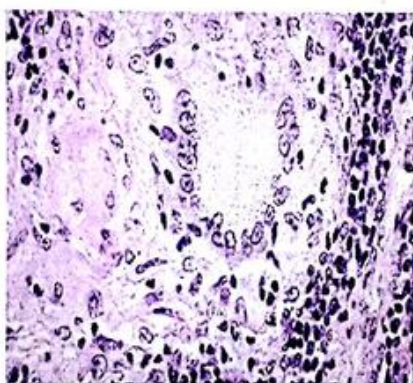
Causes of False Negative and False Positive MT

False negative

- * Very young age
- * Malnutrition
- * Severe bacterial infection including TB meningitis
- * Millitary TB
- * Viral infections *e.g. measles, mumps, infectious mononucleosis, chicken pox*
- * Malignancy
- * Immunosuppressive drugs *e.g. steroid, anti-cancer drugs*
- * Improper technique

False positive: Prior BCG vaccination

- Lymph node biopsy & histopathology: Central caseation surrounded by epithelioid and multinucleated giant cells



Lymph node biopsy showing giant cells and caseation

Source: Internet

- Z-N staining of samples *e.g. sputum, gastric lavage, CSF, pleural and ascitic fluids* for AFB
- Gene X-pert. It can diagnose pulmonary and extrapulmonary TB and resistance to Rifampicin at the same time from sputum samples or other body fluids. It is based on PCR technique and requires only 2 hours to get the report
- Microbial culture in Löwenstein–Jensen medium
- Other investigations
 - * Nucleic acid amplification (PCR)
 - * Interferon-Gamma Release Assays (IGRA)
 - * Adenosine deaminase (ADA)
 - * ELISA

Specialty of childhood TB

The epidemiology, clinical presentation, investigations as well as treatment of tuberculosis are almost similar in both children & adults. However, there are certain specialties of childhood TB and these are given in the table below -

	Aspects	Childhood TB
1	Risk factors	* Close contact with sputum positive adult cases * Children under 5 years of age * Severe malnutrition * Immunosuppressive conditions <i>e.g. measles, whooping cough etc.</i> * Overcrowding
2	Bacilli load	* Pauci bacillary (<10000/ml)
3	Source of infection & infectivity	* Smear positive adult cases * Generally noninfectious

	Aspects	Childhood TB
4	Site of primary focus	* Usually peripheral (<i>sub pleural</i>)
5	Haematogenous dissemination	* Common
6	Fate of primary complex	* Vast majority heal and calcify
7	Clinical features	* Mostly nonspecific * <u>Persistent non remitting cough for > 2 weeks. Cough usually nonproductive and not associated with haemoptysis</u> * Fever may be absent
8	Chance of developing extra-pulmonary TB	* More common than adults * Glandular TB: Common * More vulnerable to develop severe form of TB <i>e.g. TB meningitis/ disseminated TB</i> * Genitourinary TB: Less or rare
9	Rapidity of developing TB after exposure	* Develops TB rapidly in weeks to months and usually occurs within 1st year of exposure to <i>M. tuberculosis</i>
10	Investigations	* <u>Sputum is difficult</u> to obtain. Gastric lavage & nasopharyngeal aspirates often used to detect TB bacilli * <u>X-ray chest: Hilar lymphadenopathy is characteristic than cavitation</u> * AFB positivity rate: <20% * <u>Mantoux test</u>: Less informative as it has more chance of false negativity * <u>GeneXpert</u>: Limited role yet to diagnose childhood TB
11	Treatment in intensive phase	* With 3 drugs (3FDC) due to paucibacillary load except in <i>TB meningitis, lung cavities, extensive alveolar consolidation, osteo articular TB</i> where 4 drugs are used * <i>Pyridoxine is not routinely recommended except in severe PEM, HIV, chronic liver disease and renal failure</i>
12	Chance of developing resistance against anti-TB drugs	* Less because of paucibacillary load

Treatment

- Counsel the parents about the disease
- Antitubercular drugs given in 2 phases -
 - * Intensive phase
 - * Continuation phase

Recommended Treatment Regimens for Children in each TB Diagnostic Category

TB diagnostic category	TB cases	Regimen	
		Intensive phase	Continuation phase
I	<u>All intrathoracic TB in absence of lung cavities or extensive alveolar consolidation,</u> TB lymph node, TB pericarditis, Abdominal TB, TB pleural effusion	2 (HRZ)	4 (HR)
	<u>Intra-thoracic TB with lung cavities or extensive alveolar consolidation</u>	2 (HRZ) E	4 (HR)
	<u>TB meningitis*</u>	2 (HRZ) S	10 (HR)
	Osteoarticular TB	2 (HRZ) E	10 (HR)
II	Previously treated smear-positive pulmonary TB (relapse, treatment after interruption, treatment failure)	2 (HRZ) ES + 1 (HRZ)E	5 (HR)E
DR-TB	MDR TB XDR TB	Specially designed standardized treatment	
<i>* Treatment of TBM and osteo-articular TB may be extended upto 12 months based on clinical judgement</i>			
H - Isoniazid (5-15 mg/kg) R - Rifampicin (10-20 mg/kg) Z - Pyrazinamide (30-40 mg/kg) E - Ethambutol (15-25 mg/kg) S - Streptomycin (12-18 mg/kg)			

Indications of corticosteroid

- * CNS TB including TB meningitis
- * TB pericarditis
- * Abdominal TB

** Age & weight specific FDC are given in annex (p-328)

Drug Resistant TB (DR-TB)

DR-TB is confirmed through laboratory tests when the isolates of *Mycobacterium tuberculosis* grow in vitro in the presence of one or more antitubercular drugs.

Classification of DR-TB: Four different categories of DR-TB have been established -

- Mono-resistance: Resistance to one antitubercular drug
- Poly-resistance: Resistance to more than one first line antitubercular drugs
- Multi-drug resistance (MDR-TB): When TB is resistant to Isoniazid and Rifampicin (in vitro), with or without resistance to any other drugs
- Extensively drug-resistance (XDR-TB): When TB, resistant to multiple first-line anti-TB drugs as well as to any one of the fluoroquinolones and to at least one of three injectable second-line drugs e.g. Amikacin, Capreomycin or Kanamycin
- Total drug-resistance (TDR-TB): Resistance to all first and second line anti-TB drugs

Treatment regimen for MDR TB

- **Intensive phase** (8 months): Treatment with Kanamycin, Pyrazinamide, Levofloxacin, Ethionamide, Cycloserine
- **Continuation phase** (12 months): Treatment with Levofloxacin, Ethionamide, Cycloserine, Pyrazinamide

MEASLES

Organism: *Rubeola virus*, an RNA virus

Transmission: Inhalation of air borne droplets

Incubation Period: 7-18 days

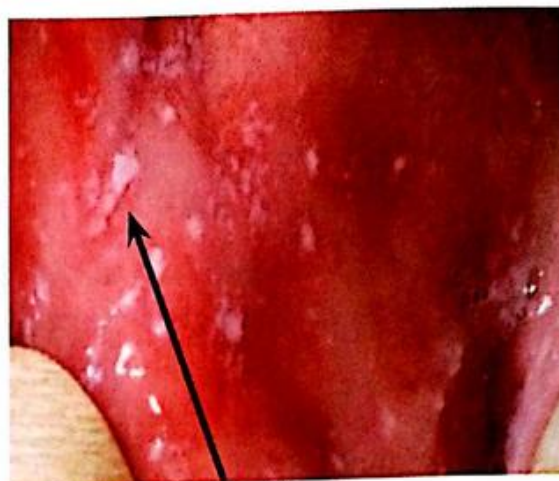
Pathogenesis

After entry into the host, viruses replicate in nasopharynx and regional lymph nodes and subsequently cause viraemia. It principally affects cytotoxic T cells and causes vasculitis particularly of skin, mucosa of nasopharynx, bronchi, gut and conjunctiva.

Clinical Manifestations

Clinical course pass through following stages-

Prodromal stage (duration 3 to 4 days)	* Fever * Cough * Runny nose (coryza) * Red eyes * Appearance of Koplik's spot (small white papules found on buccal mucosa against upper molar teeth)
Exanthematous stage (duration 6 to 7 days)	* Orderly appearance of maculopapular rash starting on the 4th day of fever and with the peak of fever * Rash starts behind the ear, reaches extremities centrifugally in 3-4 days
Convalescence phase	* Symptoms begin to subside * The rash fades in the same progression as it evolved, often leaving a fine desquamation of skin. * Cough may persist for 2 weeks



Koplik's spot



Maculo-papular rash



Runny nose, red eyes

Complications

- * Immune deficiency & secondary bacterial infections *e.g. otitis media, bronchopneumonia, flaring of healed TB, conjunctivitis, diarrhoea*
- * Depletion of vitamin A and Xerophthalmia *e.g. night blindness, corneal xerosis, corneal ulceration etc.*
- * Severe malnutrition
- * Neurological complications *e.g. encephalitis, subacute sclerosing panencephalitis (SSPE)*
- * Others *e.g. stomatitis, acute renal failure, noma*

Diagnosis

• Clinical

- * History of exposure to measles cases, 7-14 days before the onset of illness
- * Characteristic prodromal features and
- * Orderly distributed maculopapular rashes

- **Investigations** (little value): CBC may show leukopenia with absolute lymphopenia

Treatment

Counsel parents about the disease, its complications, treatment and prognosis.

Treatment is mainly supportive -

- Paracetamol for fever
- Fluid intake should be adequate
- Vit A supplementation

Age 6 mo to 1 year	Children over 1 yr of age	Children with xerophthalmia/malnutrition
* Single dose of 100,000 IU of VAC on admission * Another dose of 100,000 IU of VAC on the following day	* Single dose of 200,000 IU of VAC on admission * A second dose on the following day	* First dose on the day of admission * Second dose on the following day * Third dose at 2 weeks of 1st dose

- Foods: Energy dense foods *e.g. oily foods*
- Care of eyes: Antibiotic eye ointments, artificial tears if eye complications
- Cough remedy *e.g. warm water, tulsi leaf juice, lemon juice etc.* can be given to soothe the throat
- Identify and treat any complication
- Antibiotics: When evidence of secondary bacterial infection

Ribavirin may be given to an infected immuno-compromized child.

Prevention

Measles and MR/MMR vaccine. Cases should be isolated for 4 days after appearance of rash, as patients are infectious to contacts from 4 days before to 4 days after appearance of rash.

MUMPS

Organism: *Mumps virus*, an RNA virus

Transmission: Inhalation of air borne droplets

Incubation Period: 2 - 4 weeks

Pathogenesis

Virus replicates in the nasopharynx, spread to regional lymph nodes and finally viraemia occurs. Organisms then spread to multiple target tissues such as the salivary glands, pancreas, testes, ovaries, thyroid, meninges, heart, liver, kidneys and joints.

Clinical Manifestations

- Prodromal stage: 1-2 days and characterized by anorexia, fever, myalgia, malaise, headache, vomiting, sore throat and earache on chewing & swallowing



Swelling of left parotid gland

- At the end of prodromal stage, there is painful swelling of the parotid gland (obliterating mandibular angle). May be unilateral initially but later on becomes bilateral (70%). The opening of Stensen duct may be red and oedematous. Submandibular salivary glands may be involved with or without parotid swelling

Complications

- * Orchitis or epididymo-orchitis. Sometimes testicular atrophy, but sterility is rare
- * Oophoritis (ovarian inflammation)
- * Aseptic meningitis/Meningoencephalitis
- * Myocarditis
- * Transient myelitis
- * Polyneuritis
- * Hearing loss
- * Others e.g. *Pancreatitis, carditis, thyroiditis, arthralgia, arthritis, nephritis*

Diagnosis

- History of contact with an affected patient
- Characteristic clinical features

Investigations

- Complete blood counts with PBF
- Serum amylase level is elevated in both mumps parotitis and pancreatitis
- Serum lipase level is elevated in pancreatitis but not in parotitis

Treatment

- Counseling the parents about the disease
- Normal diet with plenty of fluid intake
- Paracetamol for fever and pain
- Maintenance of oral hygiene e.g. *warm saline mouth wash*
- For orchitis: Steroid helps in reducing pain and oedema, but it does not alter the clinical course of the disease or prevent future complications. Prednisolone (40 mg/day) can reduce pain & swelling

Prevention

- MMR vaccine : 2 doses (1st dose at 12-15 months age and 2nd dose by 4-6 years of age)

Affected children should be isolated from school and child care centers for 9 to 10 days from the onset of parotid gland swelling to prevent spreading to healthy children.

CHICKENPOX

Organism: *Varicella zoster virus*, a DNA virus

Transmission: Inhalation of air borne droplets

Incubation period: 10-21 days

Pathogenesis

The virus colonizes the upper respiratory tract. Over the next 2-4 days it replicates in regional lymph nodes; 4-6 days later, a primary viraemia spreads the virus to reticuloendothelial cells in the spleen, liver and elsewhere. After a week, a secondary viraemia disseminates the virus to the viscera and skin, eliciting the typical skin lesions.

Clinical Manifestations

- **Prodromal phase:** Fever, malaise, anorexia, headache and occasionally mild abdominal pain
- **Rash** Characteristic rash that appears after 24 hours of prodromal symptoms



- * Each lesion starts as a red macule and passes through stages of papule, vesicle, pustule and crust. The appearance of the rash is described *as a pearl or dewdrop on a rose petal*
- * New lesions continue to erupt for 3-5 days
- * Lesions usually crust by 6 days (range 2-12 days), and completely heal by 16 days (range 7-34 days)

- * While the initial lesions are crusting, new crops form on the trunk and then the extremities; *the simultaneous presence of lesions in various stages of evolution is characteristic of Varicella*



Simultaneous presence of various stages of lesion

- * Lesions may also involve the mucosa of oropharynx, eyelids, conjunctiva etc. but corneal involvement is rare

Complications

- * Brain *e.g. encephalitis particularly cerebellitis and cerebellar ataxia*
- * Skin *e.g. secondary bacterial infection*
- * Lungs *e.g. pneumonia*
- * Hepatobiliary *e.g. hepatitis, pancreatitis*
- * Haematologic *e.g. thrombocytopenic purpura*
- * Kidney *e.g. nephritis, nephrotic syndrome*
- * Joints *e.g. arthritis*
- * Heart *e.g. myocarditis*

Diagnosis: Clinical

Treatment

A. Supportive

- Normal foods and fluids, no restriction
- Paracetamol (15 mg/kg) 6 hourly for fever
- Management of pruritus-
 - * Cool compression and regular bathing
 - * Oral antihistamines, such as Diphenhydramine and Hydroxyzine
 - * Topical Diphenhydramine ointment

Topical calamine lotion may cause excessive drying of the skin, causing the child to scratch.

B. Specific

- Oral Acyclovir (20 mg/kg/dose) 5 to 6 hourly for 5 days
- Varicella zoster immunoglobulin (VZIG): Recommended for immunocompromised children and newborns exposed to maternal varicella (*described in page 67*)

Prevention

- Varicella vaccine: Usually single dose, given after 12 months of age
- Affected children should be excluded from school until the 6th day of rash

TETANUS

Organism: *Clostridium tetani* (gram positive spore forming anaerobic bacilli)

Transmission

- Through contamination of wounds by bacilli
- Newborn: Contamination of umbilical cord by clostridial spores

Incubation period: 4-14 days

Pathogenesis

Clinico-pathological events are related to toxin (Tetanospasmin). Toxins bind at neuromuscular junction and enter the spinal cord by retrograde axonal transport, where it prevents release of GABA. Toxins thus block normal inhibition of antagonistic muscles and as a consequence affected muscles show sustained contraction and cannot relax.

Clinical Manifestations

Often mild pain at wound site, followed by **hypertonicity and sudden muscle spasm** lasting for seconds to minutes, occur either spontaneously or following any external stimuli like **slight sound or touch**. The patient remains fully conscious (as toxin does not affect cortical function) in fearful anticipation of the next tetanic seizure.

Muscle spasms are manifested by -

- **Opisthotonus**, characterized by extension of upper limbs, clenched fists and flexion of legs



Opisthotonus

- **Trismus**, due to spasm of masseter muscles, lock jaw



Trismus

- **Risus sardonicus** results from spasms of laryngeal and respiratory muscles



Risus sardonicus

- Apnoea may occur

Newborns present between 3 days to 3 weeks with irritability and inability to feed. They may have lock jaw and stiffness of neck, generalized hyperreflexia, rigidity and spasm of muscles of the abdomen and back



Neonate with lock jaw

Diagnosis

- **Clinical** e.g. history of non-immunization, hypertonicity, hyperreflexia and stimulus sensitive episodic generalized muscle spasm
- **Investigations** are of very little value. However, Gram staining of pus from the wound may reveal the organism

Treatment

Counsel parents about the disease, its complications and outcome.

Courtesy: Dr. Manisha Banerjee

Source: Internet

A. Supportive

- The child should be managed in a quiet room
- Put the child on IV fluid to ensure adequate hydration & nutrition
- Monitor closely to note any respiratory distress due to spasm
- Consider tracheostomy and/or endotracheal intubation if necessary
- Do thorough exploration, cleansing and debridement of the wound
- Give Benzodiazepines *e.g. Inj. Diazepam 0.1–0.2/kg every 3–6 hours* for spasm and rigidity

B. Specific

- **Human TIG:** A single dose to be given IM to neutralize the unbound toxin.
 - * For children: 3000-6000 U
 - * For infants: 500 U
- Antibiotics
 - * Benzyl Penicillin (100 000 U/kg/day) IV at 4 to 6 hours intervals for 10 -14 days*If penicillin is not available -*
- Metronidazole (30 mg/kg/day) Oral or IV 6 hourly for 14 days or
- Erythromycin and Tetracycline for Penicillin-allergic patients

Prevention

Penta vaccine for children (in EPI schedule) and TT vaccine to woman during reproductive age or during pregnancy.

PERTUSSIS

Organism:

Bordetella pertussis
(gram-negative
cocco-bacilli)

Transmission:

Inhalation of air
borne droplets

Incubation period:
3-14 days



Source: Internet

Pathogenesis

Clinicopathological events are related to toxin. Bacteria attach and multiply over ciliated columnar epithelium of respiratory tract, release toxin, cause damage of respiratory epithelium (tracheobronchitis) and give rise to paroxysmal cough and other clinical features.

Clinical Manifestations

Intense coughing. The clinical manifestations are presented in 3 stages -

Stages of the disease	Clinical manifestations
Catarrhal stage (1–2 weeks)	Mild cough & coryza with low-grade fever, sneezing, lacrimation and conjunctival suffusion
Paroxysmal stage (2–6 weeks)	Paroxysmal uninterrupted coughing lasting up to several minutes ending with loud whoop. Infants younger than 6 months do not have the characteristic whoop but may have apnoeic episodes and are at risk for exhaustion. Post tussive vomiting is common
Convalescent stage (≥2 weeks)	Patients have chronic cough, which may last for weeks

Complications

- * Bronchopneumonia
- * Pulmonary collapse
- * Otitis media
- * Pulmonary hypertension
- * Apnoea and sudden death
- * Subconjunctival haemorrhage
- * CNS complications *e.g. encephalopathy, seizure*
- * Hernia
- * Rectal prolapse

Diagnosis

Usually clinical *e.g. history of non-immunization and long duration paroxysmal cough with whoop.*

Investigations

Complete blood counts: Leukocytosis & leukaemoid reaction ($15,000-50,000 \times 10^3/\mu\text{L}$) with absolute lymphocytosis.

Treatment

Counsel the parents about the disease, its complications and outcome.

A. Supportive

- Isolation of the patients to limit spreading to the contacts
- O_2 inhalation, if respiratory distress
- Maintain adequate hydration & nutrition by -
 - * Frequent small feeding
 - * Adequate fluid intake
 - * IV fluid administration (if required)
- Provide ICU support for infants whose paroxysms repeatedly lead to life-threatening events

B. Specific: Antibiotic

- Azithromycin (10 mg/kg/day as a single daily dose PO for 5 days) or
- Erythromycin (40–50 mg/kg/day 6 hourly PO for 14 days)

Prognosis

Variable, but poor in children <1 year and if associated with encephalopathy.

Prevention

Penta vaccine (DPT + Hib + HBV) 3 doses given at 6, 10 and 14 weeks of age.

DIPHTHERIA

Organism: *Corynebacterium diphtheriae* (gram-positive aerobic, non-capsulated, non-spore forming, mostly nonmotile, pleomorphic, bacilli)

Transmission: Direct contact with infected respiratory secretions through airborne droplets from -

- * Symptomatic individuals
- * Infected skin lesions
- * Fomites

Incubation period: 2 - 5 days.

Pathogenesis

C. diphtheriae causes toxin mediated skin and mucosal damage of pharynx, tonsil, larynx and sometimes nose & vulva. Toxin inhibits protein synthesis and causes local tissue necrosis. Within first few days of infection, a **pseudomembrane** is formed in the pharynx and interfere with respiration. The dissemination of diphtheria toxin can also lead to systemic disease, causing complications such as necrosis of kidney tubules, thrombocytopenia, cardiomyopathy and demyelination of nerves.

Clinical Manifestations

- Fever is present in about 50% cases
- Cough is usually absent
- Other manifestations are according to the sites of involvement, given in a table -

Sites of involvement	Clinical Manifestations
Pharynx & Larynx	• Sore throat, dysphagia, hoarseness • Respiratory obstruction, stridor, dyspnoea • Toxic look, <i>bull neck appearance</i> • Pseudomembrane in fauces and beyond, which is grayish brown in colour with areas of green or black necrosis surrounded by a minimal amount of erythema • Attempts to remove this pseudomembrane causes bleeding
 <i>Bull neck</i>	 <i>Pseudomembrane</i>
Nose Vagina Skin	• Ulceration, membrane formation and serosanguinous discharge

Source: Internet

Complications

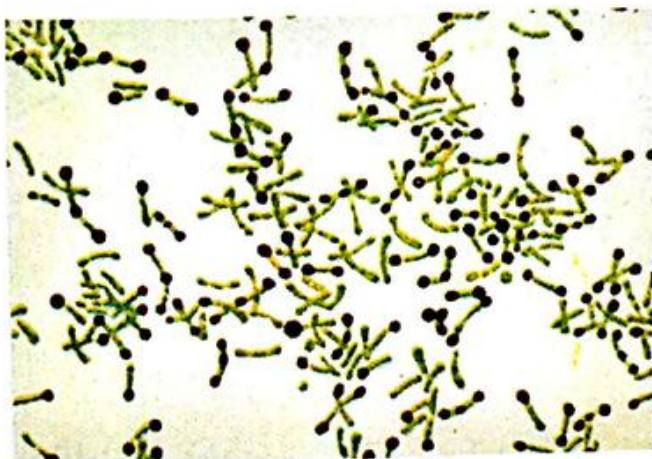
- Respiratory obstruction: Cyanosis
- Carditis: Undue tachycardia, arrhythmia, heart failure
- Neuropathy: Features of lower motor neuron paralysis, palatal palsy, 3rd cranial nerve palsy, sensory disturbances
- Adrenal failure: Circulatory collapse

Diagnosis

Based on clinical features, particularly the presence of pseudomembrane which is pathognomonic of diphtheria and on the relevant investigations.

Investigations

- Swabs taken from the nose, pseudomembrane, tonsillar crypts, from any ulcerations or discolourations and send for -
 - * Gram stain: Gram positive bacilli, straight or slightly curved and often enlarged (clubbing) at one or both ends as Chinese letters or V shaped
 - * Albert staining (KLB) shows metachromatic granules which give the bacillus beaded appearance
 - * Cultures in Tellurite agar media yield growth of bacteria
- Toxigenicity: Elek test
- Complete blood counts: May show moderate leukocytosis



Club shaped bacilli

Source: Internet

Treatment

Counsel the parents about the disease, its complications and outcome.

A. Supportive

- Isolation of the patients to limit spreading to the contacts
- Bed rest, IV fluid, oxygen inhalation, nutrition (feeding by NG tube if necessary) should be provided
- Close monitoring to note any respiratory distress due to laryngeal pseudomembrane
- Tracheostomy should be considered if respiratory obstruction

B. Specific

- Anti Diphtheria Serum (ADS): 10,000-150,000 units, depending on the severity of disease. Single dose should be given within 48 hours of onset of disease

• Antibiotics

a) Symptomatic individual

- * Erythromycin (40-50 mg/kg/day 6 hourly PO) for 14 days or
- * Benzyl penicillin (100,000-150,000 U/kg/day) 6 hourly IV or IM for 14 days or
- * Procaine penicillin (25,000-50,000 U/kg/day 12 hourly IM) for 14 days

b) Asymptomatic Contacts

- * Erythromycin (40-50 mg/kg/day 6 hourly PO) for 10 days or
- * Benzathine penicillin (600,000 U for <30 kg, 12,00,000 U for ≥30 kg IM) single dose

Prevention

Penta vaccine (DPT + Hib + HBV) 3 doses given at 6, 10 and 14 weeks of age.

References

1. Infectious Diseases. In: Kliegman RM, Stanton BF, Geme III JWS, Schor NF, Behrman RE. Editors. Nelson Textbook of Pediatrics, 20th Edition. New Delhi: Elsevier; 2016: 1231-1756
2. Khan MR, Rahman ME. Essence of Pediatrics. 4th ed. New Delhi: Elsevier; 2011. Chapter 21, Immunization and infectious Diseases; p. 370-422.
3. Kumar AVG, Kothari MV, Krishnan A and Karnad DR. Benzathine penicillin, metronidazole and benzyl penicillin in the treatment of tetanus: a randomized, controlled trial. *Annals of Tropical Medicine & Parasitology*. 2004; 98(1): 59-63.
4. American Academy of Pediatrics. [Measles, Mumps, Varicella-Zoster Infections, Pertussis, Tetanus, Diphtheria]. In: Pickering LK, Baker CJ, Kimberlin DW, Long SS, eds. Red Book: 2009 Report of the Committee on Infectious Diseases. 28th ed. Elk Grove Village, IL: American Academy of Pediatrics; 2009.
5. Quintana EC, Bachur RG, Pediatric Mumps.[Internet]. 2010 [updated 2010 Feb 10; cited 2011 May 1]. Available from: <http://emedicine.medscape.com/article>.
6. Masarani M, Wazait H, Dinneen M. Mumps orchitis, *Journal Of The Royal Society of Medicine*. 2006 Dec; 99: 573-575.
7. Government of the People's Republic of Bangladesh. Ministry of Health and Family Welfare. Directorate General of Health Services National Guideline for Tuberculosis in Children. 1st edition; March 2012.

SELF ASSESSMENT

Short answer questions [SAQ]

1. Name the disease being prevented by vaccines in National EPI schedule of Bangladesh.
2. Write down the current EPI schedule of Bangladesh. What is AEFI?
3. Write down the contraindication of immunization.
4. Write down the classic manifestation of tetanus.
5. Write down the complication of measles.
7. What is primary complex?
8. How will you diagnose PTB in children as per national guideline?
9. Write down the fates of primary complex.
10. Define MDR & XDR tuberculosis.
11. Describe the paroxysmal stage of pertussis.
12. Describe the typical patch in pharynx in diphtheria.
13. A 5 years old girl presents with low grade fever for 2 months, swelling in neck for 1 month. She has evening rise of temperature and loss of weight for last 1 month.
 - a) What is the most probable diagnosis?
 - b) How will you investigate & treat the case?

Multiple choice questions [MCQ]

- Complications of mumps include-

☐ a) meningoencephalitis	☐ b) myocarditis	☐ c) oophoritis
☐ d) laryngitis	☐ e) sterility	
- Vaccines included in the national EPI schedule of Bangladesh are-

☐ a) MMR	☐ b) Hib	☐ c) hepatitis B
☐ d) typhoid	☐ e) Rota virus	
- Mantoux test may be false negative in-

☐ a) rheumatic fever	☐ b) leukaemia	☐ c) kwashiorkor
☐ d) hypothyroidism	☐ e) measles	
- The complications of diphtheria include -

☐ a) laryngeal obstruction	☐ b) renal failure	☐ c) polyneuritis
☐ d) myocarditis	☐ e) meningitis	
- Treatment of neonatal tetanus include

☐ a) Benzathine penicillin	☐ b) Diazepam	☐ c) Tetanus toxoid
☐ d) Human TIG	☐ e) Metronidazole	
- Causes of maculopapular rash are

☐ a) measles	☐ b) chicken pox	☐ c) drugs
☐ d) rubella	☐ e) meningococcal septicaemia	
- Following are the complications of measles

☐ a) bronchopneumonia	☐ b) renal failure	☐ c) acute otitis media
☐ d) intestinal obstruction	☐ e) subacute sclerosing panencephalitis	
- The following condition are characterized by patches in the throat

☐ a) Streptococcal tonsillitis	☐ b) diphtheria	☐ c) agranulocytosis
☐ d) eosinophilia	☐ e) Herpes simplex infection	
- Indications of steroid in TB are -

☐ a) meningitis	☐ b) intestinal TB	☐ c) TB pericarditis
☐ d) TB lymphadenopathy	☐ e) TB arthritis	
- The pathognomonic radiologic feature of pulmonary TB is

☐ a) patchy opacities	☐ b) consolidation	☐ c) pleural effusion
☐ d) cardiomegaly	☐ e) hilar lymphadenopathy	
- Hypersensitivity phenomenon of tuberculosis are-

☐ a) arthritis	☐ b) erythema nodosum	☐ c) phlyctenular conjunctivitis
☐ d) hilar lymphadenopathy	☐ e) lupus vulgaris	
- Duration of treatment of TBM is

☐ a) 6 months	☐ b) 7 months	☐ c) 8 months
☐ d) 10 months	☐ e) 12 months	
- Number of anti TB drugs used in TBM are

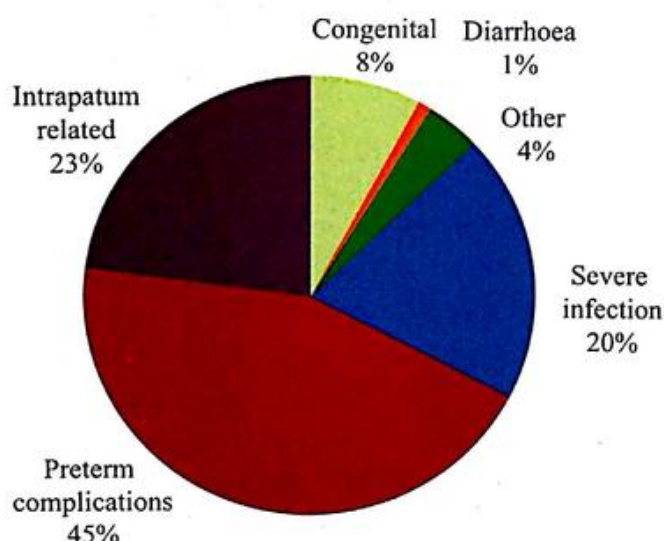
☐ a) 3	☐ b) 4	☐ c) 2
☐ d) 5	☐ e) 6	
- Histological landmark of TB lymphadenitis is the presence of -

☐ a) caseation necrosis	☐ b) blast cells	☐ c) small round cells
☐ d) TB bacilli	☐ e) Reed Sternberg cells	

NEWBORN AND COMMON NEONATAL PROBLEMS

A HEALTHY TERM NEWBORN	46
NEWBORN CARE	48
COMMON NEONATAL PROBLEMS	
• LOW BIRTH WEIGHT	49
• PERINATAL ASPHYXIA	52
• RESPIRATORY DISTRESS SYNDROME	57
• NEONATAL SEPSIS	59
• NEONATAL JAUNDICE	61
• NEONATAL CONVULSIONS	64
• BIRTH INJURIES	67

Neonatal mortality rate in Bangladesh is still high and is around 28 per 1,000 live births (BDHS' 2014). Of the different causes, *perinatal asphyxia*, *preterm birth complications* and *severe infections* contributing to around 88% of all neonatal deaths.



Source: Child Health Epidemiology Reference Group (CHERG) 2010

The other causes of neonatal deaths are congenital anomalies, birth injuries, diarrhoea etc.

To understand specific neonatal problem, it is imperative to know the characteristics of healthy term newborn (delivered within 37 to 42 weeks of gestation).

CHARACTERISTICS OF A HEALTHY TERM NEWBORN

- Birth weight: 2500 to 4000 grams
- Length: 50 cm approximately
- Occipitofrontal circumference (OFC): 35 cm approximately
- Colour: Pink, but mild peripheral (acral) cyanosis soon after birth may be present and is considered normal
- Breathing: Spontaneous, regular and rate is between 30-60 breaths per minute



Normal newborn with mild peripheral cyanosis

Heart rate: 100-160 beats per minute

- Axillary temperature: 97.5° to 99°F
- Muscle tone: Normal and the baby will be in a flexed position
- Ability to suck: Present soon after birth
- Urine: Most babies pass urine within 24 hours, but some may not up to 48 hours of birth
- Meconium: Most of the babies pass meconium within 24 hours of birth
- Sleep: Around 18 hours a day
- Congenital anomaly: Absent
- Primitive reflexes: Good

Primitive reflexes (involuntary neurological responses)

Reflexes	Time of appearance	Time of disappearance
Moro reflex	Birth	3 – 4 months
Rooting reflex	Birth	3 – 4 months
Palmar grasp	Birth	2 – 4 months
Planter grasp	Birth	8 – 12 months
Sucking reflex	Birth	6 – 9 months
Stepping reflex	Birth	5 – 6 weeks



Moro reflex



Rooting reflex



Palmar grasp



Stepping reflex



Sucking reflex



Planter grasp

Courtesy: Dr Farzana Sharmeen

NEWBORN CARE

Appropriate **hand washing** before handling the baby is a must.

Care at Birth

- * *Clean and safe delivery*
 - * Hold the baby at the same level of the mother
 - * Clean cord cutting and tying
- * *Cut the umbilical cord within 1-3 minutes*
 - * Tie about 2 cm from the abdominal skin with umbilical clamp and cut with a sharp sterile instrument above the clamp



Source: Internet

Prevention & management of hypothermia

- * Drying and wrapping
- * Skin-to-skin contact
- * Delayed bathing
- * Use two dry and warm clothes. Dry the baby thoroughly with one, and cover with the other



Assessment of breathing status and management of birth asphyxia if needed

- * Check baby's breathing and colour
- * Tactile stimulation
- * Bag and mask resuscitation if needed
- * Provide special care for LBW newborns

- * Identify, manage and refer for any complications
- * Keep mother and baby together, if the baby is well. Reassure mother about baby's condition

Bathing the baby immediately after birth or using oil to clean the vernix are not necessary

Care Following Birth

- Initiate breast feeding (colostrum) immediately after birth & no later than 1 hour of birth
- Do not offer any other food
- Give oral vitamin K1, 2 mg after first breast feeding (within 4 hours of birth)
- Exclusive breast feeding
- Keep the baby warm
- No bathing until 2nd or 3rd day of life
- Appropriate cord care
 - * **7.1% chlorhexidine** single application followed by dry cord care
 - * Keep umbilical cord bare, clean and dry
 - * Washing with spirit or use of drugs is not required, as it will delay shedding/falling off umbilical cord
- Check for passage of urine and stool
- Appropriate eye care
- Immunize the baby with BCG and OPV-0 soon after birth

Optimum Fluid Requirement

As the babies have larger body surface area and relatively thinner skin than adults, fluid is easily lost from them. Therefore, their fluid requirement is higher than adults and the demand increases during the first week of life as follows -

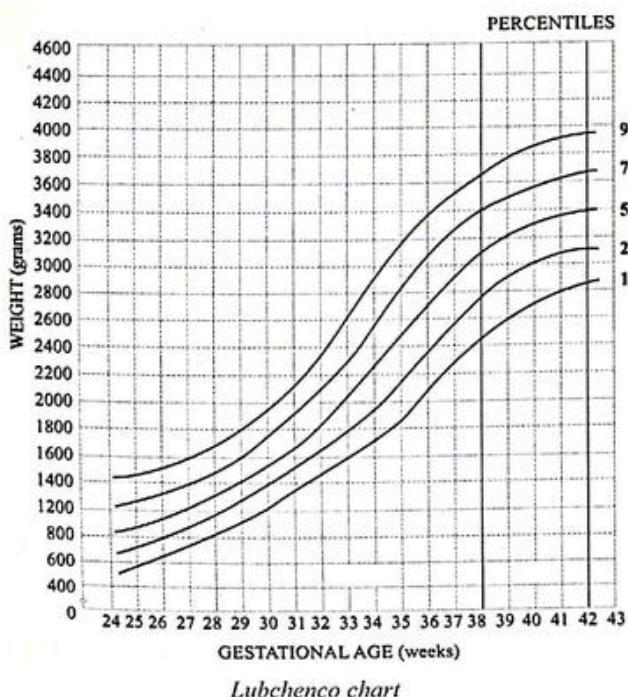
Day of life	Amount of fluid (ml/kg/day)
1	60
2	80
3	100
4	120
5	140
6 and onward	150

NB

1. Daily requirement of fluid for normal term newborns starts with 60 ml/kg and for low birth weight babies it can be started with 80-100 ml/kg/day
2. Daily increment of fluid requirement in normal weighing baby is 20 ml/kg/day and in low birth weight baby it is 15 ml/kg/day. In LBW babies amount of fluid can be raised up to 200 ml/kg/day by 14 days
3. Babies receiving phototherapy will need 10-15 ml/kg of extra fluid daily
4. These are general guidelines but fluid demand should be individualized according to other associated conditions

COMMON NEONATAL PROBLEMS**LOW BIRTH WEIGHT (LBW) BABY**

Babies with a birth weight (BW) of < 2500 grams irrespective of gestational age is defined as LBW. When BW falls below 10th centile according to the gestational age, the baby will be called small for gestational age (SGA) as shown in the Lubchenco chart given below. But if birth weight is seen above 10th centile according to gestational age but weight is <2500 gm, then this LBW is appropriate for gestational age and is mostly due to prematurity.



Therefore, LBW of a newborn may be related to-

Prematurity - Appropriate for Gestational age (AGA)	Intrauterine growth retardation - Inappropriate/ Small for gestational age (SGA)
--	---

Spectrum of LBW

Spectrum	Birth weight
Low Birth weight	< 2500 gm
Very LBW	<1500 gm
Extremely LBW	<1000 gm
Incredible LBW	<750 gm

Level of Maturity of Newborn

Preterm	< 37 weeks of gestation
Term	37 -42 weeks of gestation
Post term	> 42 weeks of gestation

Causes of Prematurity	Causes of IUGR/SGA
* Unknown mostly * Poor socio-economic status * Low maternal age * Maternal diseases e.g., <u>ante-partum haemorrhage</u>, <u>cervical incompetence</u>, <u>maternal genital infections</u>, <u>bicornuate uterus</u>, <u>multiple pregnancy</u> * Foetal malformations	* Inadequate placental growth * Multiple gestations * <u>Maternal diseases e.g. hypertension, cardiac or pulmonary disease, malnutrition, chronic illness or severe anaemia</u> * Smoking or smokeless tobacco ingestion by mother * <u>Toxaemias of pregnancy, diabetic vasculopathy</u> * <u>Foetus e.g. TORCHS infection, chromosomal disorders</u>



Preterm baby with shiny and thin skin



Alert, wasted IUGR baby

Clinical differences between Preterm and Small for date babies

Parameters	Preterm	Small for date/IUGR
Alertness	Less alert	Alert
Movement	Usually less	Comparatively more
Skin	Thin, shiny	May have cracks or peeling of epidermis
Ear lobule	Soft	Like that of normal baby
Breast buds	Less developed	Well developed
Sole crease	Less	More
Labia majora	Widely separated	Normal
Limbs	Limp	Semi flexed
Abdomen	Distended with visible coils of intestine	Usually like that of a fully term baby

Problems of Preterm LBW babies

Early

- Hypothermia (Temperature $<95^{\circ}\text{F}$)
- Hypoglycaemia (RBS <2.2 mmol/L)
- Respiratory distress syndrome (RDS)
- Apnoeic spells (caesation of respiration for ≥ 20 sec.)
- More chance of acquiring infections
- Haemorrhage *e.g. minor to fatal intraventricular, GI, pulmonary haemorrhage*
- Feeding difficulty *e.g. inability to suck, inability to tolerate feed (vomiting, abdominal distension) etc.*
- Problems of gut *e.g. necrotizing enterocolitis (NEC), gastro oesophageal reflux disease (GERD)*
- Exaggeration of physiological jaundice
- Anaemia of prematurity
- Patent ductus arteriosus (PDA)

Late

- Metabolic bone diseases *e.g. rickets of prematurity, osteopenia of prematurity*
- Retinopathy of prematurity (ROP)
- Delayed growth and development
- Cerebral palsy or other neurological deficit

Management of LBW babies

In adjunct to all care given for normal newborn, LBW babies need some special care; These are-

A. Keep the baby warm

- * Wrap with adequate clothing (including cap & socks)
- * Skin to skin contact (**Kangaroo Mother Care**)
- * Bedding with mother
- * Keep the room warm (Temp $\geq 25^{\circ}\text{C}$) with room heater
- * Use radiant warmer if available



Kangaroo Mother Care



Preterm LBW neonate under radiant warmer

B. Maintain nutrition

Appropriate feeding method to maintain nutrition of a LBW baby is determined by their gestational age, birth weight and oral feeding skills.

- * Babies who are very premature ($\text{GA} \leq 28$ weeks) and neither have proper sucking efforts nor propulsive motility in the gut should be put on IV fluid
- Trophic feed through NG tube @ 0.5 - 1.0 ml/feed 3-4 hourly should be started as test feed for gut priming as early as possible and increased gradually, if tolerate

- Babies kept NPO for prolonged period should receive daily potassium, calcium, amino acid supplementation, started usually after 48 hours of age
- * Babies > 34 weeks who have mature sucking pattern and good sucking/ swallowing and breathing coordination should be put to mother's breast
- * Babies between 28-34 weeks who have impaired or no coordination between sucking /swallowing and breathing may be fed by orogastric/nasogastric tube, with occasional spoon feeding of expressed breast milk. Babies should be put on IV fluid if shows any of the following sign of feed intolerance e.g.

* Vomiting,	* Pre feed aspirate
* Abdominal distension	>50% of previous feed volume

C. Protect against Infection

- * Wash hands properly before touching the baby each time
- * Handle the baby as minimum as possible
- * Don't give prelacteal feed
- * Keep the umbilical stump bare, clean and dry
- * Avoid overcrowding around the baby

D. Follow up the baby (in hospital): Assess the following parameters regularly -

- * Overall activity
- * Weight of the baby (daily)
- * Temperature
- * Sign of fluid overload/dehydration
- * Apnoea
- * Appearance and extent of jaundice
- * Evidence of sepsis *e.g. lethargy, stopped feeding well respiratory distress, convulsion etc.*
- * Passage of urine and stool
- * Abdominal distension

Along with clinical assessment, investigations may be needed depending upon specific situation *e.g. blood glucose*

E. Give Vitamin K₁: 2 mg orally or 1mg IM/IV within 4 hours of birth. If given orally repeat the dose on day 4 & day 28

When to plan for Discharge?

- * Able to maintain body temperature
- * Neither apnoea nor bradycardia for 5 days
- * Able to take and tolerate full feeding from breast or cup-spoon without respiratory discomfort
- * Parents confident enough to take care of the baby at home
- * Has crossed birth weight and shows a steady weight gain for 3 consecutive days

Provide vitamins & micronutrient supplementation

Name	When to start	For how long
Folic acid (1 mg/day)	Baby on full enteral feed, usually by 2 weeks of age	Till 40 Weeks Post Menstrual Age
Multivitamin containing calcium, vitamin D, phosphate and zinc	Baby on full enteral feed, usually by 2 weeks of age	Till 1 year of age
Iron 2 mg/kg/day (maximum 15 mg day)	At 6 weeks of age	Till 1 year of age

Follow up

All preterm LBW babies should be followed up. During each follow up visit the following parameters should be addressed -

- * Growth monitoring *e.g. weight, length, OFC*
- * Anaemia
- * Rickets and metabolic bone diseases
- * Retinopathy of prematurity (*ROP screening to be done between 20-30 days of post natal age*)
- * Hearing assessment
- * Milestones of development

POST MATURITY/POST TERM

The new born whose gestational age exceeded 42 weeks are called post mature.

Clinical Manifestations

- Greater birth weight
- Increase alertness
- Abundant scalp hair
- Parchment like or desquamating skin
- Long nails

Sometimes, a postmature baby may have features of placental insufficiency *e.g. pale loose skin especially around the thigh and buttock* and growth retardation.

Complications

- Meconium aspiration syndrome
- Congenital anomalies
- Perinatal asphyxia
- Persistent pulmonary hypertension
- Hypoglycaemia
- Hypocalcaemia
- Polycythaemia

PERINATAL ASPHYXIA (PNA)

Perinatal asphyxia is a clinical condition that results from impaired gas exchange in the foetus.

This leads to hypoxia, hypercarbia and acidosis and these ultimately culminate into failure to establish and sustain spontaneous respiration immediately after birth.

Normal foetal to Neonatal transition

In utero, the placenta provides O_2 to the foetus and removes CO_2 . But **after birth**, neonatal lungs take over this responsibility of gaseous exchange and to do so, the following 3 changes occur immediately after birth

- * Replacement of fluid in the alveoli by air with the onset of breathing
- * Rise of pressure in systemic circulation by constriction of umbilical vessels and
- * Fall of pressure in pulmonary vascular bed

Majority of newborn babies go through these changes smoothly without any intervention. However, some babies who cannot have this transition without help may face acute hypoxic insult that incapacitating them to breathe spontaneously.

Stimuli to initiate respiration at birth

- * Decreased PaO_2 , rise of $PaCO_2$ & fall of pH
- * Redistribution of cardiac output
- * Decreased body temperature
- * Various tactile and sensory stimuli

Risk factors

- * Maternal *e.g. hypertension, prolonged/obstructed labour, eclampsia, diabetes, hypotension, anaemia, uterine rupture and systemic disease*
- * Placental *e.g. abruptio placentae*
- * Umbilical cord accidents *e.g. prolapse, cord around the neck, knot, compression*
- * Foetal *e.g. anaemia, infection, severe cardiac/circulatory insufficiency*
- * Neonatal factors *e.g. congenital cyanotic heart disease, persistent pulmonary hypertension, cardiomyopathy*

Pathogenesis

When a foetus faces acute hypoxia in utero (antepartum or intrapartum), then certain cardiorespiratory and biochemical sequence of events occur. Initially breathing effort increases but continuing hypoxia makes the foetus unconscious and the respiratory center stops functioning.

The foetus thus enters in to the stage of **primary apnoea** which if remains unattended, agonal gasps ensue, culminating in **terminal apnoea**. Concomitant to these respiratory events, heart rate drops down after a brief initial rise and cardiac output is redistributed with preference for maintaining perfusion of heart, brain and adrenals.

At the same time, accumulation of CO_2 as well as biproduct of anaerobic metabolism (lactic acid) leads to increasing acidosis which further cause heart muscles to stop functioning.

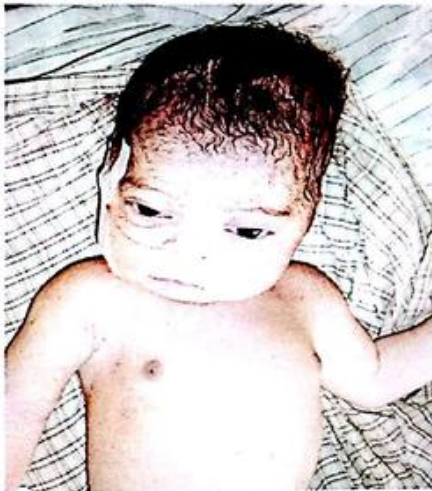
Therefore, a baby who fails to breathe spontaneously immediately after birth may be either in *primary apnoea*, *gasping respiration* or in *terminal apnoea* and resuscitation is the only way to save these babies.

The most serious consequence of PNA is **Hypoxic Ischaemic Encephalopathy (HIE)**. However, other organs may also be affected, particularly -

Organs	Pathology
Heart	Hypoxic cardiomyopathy
Kidney	Acute tubular necrosis/AKI
Gut	Necrotizing enterocolitis
Lungs	Persistent pulmonary hypertension, pulmonary haemorrhage
Adrenals	Haemorrhage
Liver	Hepatocellular necrosis

Clinical Manifestations

- Colour: Pale (*asphyxia pallida*)
- Respiration
 - * No respiration, no cry
 - * Absent or poor respiratory effort
 - * Gasping respiration with long pauses in between respiration
- Heart rate: Bradycardia (<100 beats/min)
- Tissue perfusion: Less (*capillary refill time* > 3 sec)
- Muscle: Hypotonia
- Others e.g. *convulsion, oliguria, shock*



An asphyxiated baby (vacant stare)

Hypoxic Ischaemic Encephalopathy (HIE)

This is an abnormal neurobehavioral state that accompanies severe perinatal asphyxia. It is due to hypoxia as well as due to impaired cerebral blood flow (ischaemia). The severity of this neurologic syndrome depends on the extent of brain injury and is classified into 3 stages:

HIE I	<u>Hyperalert, irritable with dilated pupils and strong moro reflex. Muscle tone normal. Symptoms usually persist for <24 hours</u>
HIE II	<u>Convulsion, lethargy, weak moro reflex, mild hypotonia and constricted pupils</u>
HIE III	<u>Comatose, flaccid muscles, absent primitive reflexes, diminished or absent spontaneous movement and unequal pupils</u>

Ref: Sarnat '1976

Preparation for newborn resuscitation

- * Person: At least one person trained in newborn resuscitation
- * Warm environment: closing windows, minimizing draughts, pre-warming towels, head covering for the baby, heater/radiant warmer
- * Resuscitation surface: Arrangement for flat and firm surface
- * Resuscitation equipments:
 - i) Self-inflating bag with correct size mask
 - ii) Oxygen source
 - iii) Pulse-oxymeter with probe
 - iv) Intubation equipments: Laryngoscopes with straight blades, endotracheal tubes
 - v) Drugs: Adrenaline (1:10,000), Naloxone, 10% D/A, 0.9% NaCl
 - vi) Others e.g. *stethoscope, umbilical venous catheter*

Management

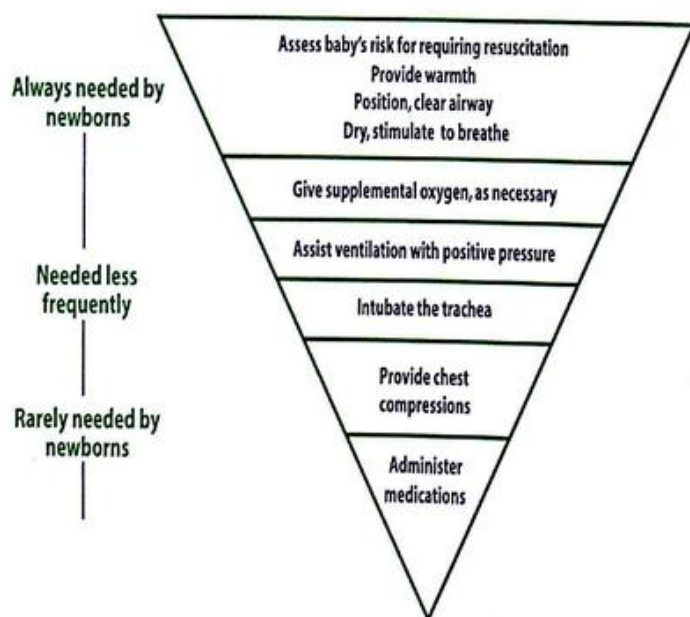
A) Immediate resuscitation B) Post resuscitation management

A. Immediate resuscitation

It is a set of interventions, required at the time of birth to support establishing breathing

and circulation. The process tries to support the baby in achieving normal transition rather than imposing an alternate process. The key points of resuscitations are:

- * **Keeping the baby warm** *e.g. warm environment, immediate drying, wrapping with dry warm towel, and providing skin to skin contact with mother if possible*
- * **Opening and maintaining airway by**
 - Neutral airway position (neither over-extension nor hyperflexion of neck)
 - Chin lift
 - Jaw-thrust
 - Placing towel roll of 2 cm under shoulder
 - Clearing airway by gentle suction etc.
- * **Supporting breathing by**
 - Stimulating the baby *e.g. rubbing the back gently, slapping or flicking the soles of the feet*
 - Positive pressure ventilation using *bag and mask* with or without Endotracheal tube
 - Mechanical ventilation
- * **Maintaining circulation and oxygenation by** chest compression and coordinated positive pressure ventilation



Steps of Resuscitation at a glance

B. Post resuscitation management

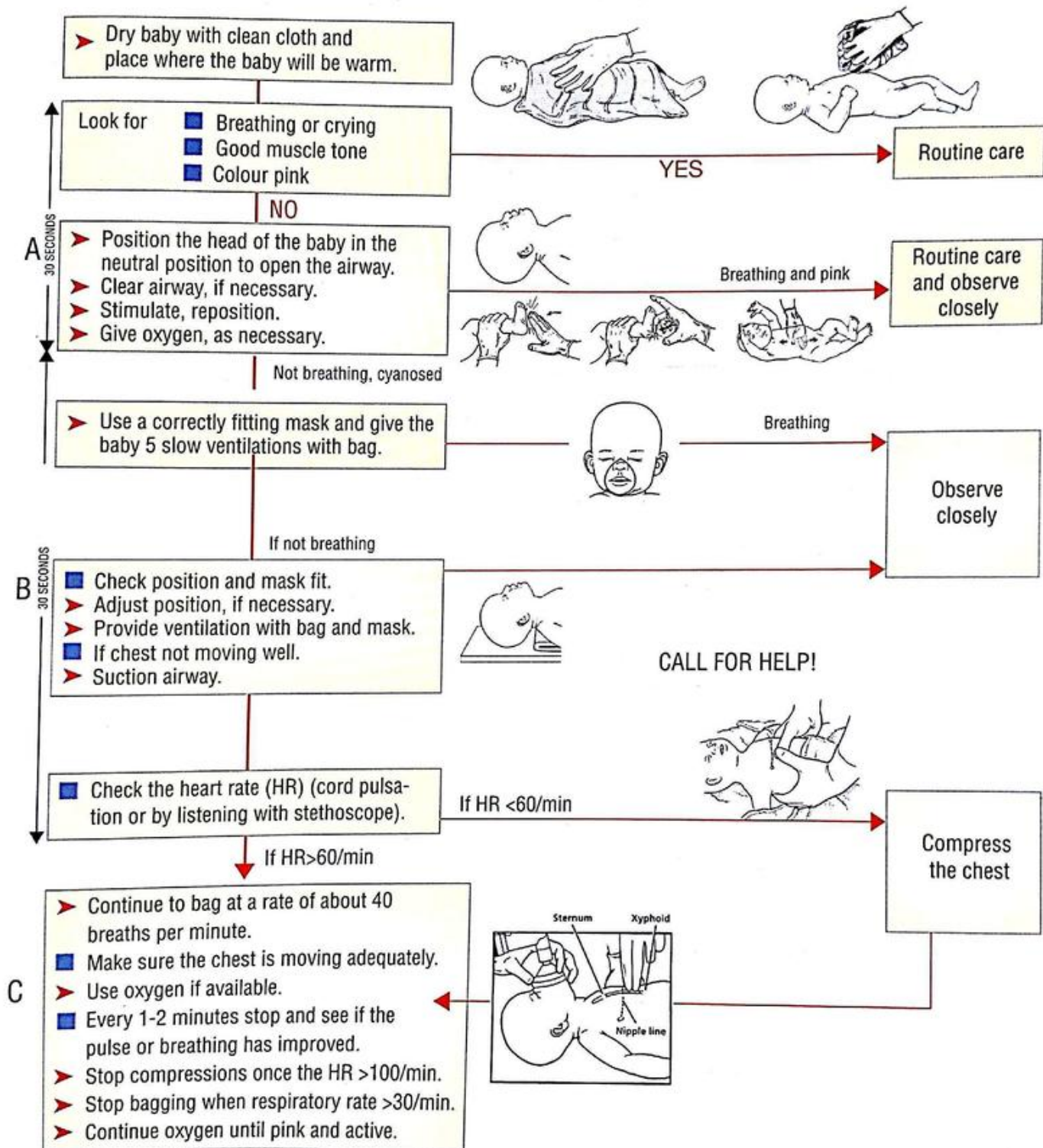
- * **Maintain body temperature**
- * **Support respiration:** By
 - Supplemental oxygen 2 L/min by nasal canula, head box 5-6 L/min
 - Mechanical ventilation
- * **I/V Fluid & electrolytes:** To maintain adequate hydration, electrolytes and glucose homeostasis. Fluid to be restricted 10-20% of total daily allowance
- * **Other managements**
 1. **Regular bedside monitoring of**
 - Respiratory status *e.g. cyanosis, resp. rate, rhythm & pattern*
 - Circulatory status *e.g. CRT, heart rate, blood pressure*
 - Capillary glucose status
 - Arterial blood gas (ABG) analysis
 2. **Treatment of specific situations**
 - If signs of shock *e.g. CRT > 3 sec, low pulse volume, low blood pressure*
 - a) Infuse Normal Saline 10 ml/kg over 30 min
 - b) Give Dopamine/Dobutamine 5-10 µgm/kg/min
 - If convulsion: Control as per protocol (*Page 61*)
 - If sepsis: Parenteral antibiotics

Prognosis

- Overall mortality 10-30%.
- Among the survivors, 15-45% develops neurodevelopmental sequelae *e.g. cerebral palsy, cranial nerve palsy, epilepsy, intellectual disability, microcephaly etc.*

The Steps of Resuscitation (WHO 2005)

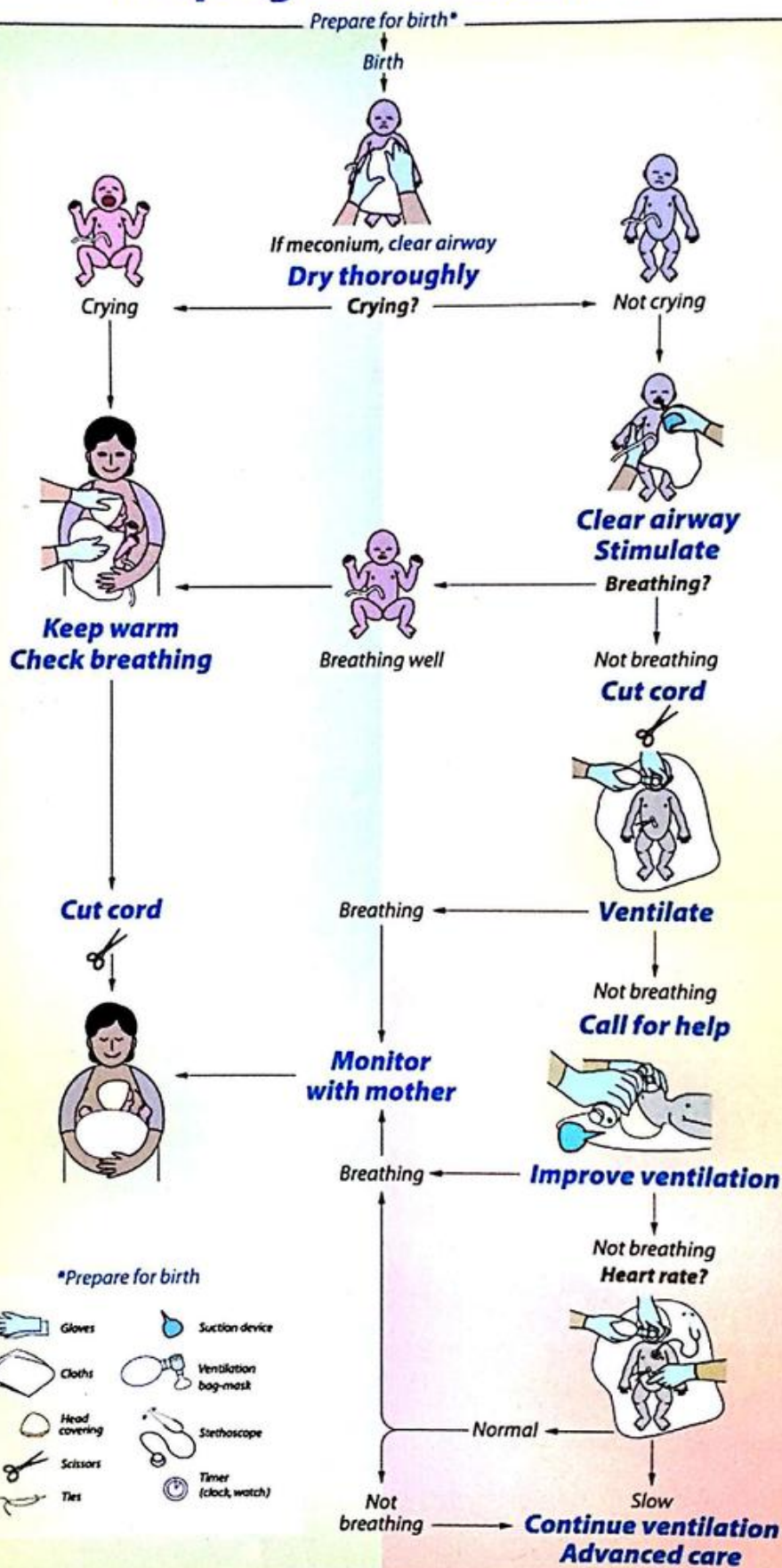
Neonatal resuscitation



If after 20 minutes of resuscitation the baby is not breathing and pulse is absent stop all efforts and counsel parents that the baby is dead.

ACTION PLAN

Helping Babies Breathe



The Golden Minute™

60 sec

Adapted from: American Academy of Pediatrics. Helping Babies Breathe, Learner Workbook; 2010

RESPIRATORY DISTRESS IN NEWBORN

The common differential diagnoses are-

- * Respiratory distress syndrome (RDS)
- * Perinatal asphyxia
- * Transient tachypnoea of newborn (TTN)
- * Meconium aspiration syndrome
- * Congenital pneumonia
- * Spontaneous pneumothorax
- * Diaphragmatic hernia
- * Persistent pulmonary hypertension
- * Congenital heart diseases/heart failure
- * Pulmonary hypoplasia

In this section RDS and TTN will be discussed.

RESPIRATORY DISTRESS SYNDROME (RDS)

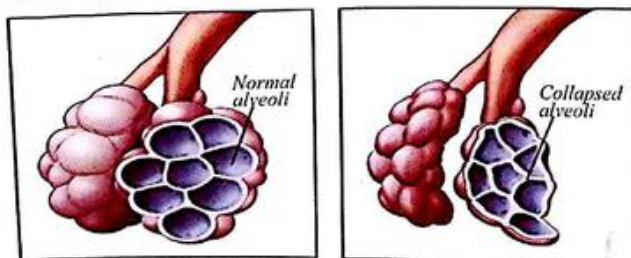
RDS is defined as respiratory difficulty starting shortly after birth, commonly among preterm infants, and is due to deficiency of surfactant.

Risk factors

- * Prematurity
- * Perinatal asphyxia
- * Infant of diabetic mother
- * Hypovolaemia
- * Hypotension
- * Cesarean section
- * Pulmonary ischaemia

Pathophysiology

Normally, surfactant (which appears in foetus by 23-24 weeks of gestation, but adequate amounts are not secreted until 30 – 32 weeks of gestation) reduces surface tension in the alveoli and helps to maintain alveolar stability. In RDS, deficiency of surfactant results in collapse of alveoli, reduced air entry in alveoli, impairment of gas exchange and respiratory distress.



Clinical Manifestations

- Respiratory difficulty occurring within 1st hour of birth as manifested by-
 - * Tachypnoea (> 60 breaths/min)
 - * Grunting
 - * Sternal & intercostal retraction
- Cyanosis in room air
- Reduced air entry into lungs *e.g. feeble breath sounds, paucity of chest movement*
- SPO₂: Falling (< 90%)

Investigations

1. Chest X -ray:

- * Ground glass appearance
- * Air bronchogram
- * Complete white out lungs *e.g. loss of demarcation/ visualization of heart borders*



Ground glass appearance with air bronchogram

- * Pneumothorax with pneumomediastinum (in case of air leak)

2. Blood

- * Complete blood counts, peripheral blood film
- * C reactive protein (CRP): may be raised when associated with infection
- * Arterial blood gas (ABG): may be altered *e.g. acidosis*
- * Serum electrolytes: may have dyselectrolytaemia

Management

A. Supportive

- * Keep the baby warm *e.g. keeping under radiant warmer*
- * Keep the baby NPO and put on IV fluid *e.g. 10% DA up to 24 hours then 5- 10% Dextrose in 0.225% NaCl*
- * Respiratory support *e.g. Oxygen inhalation: 3-4 L/min (up to 8 L/min) through head box*



O₂ supplementation through Head box

- If baby does not improve and develop severe breathing difficulty with falling SPO₂, then keep the baby in CPAP and if required in mechanical ventilator



Respiratory support with CPAP



Mechanical ventilation

Courtesy: Dr. Farzana Sharmeen

- Give broad spectrum antibiotics: Ampicillin plus Gentamicin if sepsis is suspected
- Monitor: Respiratory rate, heart rate, temperature, cyanosis, air entry, CRT, SpO₂

B. Specific

- Administer surfactant (4 ml/kg divided into 4 aliquots) and given through ET tube and continue keeping the baby in CPAP or mechanical ventilator as required

TRANSIENT TACHYPNOEA OF NEWBORN (TTN): WET LUNGS

TTN is a relatively mild, self-limited pulmonary disorder resulting from delayed absorption of foetal lung fluid most commonly affecting babies who are born at or near term.

Clinical Manifestations

- Presents with mild to moderate respiratory distress as manifested by -
 - Tachypnoea
 - Chest retractions
 - Nasal flaring
- In some cases -
 - Grunting
 - Cyanosis may be present

Investigations

X-ray chest shows prominent vascular markings, fluid in the interlobar fissure, over-aeration, flat diaphragm

Treatment

Mainly supportive. Patients with TTN usually improves by 12-24 hours with O₂, keeping the baby warm and on IV fluid.

NEONATAL SEPSIS

Sepsis is one of the leading cause of neonatal morbidity and mortality. Recent data shows that neonatal sepsis contributes to about 20% of neonatal deaths.

According to the time of acquiring infection, neonatal sepsis is divided as -

- **Early onset sepsis (EONS):** Sepsis that is acquired before or during birth and the manifestations are present within first 72 hours of birth *7 days*
- **Late onset sepsis (LONS):** Sepsis that is acquired after delivery (in the nursery or in the community) which usually presents after 72 hours of age *7 days*

Common Organisms

EONS	LONS
* Group B <i>Streptococcus</i>	* <i>Staphylococcus aureus</i>
* <i>Escherichia coli</i>	* Coagulase negative <i>Staphylococcus</i>
* <i>Haemophilus influenzae</i>	* <i>Klebsiella pneumoniae</i>
* <i>Klebsiella sp</i>	* <i>Pseudomonas aeruginosa</i>
* <i>Listeria monocytogenes</i>	* <i>Enterobacter</i>
	* <i>Candida sp</i>
	* <i>Serratia</i>
	* <i>Acinetobacter</i>

Risk Factors

- Prematurity (< 37 weeks)
- Low birth weight (<2500 grams)
- Febrile illness of mother with evidence of bacterial infection within 2 weeks prior to delivery
- Foul smelling and/or meconium stained liquor
- Rupture of amniotic membrane >18 hours
- Single unclean or > 3 sterile vaginal examination(s) during labour
- Prolonged labour (sum of 1st and 2nd stage of labour > 24 hours)
- Perinatal asphyxia (APGAR score <4 at 1 minute)
- Mechanical ventilation
- Invasive procedures
- Poor hygiene, poor cord care
- Bottle-feeding, prelacteal feeds

Clinical Manifestations

Non-specific mostly -

- * Not feeding well/refusal to suck
- * Less alert/less active
- * Lethargy, poor muscle tone, poor cry
- * Low body temperature or fever
- * Movement only when stimulated or no movement at all
- * Vomiting



Lethargic baby

Specific Manifestations

Related to involvement of specific body systems.

Systems	Clinical features
Central nervous system	Irritability, full fontanelle, seizure, vacant stare, high pitched cry, neck retraction, hypotonia. Presence of these features suggests meningitis
Respiratory system	Grunting, apnoea, irregular breathing, fast breathing, severe chest indrawing or cyanosis
Cardio-vascular system	Bradycardia or tachycardia, hypotension, poor perfusion (prolonged capillary refilling time > 3 sec), shock
Skin changes	Mottling, sclerema, multiple pustules, periumbilical redness or foul smelling umbilical discharge
Haemato-logical	Bleeding, petechiae, purpura, jaundice
Urinary	Oliguria or anuria
Primitive Reflexes	Absent or diminished

Diagnosis

Based on C/F and relevant investigations.

Investigations

• Sepsis Screening

Sepsis screening	Total leucocyte count	< 5,000/cmm
	Absolute neutrophil count	<2500/cmm for term <1000/cmm for preterm
	Immature to total neutrophil (I:T) ratio	> 0.2
	C reactive protein (CRP)	Positive >10
	Micro-ESR	>15 mm in 1st hour
	Haptoglobin	Positive (> 1mg/dl)

• Complete blood counts with PBF

- * TC: Increase or decrease
- * Hb: May be decreased
- * Platelets: May be decreased
- * PBF: Shows toxic granules or band form of neutrophil

• Blood for C/S: May reveal the organism

• Blood for pro-calcitonin: Raised

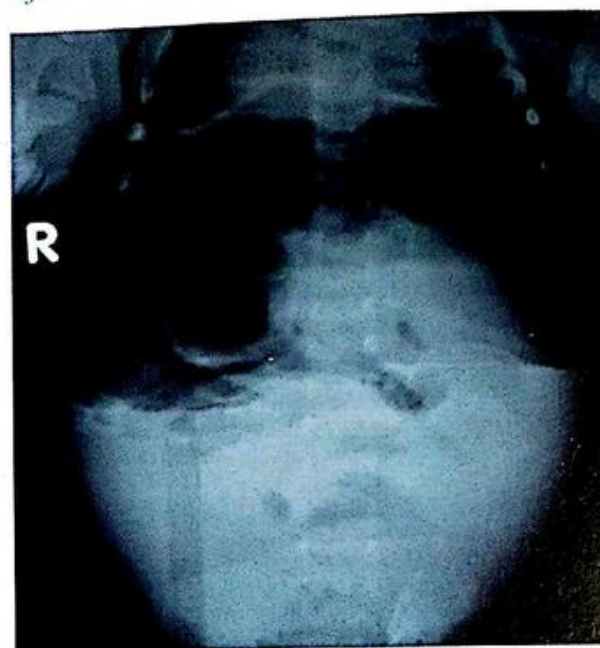
• CSF study: To assess evidence of meningitis e.g. hazy CSF, raised CSF pressure, plenty of WBC (Neutrophils), raised protein etc.

CSF picture of healthy term neonates

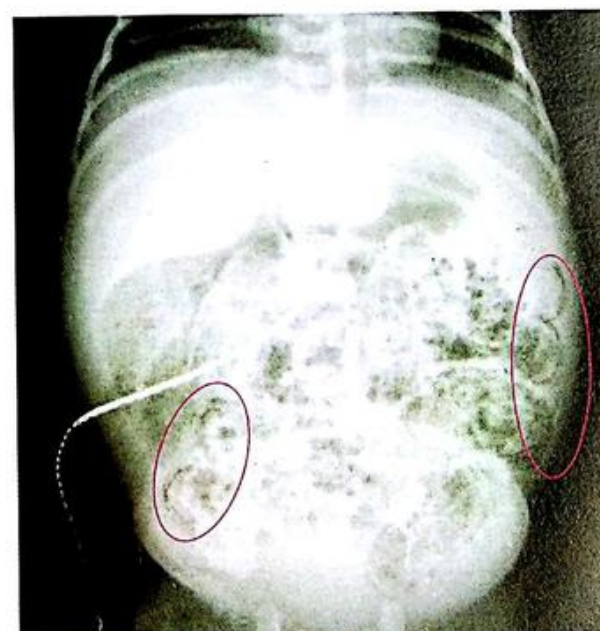
Parameters	Result
Appearance	Clear
Cell count (WBC)	0-32 mm ³
Protein	20-170 mg/dl
Glucose	34-119 mg/dl

• Urine for R/M/E, C/S: To look for evidence of infection e.g. presence of pus cells, RBC, albuminuria & growth of bacteria on C/S

- X-ray of Chest: To look for evidence of pneumonia
- X-ray of abdomen: To look for evidence of NEC e.g. pneumatosis intestinalis and gas in portal vein. Sometimes, there may be subdiaphragmatic gas (pneumoperitoneum) as in perforation of gut



Pneumoperitoneum (Drooping Lily sign)



Pneumatosis intestinalis

- Ultrasonogram: Of brain or others as individualized

Treatment

Baby must be hospitalized.

A. Specific: Appropriate Antibiotics

	Septicaemia & Pneumonia	Meningitis
1 st line	Penicillin or Ampicillin and Gentamicin	Ampicillin + Cefotaxime
2 nd line	Ampicillin or Cloxacillin and Gentamicin or Amikacin	Add Cefotaxime
3 rd line	Cefotaxime or Piperacillin-Tazobactam or Ciprofloxacin and Amikacin	Same as septicaemia & pneumonia (Avoid Ciprofloxacin)
Consider Vancomycin and Teicoplanin if MRSA is suspected.		

N.B. antibiotics may be changed according to culture & sensitivity report.

Empirical use of reserve antibiotics e.g. Meropenem, Netilmicin, Imipenem, Cefipime, Lenolid, Teicoplanin should be avoided; they should be reserved for situations where absolutely indicated.

Duration of Antibiotic Therapy

Diagnosis	Duration
Meningitis (with or without positive blood/CSF culture)	21 days
Blood culture positive but no meningitis	14 days
Culture negative, sepsis screen positive and clinical course consistent with sepsis	7-10 days
Culture and sepsis screen negative, but clinical course compatible with sepsis	5-7 days

B. Supportive

- Hypothermia: Wrapping, keeping under radiant warmer or in incubator
- Hypoglycaemia: IV 10% DA (2 ml/kg)
- Nutrition: Allow the baby to breast feed
 - * If sucking is not satisfactory, then naso-gastric feeding of expressed breast milk
 - * If baby can not tolerate oral/naso-gastric feeding, give IV fluid (20% less than normal daily allowance)
- Others: Exchange transfusion, immunoglobulin (containing mainly IgG &

also IgM, IgA) Granulocyte-CSF (G-CSF) or Granulocyte Monocyte-CSF (GM-CSF) infusion, pentoxifylline etc. may be given

C. Follow up

- Vital signs e.g. heart rate, respiratory rate and temperature
- Primitive reflexes e.g. sucking, rooting, moro and others
- Skin condition e.g. texture, colour, tissue perfusion, any mottling etc.
- Anterior fontanelle e.g. any bulging or fullness
- Abdomen e.g. any distention, presence of bowel sound, passage of urine and stool
- Any untoward events e.g. convulsion, apnoea, cyanosis etc.

RECENT INTERVENTIONS ADDRESSING NEWBORN COMPLICATIONS AND SICKNESS '2014

- * 7.1% Chlorhexidine application as part of routine ENC for umbilical cord care to reduce infection
- * Antenatal corticosteroid (ACS) e.g. Betamethasone, Dexamethasone injection during threatened preterm labour by skilled providers to reduce complication of preterm
- * Kangaroo Mother Care (KMC) for thermal protection of preterm/low birth weight newborns
- * Management of newborn sepsis using simplified treatment protocol in lower level facilities

NEONATAL JAUNDICE

About 60% of term and 80% of preterm neonates develop jaundice during first week of life.

Although most of the neonatal jaundice are physiological but it always demands special attention because of the serious toxic effect of

unconjugated bilirubin to the brain [bilirubin induced neuronal deficit (BIND)], previously termed as Kernicterus].



Newborn with jaundice extending to palms & soles

Aetio-pathogenesis

Jaundice appears within 1st 24 hours of life

- * Rh incompatibility
- * ABO incompatibility
- * Minor blood group incompatibility
- * G-6-PD deficiency
- * Congenital spherocytosis

Jaundice appears within 3-10 days

- * Physiological jaundice
- * Jaundice of prematurity
- * Sepsis
- * Crigler-Najjar syndrome
- * Galactosaemia

Jaundice persists beyond 2 weeks

- * **Unconjugated:** Breast milk jaundice, hypothyroidism, pyloric stenosis, galactosaemia
- * **Conjugated:** Intra-hepatic cholestasis (e.g. sepsis, idiopathic neonatal hepatitis and other metabolic disorders)
- * Extra hepatic cholestasis e.g. biliary atresia, choledocal cyst

Physiological Jaundice

- * Appears on 2nd-3rd day of life
- * Reaches its peak by 5th-6th day
- * Declines by 7th-8th day of life (term) & 10th-11th day (preterm)

Non-physiological (Pathological) Jaundice

- * Appears on the 1st day of life
- * Lasts longer than 14 days in term & 21 days in preterm babies
- * Rate of rise of S. bilirubin of > 0.5 mg/dl/hour or ≥ 10 mg/dl/day
- * Jaundice with signs of sepsis/sickness
- * Jaundice extended upto palms and soles
- * Jaundice with pale stool & yellow urine

HAEMOLYTIC DISEASE OF NEWBORN

Rh incompatibility (Immune haemolysis) & ABO incompatibility

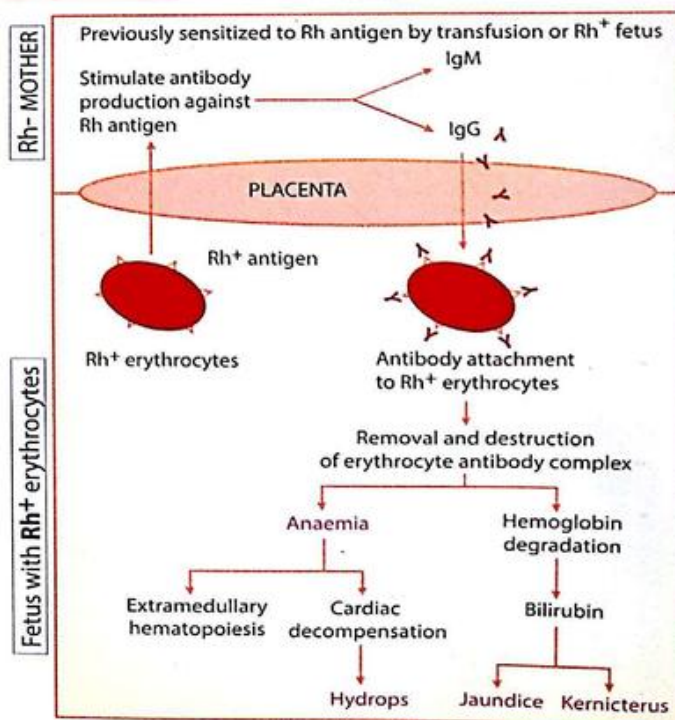
Rh incompatibility

In this condition, Blood group of -

Mother	Rh negative
Foetus/Newborn	Rh positive

Pathogenesis of Rh incompatibility

The basis of immune haemolysis in Rh incompatibility is sensitization of mother's immune system by D antigens of foetal RBC.



Pathogenesis of immune haemolysis in RH incompatibility
Adapted from Robbin's & Cotran's pathology '2010

Usually, foetal RBC reach maternal circulation during last trimester of pregnancy or during child birth. This undue exposure of mother's immune system to D antigen evokes an immunological response with production of anti-D immunoglobulin in maternal circulation. Initial exposure produces IgM immunoglobulin (cannot cross placenta), so Rh haemolysis & consequences are uncommon with 1st pregnancy.

However, exposure during subsequent pregnancies provoke brisk immunological response with huge production of IgG immunoglobulin in maternal circulation. These IgG, then cross placenta freely and enter into foetal circulation where they coat the foetal RBC and cause immune haemolysis. The newborn thus suffers from severe anaemia, severe jaundice and hydrops foetalis (generalized oedema from anaemic heart failure and low serum albumin)

ABO incompatibility

In this condition, Blood group of -

Mother: O positive

Foetus: A, B or AB positive

Mother	Blood Group	Natural Antibodies
	O	Anti A - IgM Anti B - IgM
	A	Anti B - IgM
Baby	B	Anti A - IgM
	AB	None

Pathogenesis

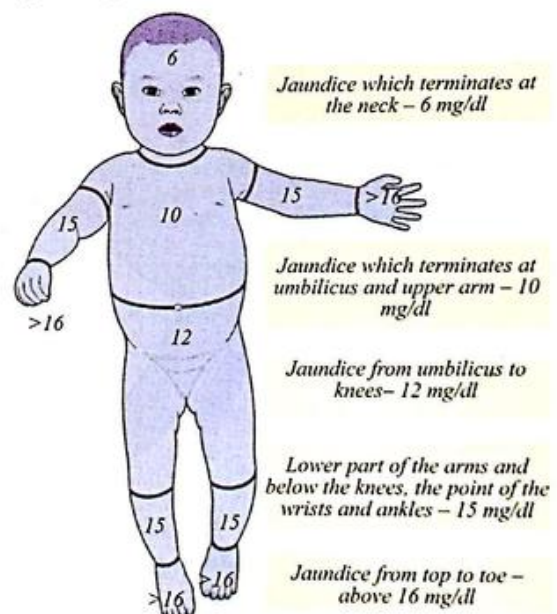
For unknown reason, certain O positive mother possess IgG anti-A and anti-B antibodies in their circulation instead of IgM type and these IgG antibodies crossing placenta, enter in foetal circulation and causes haemolysis, jaundice and anaemia though with less severity than Rh incompatibility.

Neonatal Jaundice: Diagnosis

By both clinical and laboratory evaluation.

Clinical Evaluation

- History: Relevant points are-
 - * Age of appearance of jaundice
 - * Order of pregnancy
 - * H/O jaundice in previous child
 - * H/O death of any baby due to jaundice
 - * Blood group & Rh typing of baby and mother
 - * H/O intra-uterine deaths, abortion in mother with Rh-ve blood group
- Physical examination: To look specially for -
 - * Extent of jaundice; whether extended upto palms & soles
 - * Look for
 - Other clinical features *e.g. pallor, hepatosplenomegaly*
 - Any evidence of sepsis *e.g. lethargy, poor feeding etc.*



Kramer's rule for approximate levels of S. bilirubin

- Abnormal neurological behaviour *e.g. convulsion, rigidity etc.*

Investigations

- Serum bilirubin (total, direct, indirect):
Indirect bilirubin level is increased in physiological jaundice & haemolytic disease of newborn but direct bilirubin is increased in sepsis, neonatal hepatitis, biliary atresia etc.
- Blood group and Rh typing of baby and mother

- **Haemoglobin:** Reduced due to haemolysis
- **TC, DC, Platelet counts & CRP:** To assess for evidence of associated sepsis
- **Peripheral blood film:** To see evidence of haemolysis *e.g. fragmented RBC, nucleated RBC, toxic granules etc.*
- **Reticulocyte count:** Increased (compensatory erythropoiesis as a response to haemolysis)
- **Coombs tests (direct and indirect):** May be positive in Rh and ABO incompatibility
- **Others:** As individualized

Treatment

Most of the neonatal jaundice are physiological and usually do not require any treatment. Only exclusive breast feeding and follow up is sufficient. But if serum bilirubin reaches the level of indication for intervention, it requires urgent referral for further evaluation & treatment.

The treatment options are **phototherapy** and **exchange transfusion** and the options are decided, considering serum bilirubin level, baby's gestational age, postnatal age and any associated risk factors.



Baby under phototherapy

Phototherapy is most effective with blue light (329-333) nm wave length

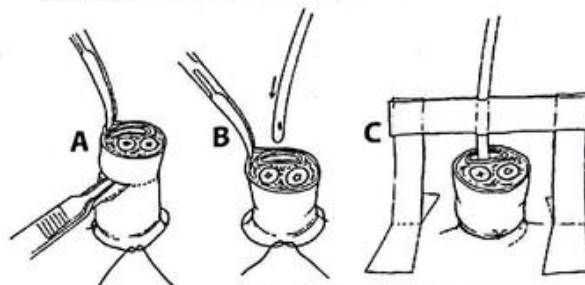
Mechanism of phototherapy

After absorbing light from skin surface, bilirubin undergoes 3 chemical changes -

- Photo-isomerisation and changing to a less toxic isomer that readily excretes in bile
- Structural isomerization and changing to lumirubin and readily excreted in bile and urine
- Photo-oxidation and changing to a more polar substance and excreted in urine

Exchange transfusion: Indications

- If intensive phototherapy has failed to reduce bilirubin to a safer range



Steps in umbilical vein catheterization

- If the risk of kernicterus exceeds the risk of the procedure
- If the initial bilirubin level is too high



Exchange transfusion

Specific bilirubin charts are adopted to select treatment option [See annexure page 323 to 327].

NEONATAL CONVULSION

Convulsion is another common neonatal problem. It is the manifestation of many underlying neurologic and metabolic dysfunctions.



A neonate having convulsion (stiff limbs & body)

Aetiology

CNS	• Perinatal asphyxia (HIE) • Meningitis, TORCHS infection • Haemorrhages, <i>e.g. Subarachnoid, intraventricular; intracerebral</i> • Structural abnormalities <i>e.g. A-V malformation</i>
Metabolic	• Hypoglycaemia • Hypocalcaemia • Hypomagnesaemia • Hyponatraemia • Hypernatraemia • Vit B6 deficiency/dependency • Inborn error of metabolism
Others	• Tetanus

Types & their characteristic features

Subtle seizure <i>Commonest type but difficult to recognize</i>	Abnormal gaze, blinking of eyes, abnormal posture, cycling, apnoeic spells, stiffness of limbs, chewing, tongue thrusting, lip smacking etc.
Clonic seizure	Characterized by rhythmic movements of muscle groups
Tonic seizure	Characterized by sustained flexion or extension of muscle groups
Myoclonic seizure	Characterized by jerky movements of upper or lower limbs

Diagnosis

Based on C/F & relevant investigations.

Investigations

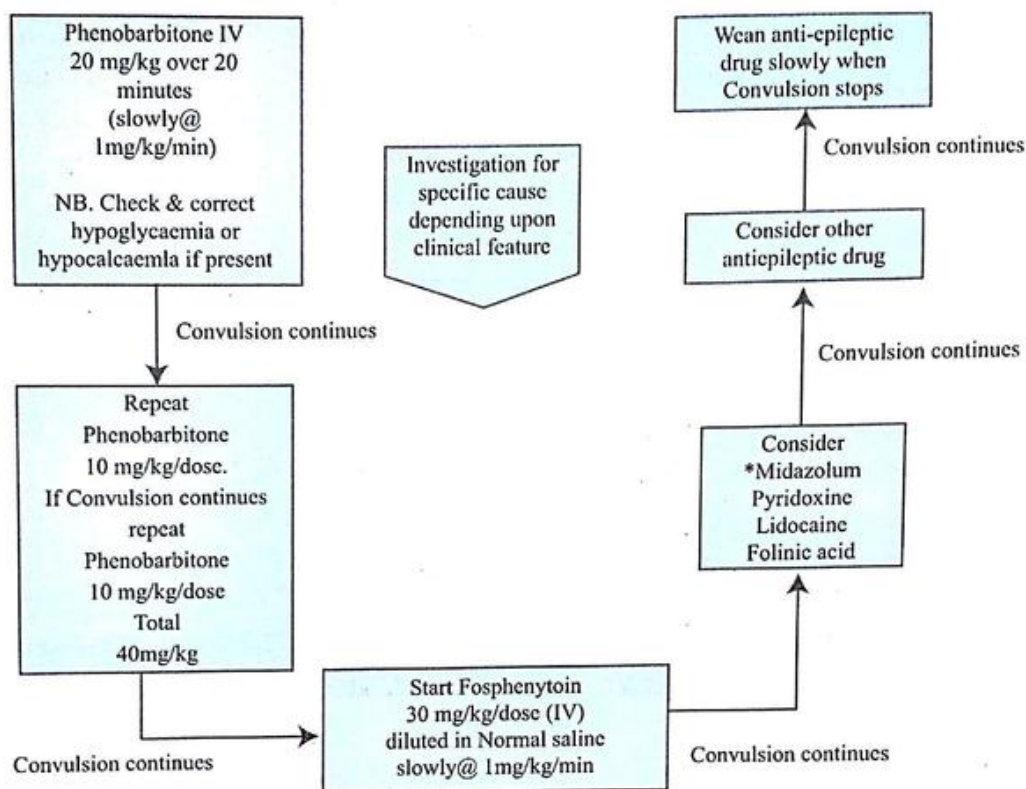
Investigations	Results
CBC with PBF, CRP	To look for evidence of sepsis
Blood glucose, calcium, magnesium	To check whether their deficiency causing convulsion
Serum electrolytes	To check any alteration, particularly Na ⁺
CSF study	To rule out meningitis

Investigations	Results
Cranial USG	To rule out intraventricular or intracerebral haemorrhage, cerebral malformation
CT scan or MRI of brain	To assess subarachnoid haemorrhage or any developmental anomaly
TORCHES screen and VDRL	Considered when hepatosplenomegaly, thrombocytopenia, growth retardation, small for gestational age and chorioretinitis are present
Metabolic screening	Blood and urine ketones, urine reducing substances, blood ammonia, anion gap, urine and plasma amino acidogram, serum and CSF lactate/pyruvate ratio
Electro-encephalogram (EEG)	To confirm and characterize seizure activity & types

Treatment

- Maintain airway, breathing and circulation (*see page 241*)
- Control of convulsions (*see algorithm, page 66*)
- Keep the baby nothing per oral and open an IV line for infusion, anticonvulsants and drugs *e.g. Calcium, Glucose, Magnesium etc.*
- Correction of metabolic abnormalities
 - * *Hypoglycaemia: 2 ml/kg of 10% DA*
 - * *Hypocalcaemia: 1-2 ml/kg of 10% Ca gluconate (mixed with equal amount of distilled water) very slowly under cardiac monitoring*
 - * *Hypomagnesaemia: 0.2 ml/kg of 50% MgSO₄ I/M*
 - * *Pyridoxine: 50-100 mg, IV/IM. Single dose*
- O₂ inhalation: 1-2 L/min through nasal prong
- Identify & treat any underlying cause of convulsion

Algorithm for Control of Neonatal Convulsion



*Midazolam: Initial bolus 0.2 mg/kg then 0.05 - 2 mg/kg/hour in drip.
Increase every 15 minute upto 2 mg/kg/hour if no response

Source: References 13, 14 of this chapter

Management of babies delivered from mothers with specific antenatal diseases

Maternal diseases during pregnancy	Management to be given to baby
Mother with Diabetes mellitus	<i>Check babies blood glucose within 1 hour of birth, by heel prick</i> - If the infant found to be clinically well and normoglycaemic - Start and continue breast feeding - Monitor blood glucose 4-6 hourly at least for 24 hours - If the infant is asymptomatic but hypoglycaemic (blood glucose <40 mg/dl) - Put an I/V line and start glucose infusion @ 6 mg/kg/minute - Allow breast feeding & monitor blood glucose 4 hourly - If the baby is symptomatic and hypoglycaemic - Give a bolus of 10% glucose solution (2 ml/kg) - Continue infusion of glucose @ 6-8 mg/kg/min and increase the infusion rate as needed to maintain a normal blood glucose - The level should be monitored every 30-60 minutes until glucose level is stable
HBs Ag positive mother <i>Regardless of HBeAg or Anti-HBeAb status</i>	* Give Hepatitis B immune globulin (HBIG) 0.5 ml IM within 12 hour of delivery * Additionally, Give Hepatitis B (HB) vaccine at birth at a separate site and then follow the usual EPI schedule * Breast feeding to be continued

Mother with active Tuberculosis	Do X-ray chest & assess gastric aspirate (3 days) for AFB. If these do not yield evidence of TB - (i) Give INH prophylaxis to the baby for 6 months (10mg/kg/day, single dose; crush the appropriate fraction and dissolve in drinking water or multi-vitamin syrup) (ii) Withhold BCG until INH therapy is completed. Give BCG after 2 weeks of completing INH therapy (iii) Plan for MT at 3 and 6 months of age. If MT is positive at any time and if baby is symptomatic, evaluate comprehensively and treat with anti-TB drugs • <i>Breast feeding to be continued. Separation of mother and infant is only necessary if the mother is sick enough to require hospitalization or has MDR TB</i>
Chickenpox of mother occurred within 5 days before & 2 days after birth	* Give Varicella Zoster immunoglobulin (VZIG) 125 units as soon as possible and no later than 96 hours. (If VZIG is not available, then IVIG should be used) * If mother developed chickenpox 7 days prior to delivery, baby do not need VZIG as baby will get antibodies via the placenta * If the baby develops chickenpox, give Acyclovir, 10-15 mg/kg 8 hourly for 5-7 days • <i>Breast feeding to be continued</i>
Mother known to have HIV infected	* Thoroughly clean off amniotic fluid and blood from the baby just after delivery * Initiate Zidovudine (ZDV) I/V 1.5 mg/kg/dose, four times daily for 6 weeks • <i>Exclusive breast feeding for 1st 6 months of life, introducing appropriate complementary foods thereafter and continue breast feeding for 1st 12 mo of age</i>

BIRTH INJURIES

These are the impairment of the infant's body function or structure due to adverse influences, occurred at birth.

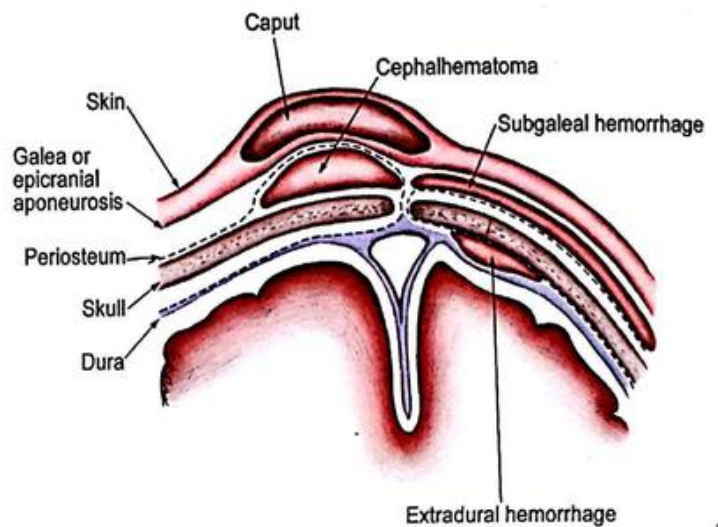
Risk Factors

- * Rigid birth canal *e.g. primiparous, small malformed pelvis, cephalopelvic disproportion*
- * Abnormal presentations *e.g. breech position, face presentation, brow, transverse*
- * Instrumental delivery *e.g. vacuum or forceps assisted delivery*
- * Macrosomia
- * Shoulder dystocia
- * Prolonged labour
- * Excessive traction during delivery
- * Prematurity

Common Birth Injuries

Regions	Lesions
Head & neck region	* Caput succedaneum - Cephalhaematoma - Subaponeurotic (subgaleal) haemorrhage * Intracranial haemorrhage
Nerve injuries	* Brachial plexus injuries <i>e.g. Erb's palsy, Klumpke's Palsy, facial palsy, phrenic nerve palsy etc.</i>
Fractures	* Clavicle, humerus, femur, skull
Eye injuries	* Subconjunctival haemorrhage * Retinal haemorrhage
Soft tissue injuries	* Echymoses, abrasion, laceration etc.
Intra abdominal injury	* Injury to liver, spleen

Among all birth injuries, trauma to the head are the commonest. These may result in haemorrhage in any layers of scalp or beneath it. The following diagram will help us to understand the site of bleeding -



Common Birth Injuries and their cardinal features



Caput succedaneum

- Subcutaneous fluid collection in the soft tissues of the scalp that is presented during vertex delivery
- Has poorly defined margins and can extend over the midline and across suture lines
- The lesion usually resolves spontaneously without sequelae over the first few days after birth



Cephalhaematoma

- Subperiosteal collection of blood which does not cross the suture line
- Presents as a soft, fluctuant mass usually over the parietal bone
- Usually resolved within 2 weeks - 3 months, depending on their size



Subgaleal Haemorrhage

- Haemorrhage between Galea aponeurotica of scalp and the periosteum. (Subaponeurotic haemorrhage)
- It appears as a fluctuant mass within few hours after birth and can extend from orbital ridges to the nape of the neck and laterally to the ears crossing the suture line
- There is massive loss of blood which may lead to anaemia, sometimes shock and jaundice from extravascular haemolysis

Common Birth Injuries and their cardinal features



Left facial nerve injury

- It is usually due to pressure by the forceps blade on the facial nerve
- Appears within 1-2 days after delivery due to resultant oedema and haemorrhage around the nerve
- Spontaneous recovery usually occurs within 14 days

Source: Internet



Skull Fracture

- Usually depressed skull fractures resulting in a "ping-pong" deformity without discontinuity
- Rarely require surgical elevation



*Brachial plexus injuries
e.g. Duchenne-Erb's palsy,
Klumpke's palsy.*

- The characteristic position in Duchenne-Erb's palsy consists of:
(waiters tip hand)
 - * Adduction at the shoulder
 - * Internal rotation of the upper arm
 - * Pronation of the forearm
 - * Outward direction of the palm of the hand
- In addition the patient will have asymmetric Moro reflex, absent biceps jerk but hand grasp is usually present

Management

- Relaxation of the paralyzed muscles (abduction at the shoulder, external rotation of the upper arm, supination of the forearm, simply by holding of the wrist to the head of the bed)
- Physiotherapy, mild electrical stimulation, neuroplasty

Source: Internet



Fracture clavicle

- Infant does not move the arm freely on the affected side
- Crepitus and bony irregularity may be palpated
- A remarkable degree of callus develops at the site within a week and may be the first evidence of the fracture
- Treatment consists of immobilization of the arm and shoulder on the affected side
- Prognosis is excellent

Common Birth Injuries and their cardinal features



Fracture Humerus

- Spontaneous movement of the fractured limb is usually absent
- Moro reflex is absent in the affected limb
- Treatment consists of a triangular splint and a bandage or a cast



Source: Internet

Fracture Femur

- Spontaneous movement of the affected limb is absent
- Moro reflex is absent in the affected limb
- Treatment consists of traction-suspension of both lower extremities, even if the fracture is unilateral

References

1. Cloherty, JP, et al. Manual of Neonatal Care, 6th ed. USA: Lippincott Williams & Wilkins; 2008
2. Gomella TL. Neonatology, Management, Procedures, On-Call Problems, Diseases and Drugs. 6th ed. USA: The McGraw - Hill Companies; 2009
3. The Fetus and the Neonatal Infant. In: Kliegman RM, Stanton BF, Geme III JWS, Schor NF, Behrman RE. Editors. Nelson Textbook of Pediatrics, 20th Edition. New Delhi: Elsevier; 2016: 789-925
4. Khan MR, Rahman ME. Essence of Pediatrics. 4th ed. Elsevier; 2011. Chapter 2, Neonatology; p. 7-48
5. Molla MR. Concise Textbook of Pediatrics. 2nd ed. Dhaka: Child Friendly Publications; 2007.
6. National Neonatal Health Strategy and Guidelines for Bangladesh '2009
7. Sankar MJ et al. Sepsis in the Newborn. Indian Journal of Pediatrics March, 2008;75 :261-6
8. Rahman MM, Saha NC, Mannan MA. Neonatal Seizure: An Update. BJCH 2008; 32(1):21-28
9. Joint statement and recommendations on Vitamin K administration to newborn infants to prevent vitamin K deficiency bleeding in infancy (2000)

10. Davies L, McDonald S. Examination of the Newborn and Neonatal Health: A Multidimensional Approach. 1st ed. London: Churchill Livingstone; 2008.
11. WHO. Pocket Book of Hospital Care for Children, '2013. chap 8. Children with HIV/AIDS.
12. Mittal H. et al. Management of newborn born to mother suffering from TB: Current recommendations & Gaps in knowledge. Indian J Med Res 140, July 2014, pp. 32-39.
13. Saha NC et al. Neonatal Seizure: An Update. Bangladesh J Child Health 2008; Vol 32 (1) : 21-28.
14. Begum N et al. Seizures in Newborn: An Update. J Shaheed Suhrawardy Medical College, 2012; 4 (1):26-31.
15. Champion P. In: Examination of newborn and neonatal health. Davies L, McDonalds S editors. Churchill Livingstone, 2008: 127-40.

SELF ASSESSMENT

Short answer questions [SAQ]

1. What are the major illnesses causing high neonatal deaths in Bangladesh?
2. Enumerate 5 common features of neonatal sepsis.
3. What investigations will you do for sepsis screening? Write down the treatment of a baby with septicaemia.
4. What are the important causes of jaundice during neonatal period?
5. A newborn is delivered at 34 weeks of gestation by LUCS for fetal distress and severe hypertension of the mother. The baby failed to take breath immediately after birth. a) What is the most likely diagnosis? b) Outline the steps of resuscitation.
6. A 32 weeker newborn, weighing 1500 gm is admitted in neonatal ward with respiratory distress. a) What are the problems of this baby? b) Write down the important complications that this baby may develop. c) Outline your plan of management.
7. A 3 days old baby presents with convulsions. a) Write 5 important causes of convulsions. b) Outline the management steps.

Short answer questions [SAQ]

1. Common causes of neonatal convulsion include

___ a) jaundice of prematurity	___ b) meningitis	___ c) hypoglycaemia
___ d) RDS	___ e) hypocalcaemia	
2. Direct hyperbilirubinaemia in newborn occurs due to

___ a) blood group incompatibility	___ b) congenital biliary atresia	
___ c) physiological jaundice	___ d) cystic fibrosis	___ e) breast milk jaundice
3. The cause of jaundice in a 3 days old baby are-

___ a) Rh incompatibility	___ b) congenital hypothyroidism	___ c) biliary atresia
___ d) physiological jaundice	___ e) septicaemia	
4. Drugs commonly used to control neonatal convulsion include-

___ a) Phenobarbitone	___ b) Fosphenytoin	___ c) Diazepam
___ d) Lidocaine	___ e) Midazolam	

NUTRITIONAL DISORDERS

PROTEIN ENERGY MALNUTRITION (PEM)	72
SEVERE ACUTE MALNUTRITION (SAM)	74
VITAMIN DEFICIENCY DISORDERS	
• XEROPHTHALMIA	79
• SCURVY	80
• RICKETS	81
CHILDHOOD OBESITY	84

In a developing country like Bangladesh, many children suffer from various nutritional problems because of inadequacy of food & nutrients and ignorance. Common nutritional disorders of children in Bangladesh are -

- * Protein energy malnutrition (PEM)
- * Vitamin and other micronutrient deficiencies
- * Nutritional anaemia *e.g. iron deficiency anaemia*
- * Iodine deficiency disorders *e.g. hypothyroidism*

In this section protein energy malnutrition (PEM) and few vitamin deficiency disorders will be discussed. Another nutritional disorder, **obesity** is also highlighted in this chapter.

PROTEIN ENERGY MALNUTRITION (PEM)

It is a pathological condition occurring most frequently in infant and young children due to long-continued deficient intake of protein and calories. It is an important cause of death of Under 5 children in Bangladesh.

Current nutritional status of under 5 children in Bangladesh indicate that 41% are stunted, 16%

are wasted, 36% are underweight (BSHS 2011). These figures are on the decline in contrast to previous years.

Aetio-pathogenesis

Risk Factors	* Scarcity of food due to poverty
	* Lactation failure
	* Poor complementary feeding practices: Early or late starting of complementary feeding, faulty preparation of foods <i>e.g. low calorie food, food deficient in protein, fat and minerals</i> due to lack of knowledge
	* Close pregnancies
	* Lack of tender love and care
	* Helminthiasis
	* Mental or physical handicap or other concomitant diseases

Classification

PEM is classified in different ways by different authorities.

1. Welcome classification

Weight-for-age (% of median*)	Without oedema	With oedema
60-80	Under nourished	Kwashiorkor
<60	Marasmus	Marasmic-kwashiorkor

2. Gomez classification

Weight-for-age (% of median*)	Status of nutrition
90-110	Normal
75-89	1 st degree- Mild malnutrition
60-74	2 nd degree- Moderate malnutrition
<60	3 rd degree- Severe malnutrition

* Median is the 50th percentile value of CDC chart.

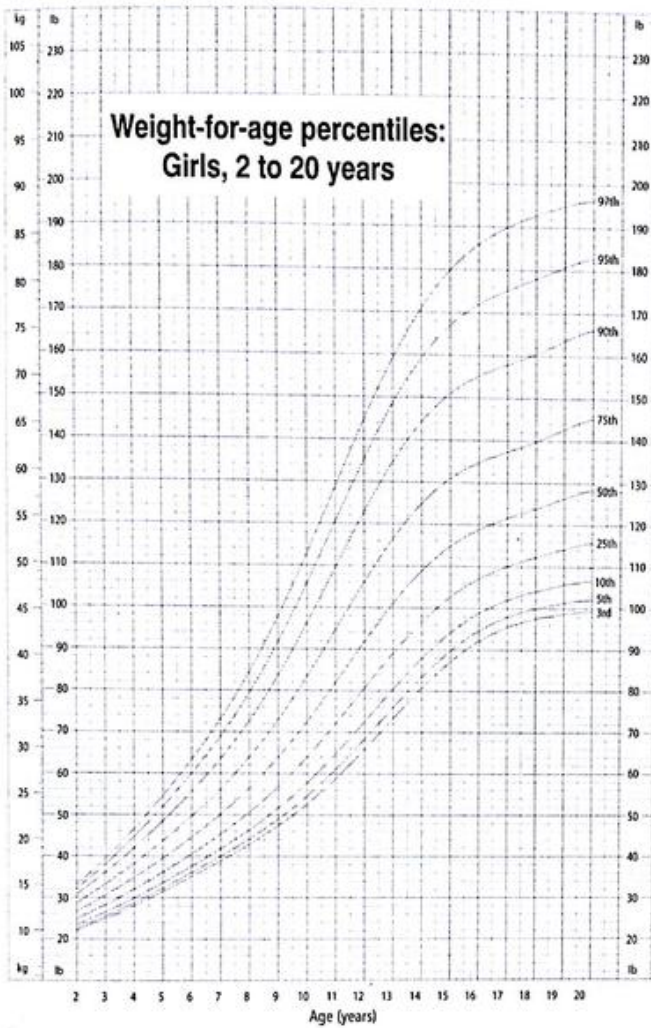


Chart 1

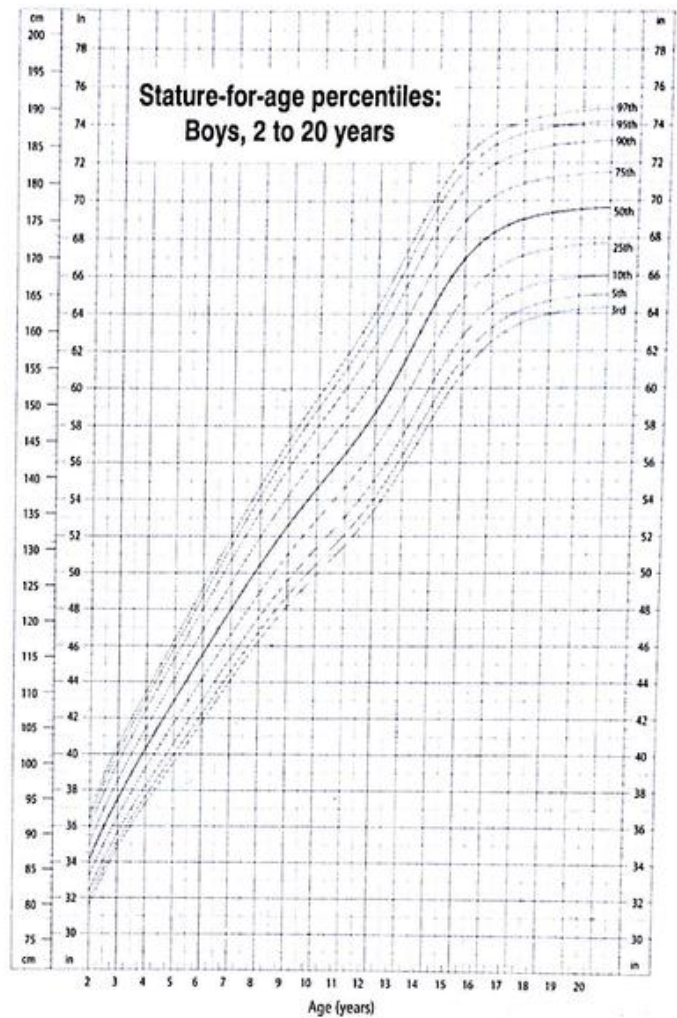


Chart 2

How to Calculate Z Score

$$\text{SD or Z score} = \frac{\text{Observed value} - \text{Expected value (median)}}{\text{One standard deviation (1SD)}}$$

$$1 \text{ SD} = \frac{\text{Median value} - 5 \text{ percentile value}}{1.8}$$

$$= \frac{50 \text{ Percentile value} - 3 \text{rd percentile}}{2}$$

Example: If we consider a 5 years old boy with 90 cm height, from chart 2,
his, 50th percentile value of height = 109 cm (median)

5th percentile value of height = 101 cm

$$\text{So, } 1 \text{ SD} = \frac{\text{median value} - 5 \text{th percentile value}}{1.8} = \frac{109 - 101}{1.8} = 4.4$$

$$\text{SD or Z score} = \frac{\text{Observed value} - \text{Expected value (median)}}{1 \text{ SD}} = \frac{90 - 109}{4.4} = -4.3$$

ACUTE MALNUTRITION

Whenever a child presents with features of acute malnutrition e.g. $MUAC < 125$ mm and/or weight for length/height < -2 SD, his nutritional status should be classified as follows

Parameters	Normal	MAM	SAM
MUAC mm	≥ 125	115 to 124	< 115
WHZ SD	≥ -2 SD	-3 to < -2 SD	< -3 SD
Bipedal oedema	Absent	Absent	Present

MAM - Moderate Acute Malnutrition

SAM - Severe Acute Malnutrition

WHZ - Weight for Height Z score

SEVERE ACUTE MALNUTRITION

(WHO 2009)

Severe acute malnutrition (SAM) is defined by the presence of severe wasting e.g. low weight for height ($WHZ < -3$ SD, $MUAC < 115$ mm) and or bipedal oedema. Here, no distinction is made between marasmus, kwashiorkor or marasmic-kwashiorkor as their management approach is similar

Revised Diagnostic Criteria for SAM

a. Children between 6-60 months

(WHO '2009)

Indicators	Measure	Cut-off
Severe wasting ²	Weight -for-height ¹	< -3 SD
Severe wasting ²	Mid-upper arm circumference (MUAC)	< 115 mm
Bilateral oedema ³	Clinical sign	Present

1=Based on WHO standard; 2,3=independent indicators of SAM

b. Children < 6 months

(Bangladesh Guideline '2012)

- * $WHZ < -3SD$
- * Visible wasting
- * Bipedal oedema

Clinical Features of SAM

(Kwashiorkor & Marasmus)

Skin changes

- Flaky paint dermatosis
- Crazy pavement dermatosis
- Reticular pigmentation
- Mosaic dermatosis
- De-pigmentation
- Indolent sores & ulcers
- Superimposed infection



Shiny skin due to oedema (Seen in kwashiorkor)



Crazy pavement dermatosis with sores (Seen in kwashiorkor)



Flaky paint dermatosis with hypo and hyper pigmentations (Seen in kwashiorkor)



Flaky paint dermatosis with hypo and hyper pigmentations (seen in kwashiorkor)



Severe wasting of periorbital and other facial muscles



Baggy pant appearance (seen in marasmus)

Salient Features: Marasmus & Kwashiorkor

Clinical features	Marasmus	Kwashiorkor
Face	Well alert wizened face	Rounded and oedematous
Visible severe wasting	Obvious	Less obvious
Oedema	Absent	Present
Skin changes	Less frequent	Present
Hair change	Absent	Present
Mental change	Sometimes	Usually present
Appetite	Good	Poor
Hepatomegaly	Absent	Present

Complications

- * Infection, both overt & hidden *e.g. TB*
- * Dehydration & dyselectrolytaemia
- * Hypoglycaemia
- * Hypothermia
- * Anaemia
- * Congestive Cardiac Failure
- * Bleeding
- * Xerophthalmia & blindness
- * Sudden infant death syndrome

Diagnosis

Virtually clinical. However, investigations should be done to assess the biochemical status and to screen infection. These are-

Investigations	Results
Complete blood counts with PBF	Low Hb, leukocytosis, PBF shows microcytic hypochromic or dimorphic blood picture
Blood biochemistry	RBS (low), S. total protein, albumin (hypoalbuminaemia), electrolytes (hypokalaemia)
Infection screening	Urine for R/M/E, C/S, blood C/S
X-ray chest	To look for evidence of pneumonia and pulmonary TB

Management

WHO has mentioned 10 steps for the management of SAM. These 10 steps are accomplished in 2 phases.

1. Stabilization phase

This phase is meant for making the patient stable. During this phase-

- * The life-threatening problems are identified & treated
- * Specific deficiencies are corrected
- * Metabolic abnormalities are reversed
- * Feeding is begun

2. Rehabilitation phase

This phase is signaled by return of appetite and a loss of most/all of the oedema. It usually takes about one week of meticulous management in stabilizing phase. During this phase-

- * Intensive feeding is started but gradually to recover the lost weight
- * Breast feeding is re-initiated and/or encouraged
- * Emotional and physical stimulations are increased
- * The mother or care givers are trained how to continue care at home, and
- * Preparations are made for discharge of the child

Time-frame for Management of SAM

Steps	Stabilization Phase Days 1-7	Rehabilitation Phase Weeks 2-6
Hypoglycaemia	→	
Hypothermia	→	
Dehydration	→	
Electrolytes	→	→
Infection	→	
Micronutrients	No Iron	Iron →
Cautious feeding	→	
Catch up growth		→
Sensory stimulation	→	→
Prepare for discharge & follow up		→

General Principles of 10 Steps

Step 1: Treat/Prevent Hypoglycaemia

Assume all severely malnourished children are hypoglycaemic and are often accompanied by hypothermia.

- The child may present with lethargy, limpness, convulsions and loss of consciousness. If blood sugar is found low (<3 mmol/L)

- Give 50 ml of 10% glucose orally /NG tube or 5 ml/kg of 10% glucose IV
- Start & continue 2 hourly feed day and night

Step 2: Treat/Prevent Hypothermia

(Axillary <35°C or 95°F, Rectal < 95.9°F or 35.5°C)

- Warm the child
 - * Clothe the child including the head, cover with a warm blanket and increase the ambient temperature with safe heat source

OR



- * Put the child on mother's bare chest for skin to skin contact and cover them (Kangaroo mother care)
- Ensure the child is covered at all time, especially at night and keep away from cold air
- Avoid prolonged exposure for examination & procedure

Step 3: Treat/Prevent Dehydration

As it is difficult to assess dehydration status in a severely malnourished child, assume that a child with watery diarrhoea may have dehydration.

- Slow oral correction with fluid low in Na & high in K (ReSoMal).
- Give ReSoMal 5 ml/kg orally or by nasogastric tube every 30 min for first two hours
- Then ReSoMal 5-10 ml/kg/hour, alternately with F-75 for 4-10 hours until the child is rehydrated
- Do not use IV route for rehydration except in cases of shock and do so with care. Otherwise it may lead to fluid overload and heart failure

- If child is breastfed, encourage to continue breastfeeding along with measured feeding

Step 4: Correct Electrolyte Imbalance

- All malnourished children have excess body sodium and low plasma sodium along with low potassium and magnesium. So provide-
 - * Potassium (3- 4 mmol/kg/day) – Each 5 ml contains 7.6 mmol
 - * Magnesium (Inj. 50% $MgSO_4$) - 0.3 ml/kg IM single dose

Step 5: Treat/Prevent Infection

- With broad spectrum antibiotics -
 - * Oral Amoxicillin (15 mg/kg) 8 hourly or Cotrimoxazole (Trimethoprim - 5 mg/kg) 12 hourly for 5 days
- In severely ill patients -
 - * IV/IM Ampicillin (50 mg/kg) 6 hourly &
 - * IV/IM Gentamicin (7.5 mg/kg) once daily for 7 days
- Change the antibiotic to Ceftriaxone (50 -100 mg/kg/day) with or without Inj. Gentamicin (7.5 mg/kg) once daily when -
 - * No clinical improvement (lethargy, fever persist) by 48 hours, or
 - * Deteriorates after 24 hours, or
 - * Presents with septic shock or meningitis

Step 6: Correct Micronutrient Deficiencies

Considering all malnourished children have micronutrient deficiency and give the following:

- Vitamin A : On day 1 of treatment -

Age	Dose
0-5 months	50,000 IU (2 drops from High potency vitamin A capsule)
6-12 months	100,000 IU (4 drops)
>12 months	200,000 IU (whole of a High potency vitamin A capsule)



High potency vitamin A capsule

- Give the following for 2 weeks -

Multivitamin without Iron: Usually 1-2 tsf/day

- * Folic acid: 1 tab (5mg) on day 1, then 1/5th tab (1 mg)/day
- * Zinc (10 mg/tsf): 2 mg/kg/day
- * Copper: 0.3 mg/kg/day (if available)
- * Elemental iron: 3 mg/kg/day started in the rehabilitation phase (usually after 2 wks of starting treatment)

Step 7: Start Feeding Cautiously

Considering the child's fragile physiologic state and reduced capacity to handle large feeds, feeding should be started as soon as possible in the following manner:

- Small amount & frequent (2-3 hourly) oral or NG tube feed
- IV nutrition should never be given
- Low calorie diet (F-75) should be given



NG tube feeding

- Total fluid intake should be ≤ 130 ml/kg/day but 100 ml/kg/day if oedema is present. Along with measured feeding, breast feeding should be continued and encouraged

Step 8: Achieve Catch-up Growth

- About 1 week after admission when appetite has returned and most of the oedema has lost, a gradual transition to F-100 should be done
- Weight gain should be monitored to assess response -
 - * Poor: <5 gm/kg/day
 - * Moderate: 5 -10 gm/kg/day
 - * Good: >10 gm/kg/day

	F-75	F-100
Amount of calories	75 kcal/100 ml	100 kcal/100 ml
Amount of protein	0.9 g /100 ml	2.9 g/100 ml

Step 9: Provide Sensory Stimulation and Emotional Support

- Giving tender loving care *e.g. smiling, laughing, patting, touching etc.*



- Establishing a cheerful, stimulating environment
- Organizing structured play therapy
- Involve parents or caregiver for this support and teach them how to continue at home

Step 10: Prepare for Discharge and Follow-up after Recovery

Discharge, if the following criteria are present -

Child	Mother /Caregiver
* WHZ $\geq$ - 2 SD * Oedema has resolved * Gaining weight at a normal or increased rate * Child eating an adequate amount of nutritious food that the mother can prepare at home * All infections and complications have been treated * Child is provided with micronutrients * Immunization is updated	* Knows how to prepare appropriate foods and to feed to the child * Knows how to make appropriate toys and to play with the child * Knows how to give home treatment of common ailments and can recognize danger signs

Treatment of Associated Conditions**1. Vitamin A deficiency**

- If the child presents with photophobia/xerophthalmia, vitamin A should be supplemented on days 1, 2 and 14 at doses mentioned earlier
- If associated with corneal clouding or ulceration

- * Cover eyes with eye pads soaked in saline solution and bandage
- * Antibiotic eye drop (Chloramphenicol or Tetracycline): 1-2 drops in both eyes 2-3 hourly for 7-10 days
- * Instill artificial tear to both the eyes
- * Atropine eye drops (1%): 1 drop three times daily for 3-5 days

Steroid eye ointment/drop should never be used. In case of young children it may be necessary to restrain arm movement.

2. Dermatositis

Present with hypo or hyperpigmentation, desquamation, ulceration, exudative lesions (resembling severe burns), and weeping skin lesions (in and around the buttocks)

• Treatment

- * Keep the perineum dry
- * Apply 1% Potassium permanganate solution soaked gauze over affected areas and keep for 10 minutes twice daily
- * For fungal infections -
 - Skin lesions: Clotrimazole cream twice daily for 2 weeks
 - Oral candidiasis. Drop Nystatin 1 ml (15 drops - containing 1 lac units) four times daily for 7 days

3. Helminthiasis

(Treatment should be delayed until the rehabilitation phase)

- A single dose of any one of the following Anthelmintics should be given:
 - * Oral Albendazole 200 mg for children aged 12-23 months, 400 mg for children aged ≥ 24 months or
 - * Oral Pyrantel Pamoate 11 mg/kg (any age) single dose or
 - * Oral Mebendazole 100 mg twice daily for 3 days (not recommended below 24 months)

4. Treating Diarrhoea and Dysentery

- Treat Giardiasis with oral Metronidazole (7.5 mg/kg 8-hourly for 7 days).
- Treat dysentery with either -
 - * Oral Ciprofloxacin 10 mg/kg/dose 12 hourly for 3 days, or
 - * Oral Pivmecillinam 15 mg/kg/dose 6 hourly for 5 days

5. Tuberculosis

- Suspected cases should be evaluated by Mantoux test, Chest X-ray and by gastric lavage for AFB
- If test is positive or there is a strong suspicion

of TB, start anti TB drugs as per National Guideline

VITAMIN DEFICIENCY DISORDERS

Children often suffer from different vitamin deficiency disorders either as an isolated problem or along with severe malnutrition.

Deficient Vitamins	Diseases
A	Xerophthalmia
D	Rickets
K	Bleeding tendency
B1 (Thiamine)	Beriberi
B2 (Riboflavin)	Angular stomatitis
B3 (Niacin)	Pellagra
B6 (Pyridoxine)	• Peripheral neuropathy • Convulsion in children
B12 (Cyanocobalamin)	• Megaloblastic anaemia • Subacute combined degeneration of spinal cord
Folic acid	Megaloblastic anaemia
Vit C	Scurvy

Among all these deficiencies, vitamin A, C and D deficiency disorders will be discussed in this section as these are relatively common among children.

VITAMIN A DEFICIENCY: XEROPHTHALMIA

Pathogenesis

- Vitamin A is important for the normal function of both rods and cones in the retina. Its deficiency causes maladaptation of retina in darkness leading to night blindness.
- Vitamin A is also essential for the integrity of epithelial tissue and mucous membrane.

So lack of this vitamin causes different ocular and extra-ocular problems because of epithelial changes in various organs.

Clinical Manifestations

Ocular Manifestations (Xerophthalmia)		
XN	Night-blindness	
XIA	Conjunctival Xerosis	
XIB	Bitot's spot	
X2	Corneal Xerosis	
X3A	Corneal ulceration/keratomalacia involving <1/3 of corneal surface	
X3B	Corneal ulceration/keratomalacia involving ≥1/3 of corneal surface	
XS	Corneal scar	
XF	Xerophthalmic fundi (white retinal lesion)	

Extra-ocular Manifestations	
Skin changes	Dry scaly skin specially over the outer aspect of the limbs called follicular hyperkeratosis (phrynoderma)
Susceptibility to infections	Increased
Squamous metaplasia	Involving respiratory, urinary and vaginal epithelium
Urinary problems	Renal and vesical calculi, pyuria, haematuria
CNS problems	Raised intracranial pressure, rarely optic or other cranial nerve palsy, mental retardation, apathy
Growth failure	

Treatment: Xerophthalmia

All the stages of xerophthalmia should be treated immediately with vitamin A.

Dose recommendation

- ≥ 12 months - 200,000 IU/dose
- 6 - < 12 months - 100,000 IU/dose
- < 6 months - 50,000 IU/dose

It should be given orally on 2 successive days and a third dose to be given at least 2 weeks later.

Treatment: Corneal Ulcer (Discussed on page 73)

Prevention

- Exclusive breast feeding
- Routine vitamin A supplementation (every 6 months upto 5 years of age)
- Vitamin A supplementation in special situations *e.g. diarrhoea and measles.*
- Regular intake of Vitamin A rich foods *e.g. dark green, leafy vegetables, coloured fruits, egg, liver, fat of fish, meat, cod liver oil, mola-dhela fish etc.*

VITAMIN C DEFICIENCY: SCURVY

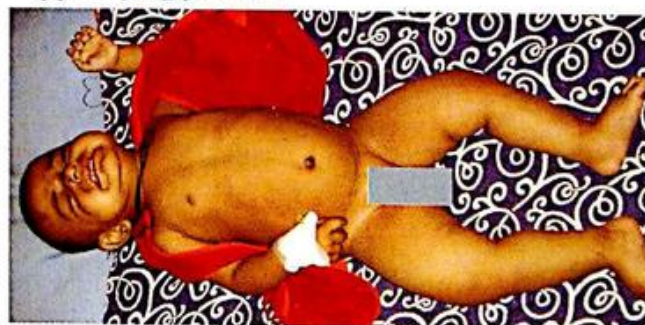
Pathogenesis

Vitamin C is essential for *hydroxylation* of lysine and proline for the formation of collagen. Its deficiency leads to faulty collagen tissue synthesis in bones, cartilages and teeth. In addition, the intercellular substance of capillaries also become defective often leading to bleeding.

Clinical Manifestations

Peak incidence is around 6-24 months of age. Presenting symptoms include -

- Vague irritability and loss of appetite
- The baby cries on handling *e.g. dressing, bathing etc.*
- Generalized tenderness especially in legs resulting in pseudo-paralysis and legs assume typical *frog position*



Legs assume typical frog position (pseudoparesis)

- Bluish purple, spongy swelling of gum mucosa is seen when teeth are erupted

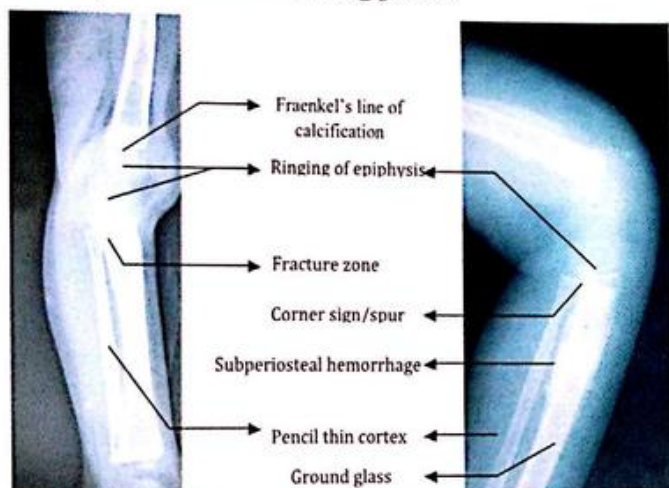
- Sharp painful scorbutic rosary is palpable at costochondral junction and depression of sternum
- Peri-follicular haemorrhage, petechial haemorrhage, ecchymosis of extremities, haematuria, melaena, orbital haemorrhage may be found
- Delay in wound healing

Differential Diagnoses

Leukaemia, osteomyelitis, suppurative arthritis

Investigations

- X-ray of limbs including joints



Typical X-ray findings of scurvy

Treatment

- Oral Vit C 200 mg daily for several weeks. The administration of 3-4 ounces of tomato or orange juice are equally effective. Clinical recovery occurs within 24-48 hours. Radiological improvement takes a week or two; disappearance of sub-periosteal haemorrhage takes months
- After scurvy has been cured, 35-50 mg of vit C should be given daily as drug or in diet

Prevention

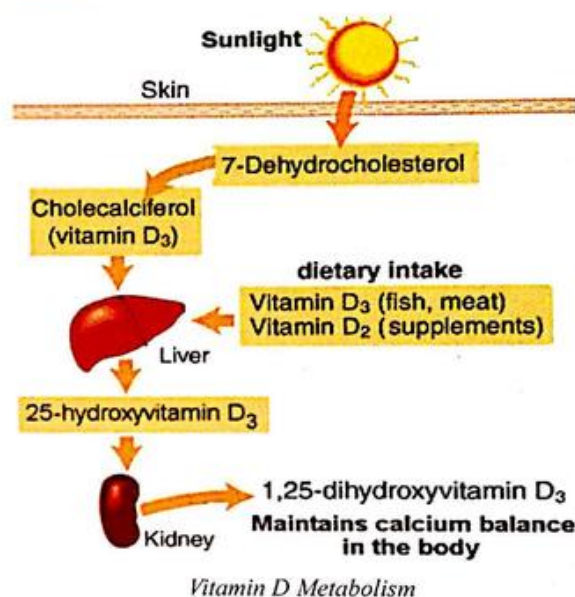
- Encouraging intake of vitamin C rich diet, e.g. citrus fruits like guava, amlaki, tomato, orange etc. and green leafy vegetables
- Exclusive breast feeding. Lactating mothers should have a daily intake of 100 mg vit C
- Formula fed babies should be supplemented with vit C

VITAMIN D DEFICIENCY: RICKETS

Rickets is a disease of growing bones. It occurs in children before fusion of epiphyses and is due to inadequate mineralization of growing bones leading to an excess of unmineralized matrix at the growth plate.

Sources

- Endogenous synthesis in skin (major source)
- Foods rich in vitamin D e.g. egg yolk, cod liver oil, butter, any fat rich diet, milk and milk products



Function and Metabolism

The principal function of Vitamin D is to maintain serum calcium (Ca) and phosphorus concentration in a range that supports cellular processes, neuromuscular function and bone mineralization. Vitamin D does this through i) Stimulation of calcium absorption from gut (duodenum), ii) Stimulation of calcium reabsorption from distal renal tubules and iii) Interaction with parathormone to regulate blood calcium

Rickets: Aetiology

- Continuous non/under exposure to sunlight
- Consumption of foods deficient in vit D
- Others:
 - * Renal disorders e.g. chronic kidney disease (CKD), renal tubular acidosis (RTA)

- * Genetic *e.g. familial hypophosphataemic rickets, Fanconi syndrome, cystinosis*
- * Malabsorption of vit D *e.g. liver & intestinal disorders (Malabsorption syndrome)*
- Vit D dependent rickets: Type I & II
- Drugs *e.g. Phenobarbitone, Phenytoin*
- Hypocalcaemic rickets

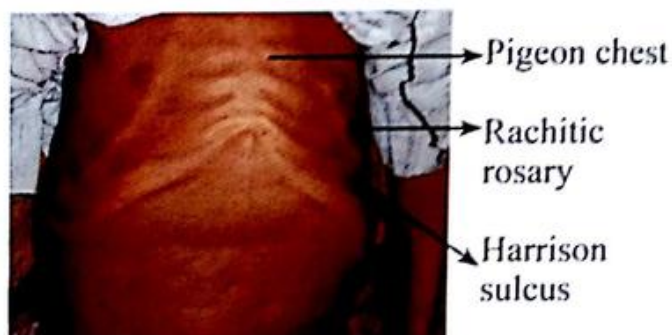
Of the various aetiological types, nutritional rickets and X-linked hypophosphataemic rickets are common.

Clinical Manifestations

Vary according to aetiology and age of presentation. Common manifestations include -

General features	* Short stature, listlessness, protruded abdomen, muscle weakness
Head	* Box like square head, hot-cross-bun appearance of skull, <i>craniotabes</i> (As the skull bone is soft, when pressure is applied they will collapse underneath it and upon releasing of pressure, the bones will snap back into place). Delayed closure of fontanels and sutures
Teeth	* Delayed dentition, dental caries and impaired enamel formation
Chest	* Pigeon chest deformity * Painless rachitic rosary at costochondral junction * Harrison sulcus
Spine	* Deformities like scoliosis, kyphosis, lordosis. These may lead to recurrent respiratory infections

Extremities	* Widening of wrist and ankle, vulgus and varus deformity, anterior bowing of leg, coxa vara, fractures and pain, gait deformity
Symptoms of hypocalcaemia	* Tetany, seizure, stridor due to laryngeal spasm



Widened wrist



Knock knee



Widened ankle & deformity of legs



Bowing of legs

In familial hypophosphataemic rickets, deformities of limbs are more prominent than other manifestations like deformity of the chest or head, which are more florid manifestation of nutritional rickets.

Investigations

- Biochemical profile in blood and urine

S. Calcium	Normal usually, may be low
S. Inorganic Phosphorus (Pi)	Low (Hypophosphataemia) due to PTH-induced renal loss. Also low in RTA, Fanconi syndrome, X-linked hypophosphataemic rickets
Rachitic Index: $S. Ca \times S. Pi$	* <30: Rickets likely * >40: Rickets unlikely * 30-40: Rickets doubtful
S. Alkaline phosphatase	High
S. Parathormone (PTH)	High
S. 25(OH) D and 1,25 (OH) ₂ D levels	Low in severe vit D deficiency but may be normal
S. creatinine	High in CKD and RTA*
S. electrolytes	Altered in CKD and RTA*
Arterial blood gas (ABG)	Metabolic acidosis in RTA*, CKD
Urine for glucose, amino acid	Glycosuria, aminoaciduria as seen in Fanconi Syndrome
24 hours urinary calcium level	Increased in Fanconi syndrome
Urinary calcium/creatinine ratio	Increased in Fanconi syndrome
24 hours urinary phosphate level	Increased (Phosphaturia) in RTA, X-linked hypophosphataemic rickets, Fanconi Syndrome

* RTA: Renal tubular acidosis

- Radiology

- * X-ray upper and lower limbs including knee, ankle, elbow & wrist joints. It shows
 - Widening, cupping and fraying of metaphysis
 - Wide gap between epiphysis and metaphysis
 - Density of shaft of bone is reduced (osteopenia)
 - Deformity of long bones may be present
 - Green stick fracture may be present



Typical X-ray of rickets

- * Chest X-ray shows
 - Chondral ends of ribs are expanded, cupped and indistinct
 - Rachitic rosary may be identified



CXR showing Rachitic rosary

Treatment

A. Nutritional Rickets

- Vitamin D supplementation as follows
 - * Vitamin D3 (Cholecalciferol)
 - Stoss therapy: 300,000 - 600,000 IU is given orally or IM 2 - 4 doses over 1 day or
 - Gradual therapy: 2000-5000 IU/day over 4-6 weeks
- Either strategy should be followed by daily maintenance vitamin D intake of -
 - * 400 IU/day (children <1 year of age) and 600 IU/day (for children >1 year of age)
 - * Stoss therapy may be repeated if required after radiological evaluation at 6-8 weeks of therapy
- Calcium supplementation (350-1000 mg/day)

B. Familial hypophosphataemic rickets

- Phosphorus supplementation as *Joulie solution* (Dibasic sodium phosphate)-
 - * 1-3 gm elemental phosphorus in 4-5 times a day for whole life

Joulie solution contains 30.4 mg/ml elemental phosphate

- Oral Calcitriol (1, 25 dihydrocholecalciferol) supplementation: 30-70 ngm/kg/day in two divided doses

Surgical Treatment

- Consultation with Orthopedic surgeon in severe deformity of limbs

Prevention of Rickets

- Encourage
 - * Exposure to adequate sunlight
 - * Intake of diet rich in vitamin D & calcium e.g. egg yolk, cod liver oil, butter, any fat rich diet, milk and milk products
 - * Regular intake of vitamin D (200-400 IU/day)

CHILDHOOD OBESITY

Obesity is a burning problem among children now a days and it is dramatically on the rise. Childhood obesity leads to adult obesity. This is a chronic preventable disease.



Courtesy: Dr Shamima Sharmin Shova

Definition

Overweight: Having excess body weight for a particular height.

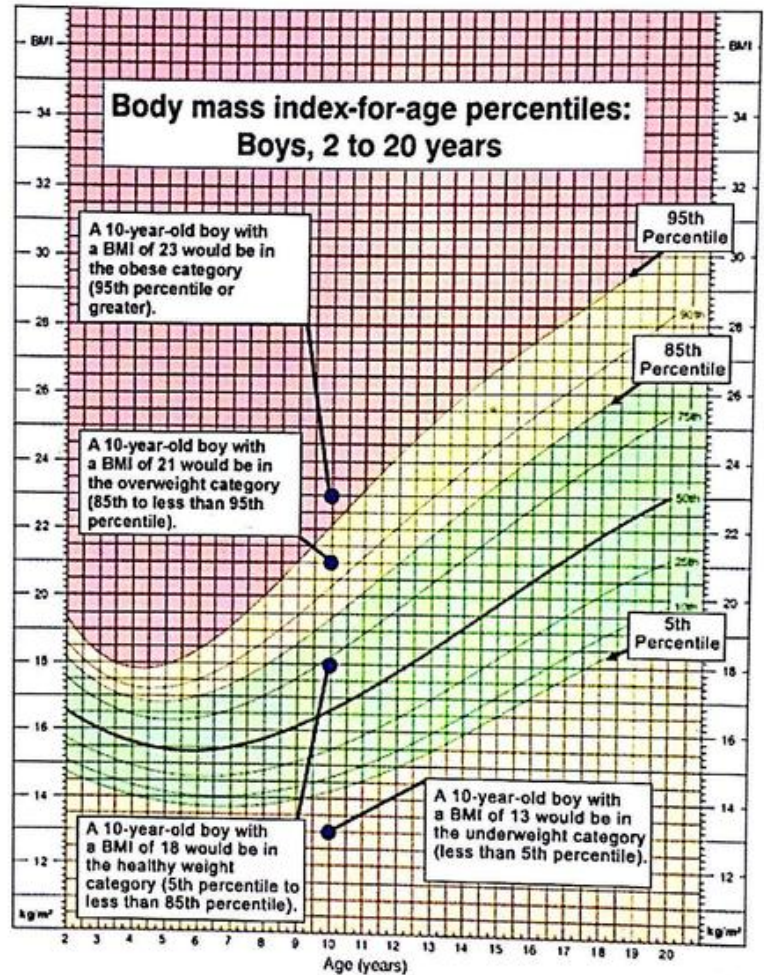
Obesity: Having excess body fat (Not simply overweight).

Ways to Measure Obesity

- Measuring Body Mass Index (BMI)

Weight (kg)/Height (m²)

BMI percentile chart to assess obesity



Interpretation of BMI for percentile chart

Weight status category	Percentile range
Underweight	<5 th
Healthy weight	5 th - 85 th
Overweight	85 th - 95 th
Obese	≥ 95 th

- Skin fold thickness or Caliper's test: Measured by thickness of skin over triceps or over the calf muscle or sub scapular skin fold



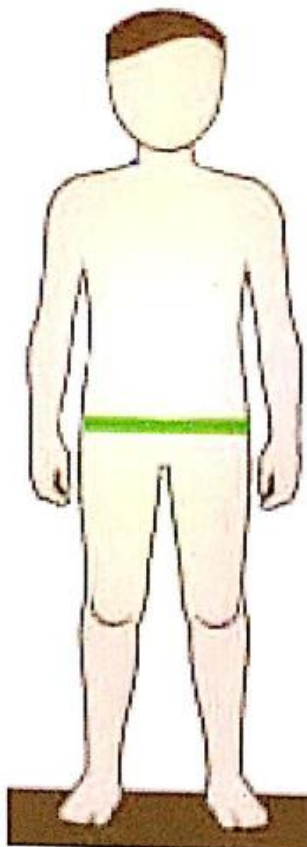
Source: Internet

Measurement of skin fold thickness with Harpenden calipers

- Waist circumference measurement:
Measured at a point midway between the 10th rib and the iliac crest.

Aetiology

- Mostly exogenous-
 - * Eating too much high calorie food (fast food)
 - * Too little exercise
- Other causes (< 5%)-
 - * Hormonal e.g. hypothyroidism, Cushing syndrome, hyperinsulinaemia etc.
 - * CNS problems e.g. hypothalamic damage due to tumor; trauma or infection
 - * Syndromes e.g. Down, Prader-Willi, Laurence-Moon-Biedl
 - * Drugs e.g. corticosteroid, insulin, antithyroid, sodium valproate etc.



Measurement of waist circumference

Source: Internet

Complications

Psychological	Poor self esteem Eating disorder
Neurological	Pseudotumor cerebri
Pulmonary	Sleep apnoea Asthma Exercise intolerance
Skin	Acanthosis nigricans
Gastrointestinal	Gall stone Steatohepatitis (inflammation of the liver with concurrent fat accumulation in liver)
Cardiovascular	Dyslipidaemia Hypertension Coagulopathy
Renal	Glomerulosclerosis
Musculoskeletal	Slipped capital femoral epiphysis Blount's disease Forearm fracture Flat feet
Endocrine	Type II diabetes Precocious puberty Polycystic ovary syndrome Hypogonadism

Treatment

- Counsel about the nature and the complications of the disease
- Behavior modification to control appetite and change of food habit
- Reduce calorie intake e.g. intake diet low in carbohydrate & fat and eat more vegetables and fruits
- Increased physical activity e.g. walk to school, play with friends, regular physical exercise
- Treatment of cause, if any

References

1. WHO and UNICEF. WHO child growth standards and the identification of SAM in Infant and Children; 2009.
2. Directorate General of Health Services of Bangladesh. National Guidelines for the Management of Severely Malnourished children in Bangladesh; March 2012.
3. Robbins & Cotran. Pathological basis of disease, 8th edition, 2010, Elsevier: p433-437
4. Greenbaum LA. Rickets & Hypervitaminosis. In: Kliegman RM, Stanton BF, Geme III JWS, Schor NF, Behrman RE. Editors. Nelson Textbook of Pediatrics, 20th Edition. New Delhi: Elsevier; 2016: 331-340
5. Bangladesh Demographic and Health Survey 2014. National Institute of Population Research and Training, Mitra and Associates, Dhaka and MEASURE DHS, USA. April 2015.
6. Kabir ARML. Pediatric Practice on Parents Presentation. 1st ed. Dhaka: Asian Colour Printing; 2011.
7. Molla MR. Concise Textbook of Pediatrics. 2nd ed. Dhaka: Child Friendly Publications; 2007.
8. Khan MR, Rahman ME. Essence of Pediatrics. 4th ed. New Delhi: Elsevier; 2011. Chapter 5, Nutritional Problems; p. 72-84.
9. BBS-UNICEF. Child and Mother Nutrition survey 2005. BBS and UNICEF, Dhaka, 2007.
10. Islam KE et al. Protocolized management of children with severe malnutrition: lessons learn from a tertiary level government hospital. Abstract book, 8th Commonwealth Congress on Diarrhea and malnutrition, 6-8 February 2006, ICDDR, Dhaka, Bangladesh, p36.
11. G. Suraj, Gomez EM. Pediatric Nutrition and Nutritional Deficiency States. In: Suraj Gupte. The Short Textbook of Pediatrics. 10th ed. New Delhi: Jaypee Bros Med Publishers Ltd; 2004.
12. Hutchinson JH. Cockburn F. Practical Pediatric Problems 6th ed. London: Lloyd Luke, PG Asian Economy ed; 1989.
13. National Institutes of Health, National Heart, Lung, and Blood Institute. Disease and Conditions Index: What Are Overweight and Obesity? Bethesda, MD: National Institutes of Health; 2010.
14. Krebs NF, Himes JH, Jacobson D, Nicklas TA, Guilday P, Styne D. Assessment of child and adolescent overweight and obesity. Pediatrics. 2007; 120:S193-S228.
15. Michèle Guillaume Defining obesity in childhood: Current Practice. American Journal of Clinical Nutrition. 1999; 70(1):126S-130S.

SELF ASSESSMENT

Short answer questions [SAQ]

1. What are the 10 steps of management of severe acute malnutrition?
2. Define obesity.
3. What are the complications & sequelae of obesity?
4. How can you control obesity?
5. A 2 year old boy weighing 5.5 kg presented with severe wasting and bipedal oedema.
 - i) Write down the common complications of severe PEM.
 - ii) How will you manage hypoglycaemia in present in this child?
6. Write down the difference between Marasmus and Kwashiorkor.
7. Write down the ocular manifestation of Xerophthalmia.
8. Describe the radiological feature of rickets.
9. Classify PEM.
10. Write short note on: Kwashiorkor

Multiple choice questions [MCQ]

- Common nutritional problems of Bangladesh are -
☐ a) acrodermatitis enteropathica ☐ b) obesity ☐ c) iodine deficiency disorders
☐ d) protein energy malnutrition ☐ e) iron deficiency anaemia
- The diagnostic criteria for severe acute malnutrition are -
☐ a) MUAC < 115 mm ☐ b) bipedal oedema ☐ c) sparse hair
☐ d) xerophthalmia ☐ e) WHZ < -3SD
- The following micronutrients are used in acute phase treatment of severe acute malnutrition -
☐ a) Zinc ☐ b) Iron ☐ c) Copper
☐ d) Vitamin E ☐ e) Folic acid
- Nutritional rickets is characterized by-
☐ a) short stature ☐ b) hepatosplenomegaly ☐ c) hypotonia
☐ d) arthritis ☐ e) recurrent chest infection
- Deficiency of vitamin B complex gives rise to -
☐ a) pellagra ☐ b) angular stomatitis ☐ c) scurvy
☐ d) convulsion ☐ e) xerophthalmia
- Beriberi occurs in the deficiency of
☐ a) Pyridoxine ☐ b) Riboflavin ☐ c) Niacin
☐ d) Thiamine ☐ e) Cyanocobalamine
- The clinical and haematological pictures of iron deficiency anaemia are-
☐ a) smooth tongue ☐ b) white nails ☐ c) increased TIBC
☐ d) normocytic normochromic picture ☐ e) decreased s ferritin level
- The clinical features of iron deficiency anaemia are-
☐ a) pica ☐ b) white nails ☐ c) smooth tongue
☐ d) irritability ☐ e) epistaxis
- The classical radiological features of scurvy are -
☐ a) ground glass appearance of shaft of long bones ☐ b) ring shaped epiphyses
☐ c) Fraenkel's white line ☐ d) cupping and fraying of metaphysis
☐ e) wide gap between epiphysis and metaphysis
- A 2 years old boy presented with severe wasting. The recommended objective clinical parameters to define severe acute malnutrition are -
☐ a) MUAC 115 mm ☐ b) WHZ -3SD ☐ c) bipedal oedema
☐ d) severe anaemia ☐ e) skin changes
- A 3 years old child having 110 mm mid upper arm circumference will be defined as -
☐ a) well nourished ☐ b) stunted ☐ c) kwashiorkor
☐ d) marasmus ☐ e) severe acute malnutrition
- The suggestive biochemical changes in nutritional rickets are-
☐ a) Normal S. calcium ☐ b) low S. inorganic phosphorus ☐ c) elevated S. creatinine
☐ d) low S. parathormone level ☐ e) low S. Alkaline phosphatase
- Obesity is assessed by -
☐ a) BMI ☐ b) MUAC
☐ d) upper and lower segment ratio ☐ e) waist circumference measurement
☐ c) Harpenden Cailper

COUGH AND OR DIFFICULT BREATHING

PNEUMONIA	89
CONDITIONS PRESENTING WITH WHEEZE	
• ACUTE BRONCHIOLITIS	93
• ASTHMA	95
CONDITIONS PRESENTING WITH STRIDOR	
• ACUTE LARYNGOTRACHEOBRONCHITIS	100
• ACUTE EPIGLOTTITIS	101
• LARYNGOMALACIA	102

Cough and/or difficult breathing are the commonest symptoms of respiratory illnesses. Whenever children present with these symptoms, the following conditions should be considered -

- | | |
|-----------------------|---------------------------|
| • Pneumonia | • Pertussis |
| • Acute bronchiolitis | • Pneumothorax |
| • Asthma | • Foreign body aspiration |
| • Croup | |

Apart from these, heart failure also presents with cough and difficult breathing.

Of the different illnesses, pneumonia, acute bronchiolitis and asthma are the major respiratory illnesses of the children and will be discussed in details. Other respiratory illnesses like acute laryngotracheobronchitis, laryngomalacia also be highlighted.

PNEUMONIA

Pneumonia is the infection of lung parenchyma. It alone contributes to >18 % of all under 5 deaths worldwide, including 4-5% deaths from neonatal pneumonia. Each year around 26,000 children die from pneumonia in Bangladesh.

Grossly, pneumonia is grouped into 3 types:

- Community acquired pneumonia (CAP) i.e. pneumonia acquired from community/outside hospital
- Nosocomial or hospital acquired pneumonia
- Pneumonia in special situations e.g. aspiration pneumonia, pneumonia in immunocompromized host (opportunistic pneumonia)

Of the different types, community acquired pneumonia is the most common and important from public health point of view.

Risk factors

- Severe malnutrition
- Infectious diseases e.g. measles, pertussis
- Immune deficiency disorders
- Congenital lesions e.g. congenital heart diseases
- Younger age e.g. infant
- Others e.g. indoor air pollution, overcrowding

Organisms causing pneumonia

Newborn	1-3 month	1-12 month	1-5 years	> 5 years
Gr. B Streptococci Enteric gram negative	C. trachomatis U. urealyticum Viruses	S. pneumoniae H. influenzae S. aureus M. catarrhalis Viruses	S. pneumoniae M. pneumoniae C. pneumoniae Viruses	S. pneumoniae M. pneumoniae C. pneumoniae

Pathogenesis

After entering in the respiratory tract and alveoli, the invading organisms evoke a local inflammatory response. This activates complement and coagulation cascades and release many chemical mediators *e.g.* *leukotrienes, prostaglandins, histamines etc.* which enhance capillary permeability and blood flow to the inflamed areas.

As a result, a protein-rich fibrino-suppurative inflammatory exudate containing leukocytes, RBC, antibodies accumulate in the alveolar spaces causing solidification of lungs tissue (consolidation). The solidification may involve a larger portion of a lobe or of an entire lobe (lobar consolidation) or may be patchy throughout one or both lungs (bronchopneumonia).

The net result is **reduction of functional areas for gaseous exchange** and patients become hypoxic and present with respiratory distress.

Clinical Manifestations

A. Symptoms

- * Fever (moderate to high grade) • Cough
- * Respiratory distress

B. Signs

General examination

- * Appearance: Dyspneic
- * Flaring of alae nasi
- * Cyanosis
- * Head nodding, present in severe hypoxia
- * Grunting may be present in severe cases
- * Fast breathing

≥ 60 breaths/min (0–2 months)

≥ 50 breaths/
min (2–upto 12
months)

≥ 40 breaths/
min (1–5 years)

- * Chest indrawing
- * Tachycardia



Chest indrawing

Systemic (Chest) Examination

	Consolidation	Pleural effusion	Pneumothorax
Movement of chest	Restricted on the affected side	Restricted on the affected side	Restricted on the affected side
Position of Trachea	Central	Shifted to the opposite side	Shifted to the opposite side
Position of Apex beat	In normal position	Shifted to opposite side	Shifted to opposite side
Vocal fremitus	Increased	Decreased/absent	Decreased
Percussion note	Woody dull	Stony dull	Hyper-resonant
Breath sounds	Bronchial	Absent	Absent
Vocal resonance	Increased	Decreased/absent	Decreased
Added sounds	Coarse crepitations	Absent, but crepitations may be present above the level of effusion	Absent

In Bronchopneumonia, the signs are similar to consolidation except the characteristic dullness of consolidation is absent and breath sound is vesicular instead of bronchial with coarse crepitations present all over the lung fields.

Diagnosis

Based on C/F & relevant investigations.

Investigations

- * X-ray chest: The findings are -

- * Lobar consolidation: Homogeneous opacity in any portion of lobe
- * Patchy consolidation: Small consolidations seen in different areas of lung fields
- * Pneumatocele: Thin walled cystic lesion classical in *staphylococcal* pneumonia
- * Interstitial infiltrate: Hyper aeration &

prominent lungs markings caused by bronchial wall thickening found in viral and atypical pneumonia

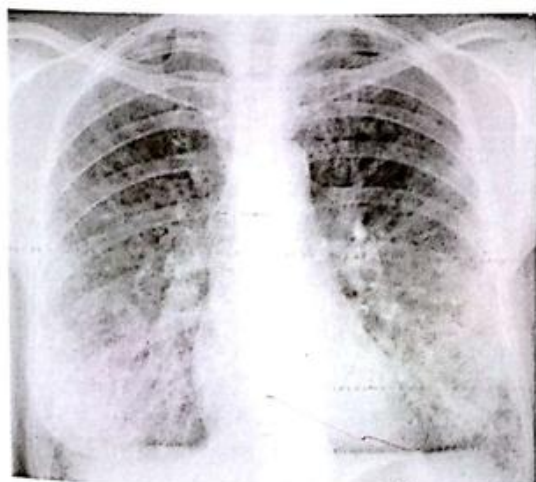
- * Features of complications e.g. pleural effusion, empyema thoracis, lungs abscess etc. (described later on)



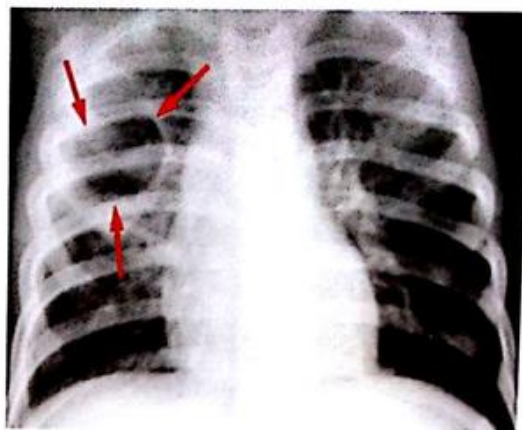
Large lobar consolidation in right lung



Patchy consolidations involving different areas of both lungs (Bronchopneumonia)



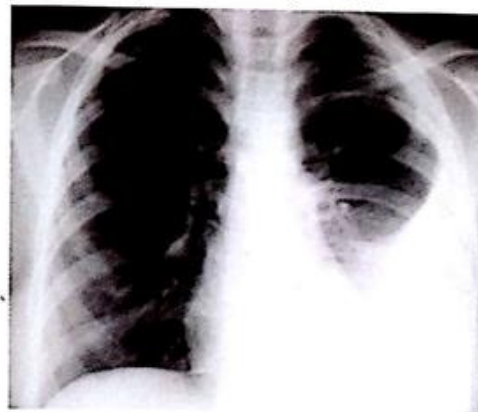
X-ray chest showing streaky densities & bilateral consolidation of lower lobes: Atypical pneumonia



Thin walled cystic lesion in the middle of the right upper lobe (Pneumatocele)



A circumscribed area in left upper lobe with air fluid level: lung abscess



Left sided pleural effusion with obliteration of left costo and cardiophrenic angles



Air fluid level in left hemithorax, obliteration of costo and cardiophrenic angles & shifting of mediastinum to the right.

- * CBC: Polymorphonuclear leukocytosis, ESR: (High)
- * Blood C/S: May isolate the organism in less than 10% of cases

Complications

- * Abscess formation (lungs abscess) resulting from tissue destruction and necrosis
- * Pleurisy and pleural effusion

- * Empyema resulting from spread and accumulation of suppurative material into the pleural cavity
- * Haematogenous dissemination of bacteria to other organs and that may cause meningitis, arthritis, infective endocarditis etc.
- * Fibrosis of lungs from organization of the exudate

Classification of the Severity of Pneumonia & Recommended Treatment (2 months - upto 5 years) WHO' 2013

Any child under 5 years of age who is brought with fever, cough and difficult breathing should be assessed after 3 doses of salbutamol nebulization in an interval of 20 minutes. The patients who responds to nebulization will be considered as wheezy child *e.g. bronchiolitis, asthma* but who do not respond to nebulization should be classified as follows-

Sign or symptom	Classification	Treatment
Any general danger sign • Severe chest indrawing (<i>deep & easily visible</i>) • Stridor in clam child	Severe pneumonia	* Give first dose of an appropriate antibiotic * Treat the child to prevent low blood sugar * Refer urgently to hospital
• Chest indrawing • Fast breathing * ≥ 50 breaths/min in a child aged 2-upto 12 months * ≥ 40 breaths/min in a child aged 1-5 years	Pneumonia	• Give oral <u>Amoxycillin</u> for 5 days • If wheezing (even if it disappears after rapidly acting bronchodilator) give an <u>inhaled bronchodilator/oral Salbutamol</u> for 5 days • Soothe the throat and relieve the cough with a safe remedy • If coughing more than <u>2 weeks or recurrent wheeze</u> refer for assessment for TB or asthma • Advise mother when to return immediately • Follow up in 3 days

Treatment

Counsel the parents about pneumonia, its complications, treatment and outcome.

A. Antibiotic therapy

Children (2 months - 5 years)

Severe pneumonia

- Inj. Ampicillin (50 mg/kg) IM or IV 6 hourly and Inj. Gentamicin 7.5 mg/kg IM/IV once a day for at least 5 days

- If no response by 48 hours and staph is suspected, switch to Gentamicin 7.5 mg/kg IM or IV once daily and Cloxacillin 50 mg/kg/dose IM or IV every 6 hours for 7 days and continue Cloxacillin for a total for 3 weeks
- Use Ceftriaxone (80 mg/kg IM or IV once daily) in cases of failure of first line treatment

Pneumonia

- Amoxicillin, 40 mg/kg/dose orally every 12 hours for 3 days (5 days in High HIV prevalent areas)

- Advice for follow up: After 72 hours (Routine) or earlier if clinical status deteriorates
 - i) to assess the response to treatment
 - ii) to look for any complication
 - iii) if require, hospitalize & investigate to exclude complications or alternate diagnosis

NB: The antibiotics mentioned above are the WHO recommended empiric choice. But other antibiotics such as macrolides, amoxicillin-clavulonic acid, 2nd and 3rd generation cephalosporins can be used, depending on patient's clinical status.

Neonates and young infants (< 2 months)

Pneumonia of any severity should be hospitalized and managed with parenteral antibiotics, O₂ and other supportive care.

The antibiotics of choice are-

- Ampicillin & Gentamicin for 7-10 days
- If Staph suspected: add Cloxacillin
- Choose other antibiotics including macrolides if requires

B. Supportive treatment

1. Oxygen therapy

- * Give Oxygen if SpO₂ < 90% by Pulse Oximeter
- * If pulse oximeter is not available, continue O₂ until the signs of hypoxia *e.g. inability to BF or RR ≥ 70/min* are no longer present
- * Remove O₂ for a trial period each day to see SpO₂. If SpO₂ remains > 90% (at least 15 min in room air) then discontinue O₂
- * Check 3 hourly that nasal prongs are not blocked with mucus and are in the correct place and that all connections are secure

2. Other supports

- * Manage Airway *e.g. remove any thick secretions from nose or throat*
- * Give paracetamol for fever (≥ 39 °C or ≥ 102.2 °F)
- * Give a rapid-acting bronchodilator for wheeze
- * Soothe the throat, relieve cough with a

safe remedy *e.g. warm water; tulsi leaf juice, lemon tea*

- * Encourage breast feeding and oral fluids
- * Start NG tube feeding, if child cannot drink
- * Avoid overhydration

Prevention

- Immunization: Against Pneumococcus, Hib, measles
- Improvement of nutritional status: By breast feeding and energy dense complimentary feeding
- Hand washing

CONDITIONS PRESENTING WITH WHEEZE

Whenever a child presents with wheeze, the following conditions should be considered -

- * Acute bronchial asthma
- * Acute bronchiolitis
- * Gastro-oesophageal reflux disease (GERD)
- * Cystic fibrosis
- * Foreign body in lungs
- * Tropical pulmonary eosinophilia

In the first 2 years of life, wheezing is mostly due to viral respiratory infections like acute bronchiolitis but afterwards, it is mostly due to asthma.

ACUTE BRONCHIOLITIS

It is an acute viral infection of the bronchioles and is characterized by cough, respiratory distress and wheeze that used to start following an episode of viral upper respiratory catarrh.



A child with bronchiolitis

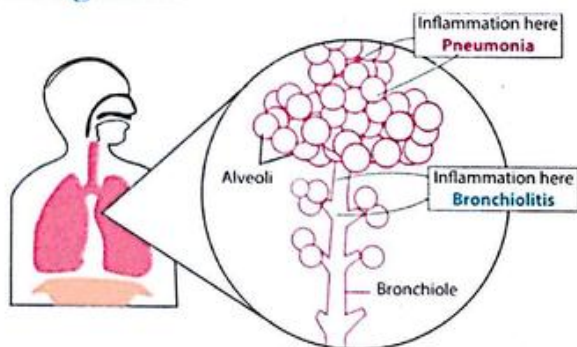
The disease occurs in children <2 years of age, mostly between 2-6 months. It occurs in epidemics, particularly during winter and rainy season. Clinically, it appears to be pneumonia but actually it is a different entity.

Aetiology (Micro-organisms)

- Respiratory Syncytial Virus (RSV): Most common
- Others: Influenza, para influenza viruses, Human metapneumovirus and sometimes mycoplasma

Risk factors

- | | |
|-----------------------------|------------------------|
| * Prematurity | * Crowded environment |
| * Low socio-economic status | * Passive smoking |
| * Non breast feeding | * Indoor air pollution |

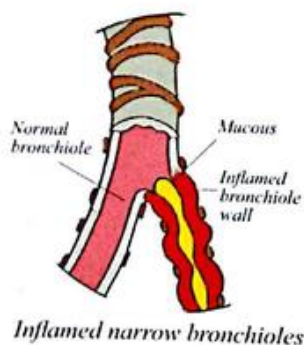
Pathogenesis

This infection of bronchioles gives rise to-

- * Inflammatory swelling of walls of bronchioles
- * Profuse mucous secretion
- * Narrowing of lumen of bronchioles &
- * Air trapping in alveoli

The net clinical effects are (i) severe cough (ii) interference with air passage resulting in respiratory distress (iii) wheeze and (iv) hypoxia.

Sometimes there is complete obstruction of bronchioles by mucous plug with consequent segmental collapse.



Drawing: Nabila Tabassum

Clinical Manifestations

- Severe respiratory distress affects feeding
- Wheeze
- Cough
- Low grade fever or no fever

In many cases, affected children are otherwise playful and afebrile (*happy wheezer*).

Examination of chest

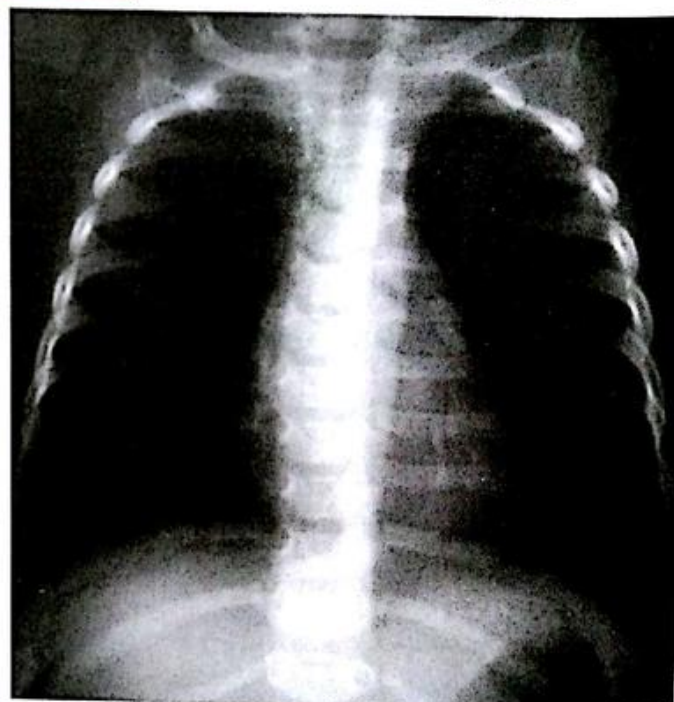
- Flaring of alae nasi, cyanosis (may be)
- Inspection
 - * Fast breathing
 - * Suprasternal recession
 - * Chest indrawing
 - * Hyper inflated chest
- Palpation: No characteristic finding
- Percussion note: Hyper resonant
- Auscultation: Breath sound is vesicular with prolong expiration, widespread rhonchi. Sometimes fine crepitations are present
- SpO₂ : Low

Diagnosis

Based on C/F & relevant investigations.

Investigations

- X-ray chest: The characteristic findings are-



Typical X-ray chest of bronchiolitis

- * Hypertranslucency *e.g. more blackish lung fields*
- * Hyperinflation *e.g. horizontal ribs, depression of domes of the diaphragm*
- CBC, CRP: Unremarkable

Treatment

Counsel the parents about the disease.

I. Mild cases

- Home care -
 - * Head up position
 - * Normal feeding
 - * Cleaning nose with normal saline drop
 - * Bathing with lukewarm water
 - * Advice when to return to hospital

II. Severe cases

- Hospitalization
- Humidified oxygen: The mainstay of treatment and to be continued until clinical improvement
- Nebulization with 7%, 3% Saline or 0.9% Saline. Efficacy of Salbutamol/Budesonide, Theophylline, Ipratropium bromide doubtful
- NPO and IV fluid in severe cases
- Monitoring, particularly SPO_2 by pulse oximeter
- CPAP/Ventilator support, when severe respiratory distress & falling SPO_2
- Supportive management: As in home care

Although having no conclusive benefits but other treatment options are -

- Steroids: Parenteral dexamethasone may be tried only in severe cases
- Antibiotics: No role in bronchiolitis (given only when secondary bacterial infection is suspected)

ASTHMA

It is a chronic inflammatory condition of respiratory tract presenting with features of reversible airflow limitation.

Actio-pathogenesis

Occurs among children with hyper-responsive airways following exposure to triggering factors

Common triggering factors

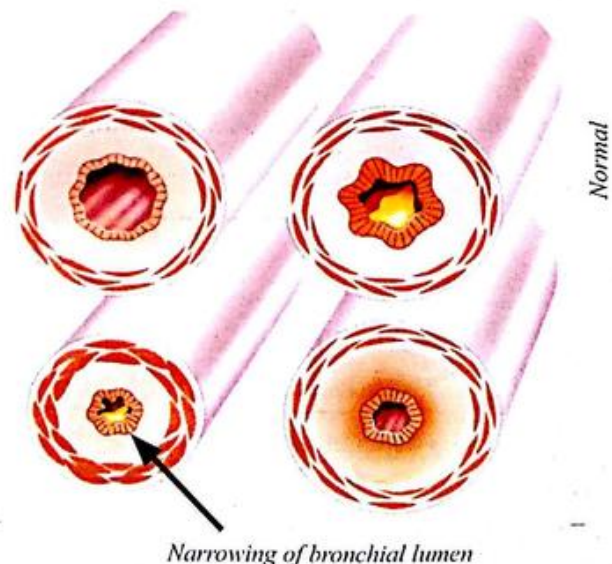
Pollens, dust, smoke, aerosol spray, viral catarrh, NSAID, foods, house dust, mites, cockroach and many others.

The Pathophysiological events are

- * Exaggerated spasm of bronchial smooth muscles
- * Vasodilation with increased permeability and swelling of wall of airway
- * Profuse mucous secretion
- * Vagal stimulation

The net pathological consequences are-

Recurrent AIRWAY	• Inflammation • Airflow obstruction/narrowing
------------------	---



Clinical Manifestations

The characteristic clinical features are -

Recurrent attacks of

- * Respiratory distress
- * Cough
- * Wheeze
- * Chest tightness (older children)

Sometimes **family history** of asthma or atopy may be present

- Low grade fever or no fever

Examination of Chest

- * Inspection: Hyperinflation of chest, suprasternal, subcostal & intercostal recession
- * Percussion: Hyper resonant
- * Auscultation: Vesicular breath sound with prolonged expiration, rhonchi
- **Associated allergic conditions** like allergic rhinitis, conjunctivitis and eczema may be present
- **Dramatic response** to rapidly acting bronchodilators and steroids

Classification & Types of Asthma

Asthma generally grouped into 3 types

- Intermittent asthma
 - Persistent asthma
 - Special variant asthma
- Any of these types may develop acute exacerbation*

Type	Daytime symptoms	Night symptoms	Spirometry FEV1
Intermittent	< 1 time/ week	≤ 2 times/ month	FEV1 at least 80% of predicted
Mild persistent	≥ 1 time/ week	> 2 times/ month	FEV1 at least 80% of predicted
Moderate persistent	Daily	1 time/ week	FEV1 at least 60-80% of predicted
Severe persistent	Continuous	Continuous	FEV1 60% of predicted or less

Special Variant Asthma

When asthma symptoms become cumbersome, following exposure to certain situations and based on these, asthma is grouped into

- * Seasonal asthma
- * Exercise induced asthma
- * Drug induced asthma
- * Cough variant asthma
- * Occupational asthma

Any of the above types may have an **acute exacerbation** and the patients may present with -

- * Severe respiratory distress
- * Widespread wheeze
- * Altered sensorium (agitated to drowsy)
- * Central cyanosis
- * Inability to drink or talk
- * Low oxygen saturation (<95%)
- * Low FEV1 (<60% in spirometry)

In extreme cases, patients may have **life threatening situations** like

- * Profound exhaustion
- * Silent chest
- * Bradycardia
- * Hypotension etc.

Diagnosis

Mainly clinical. Investigations have limited role.

Investigations

- Complete blood count: Eosinophilia
- Sputum examination: Eosinophilia
- Others: Bronchial reversibility test, spirometry etc. are less feasible for children

Differences between Acute Bronchiolitis, Pneumonia and Asthma

Parameters	Bronchiolitis	Pneumonia	Asthma
Age	<2 years; peak 2-6 mo	Any age	Usually after 2 year
Runny nose	Present	Usually absent	May be present
Wheeze	Present	Usually absent	Present
Tempera- ture	Low grade	Moderate to high	Usually absent
Crackles	+	+++	Absent
Rhonchi	+++	+	+++
Response to broncho- dilator	Variable	No	Good
WBC count	Normal	Neutrophilic leukocytosis	Normal, may have eosino- philia
X-ray chest	Hypertrans- lucency & Hyper- inflation	Consolida- tion or patchy opacities	Hyperinfla- tion

Treatment

Counseling parents and patients about the natural course of the disease.

A. Intermittent Asthma

Objective of treatment: To relieve the patients from respiratory distress *by rapidly acting bronchodilators like salbutamol*. Sometimes, additional support from steroid may be required depending on the severity.

Patients with intermittent asthma do not require any preventor drug.

- Mild cases: Salbutamol either MDI or oral at home
- Moderate cases: MDI salbutamol plus a short course of oral prednisolone (1-2 mg/kg/day) for 3-5 days at home
- Severe cases: May be life threatening and should be treated in the hospital as below -



Salbutamol nebulization (0.15-0.3 mg/kg/dose) every 20 minutes for 3 times or continuously. If nebulization is not available, then continuous inhalation of Salbutamol by MDI (inhaler) with spacer may be tried at home and on the way to hospital

- * Propped up position/head up position
- * Oxygen inhalation 4-6 liter/min through O₂ hood/head box
- * Inj Hydrocortisone 3-4 mg/kg/dose 4-6 hourly or Prednisolone 2 mg/kg/day for 3-5 days, or as necessary
- * If condition does not improve, Nebulized Ipratropium bromide may be added
- * If condition still shows no improvement, Inj. Aminophylline may be tried
- * If still no improvement, Nebulization with Adrenaline, MgSO₄
- * In refractory cases, Mechanical ventilation and PICU support

B. Persistent Asthma (PA)

Objective of management

To bring asthma symptoms under long term satisfactory control.

To do that, children and their parents require -

- Counseling (asthma education)

- Regular use of preventor drugs

- * Inhaled corticosteroids *e.g. Beclomethasone, Fluticasone, Budesonide etc.*

- * Cromones *e.g. Sodium cromoglycate, Nedocromil sodium*

- * Leukotriene antagonists *e.g.*

- Montelukast*

- * Long acting β_2 agonist *e.g. Salmeterol*



Child using inhaler through spacer

- Regular Monitoring of lung function: By peak flow meter
- Maintain asthma diary
- Avoid triggering factors as far as possible
- Treatment of acute exacerbations



Child using peak flow meter

The mainstay of treatment of persistent asthma (PA) is **inhaled corticosteroid (ICS)**. The total daily dose of ICS (according to severity of PA) has to be given in 2 divided doses, 12 hourly, preferably using a spacer.

The management protocol is followed stepwise as given below. The steps may be graded up or down based on control of patients' symptom.

A. Step Care management of asthma in children, age < 5 years

Steps		Severity	Recommended treatment	Alternative options of treatment	
IV	STEP UP ↑	Severe persistent	Continue controller and refer for specialist assessment	Add Montelukast/Theophylline/ LD OCS Add Intermittent ICS Increase dose & frequency of ICS	+ Step 1
III	TREATMENT STEPS ↓	Moderate persistent	MD ICS	LD ICS + Daily Montelukast	+ Step 1
II	STEP DOWN	Mild persistent	LD ICS	Montelukast/Episodic ICS	+ Step 1
I	Intermittent: Short acting β_2 -agonist (Salbutamol), 100-200 μ gm as and when required. 1-2 puffs up to 4-6 times daily. Additional 1-2 puffs prior to exercise, sports or exposure to triggers are advised.				

B. Step Care management of asthma in children, age 6 – 12 years

Steps		Severity	Recommended treatment	Alternative options	
V	STEP UP ↑	Severe persistent	Refer for add on treatment <i>e.g. anti Ig E</i>	Add low dose OCS	+ Step 1
IV			MD/HD ICS+ LABA	Montelukast &/or SR Theophylline	
III	TREATMENT STEPS ↓	Moderate persistent	LD ICS+LABA	MD/HD ICS or LD ICS + Montelukast or LD ICS + SR theophylline	
II		Mild persistent	LD ICS	Montelukast	
I	Intermittent: Short acting β_2 -agonist (Salbutamol), 100-200 μgm as and when required. 1-2 puffs up to 4-6 times daily. Additional 1-2 puffs prior to exercise, sports or exposure to triggers are advised.				+ Step 1

LABA: Long acting β_2 -agonist, OCS: Oral corticosteroid, SR: Sustained Release

Dose of inhaled Beclomethasone

LD: Low dose (100-200 μgm), MD: Medium Dose (200-400 μgm), HD: High Dose (>400 μgm)

Asthma education and environmental control

Source: GINA 2015

CONDITIONS PRESENTING WITH STRIDOR

Stridor is a harsh noise produced during inspiration, which is due to narrowing of the air passage of the oropharynx, subglottis or trachea. If the obstruction is severe enough, stridor may also occur during expiration.



Upper respiratory tract

Source: internet

When a child presents with cough, respiratory distress and stridor the following diseases should be taken into consideration.

- * Acute laryngotracheobronchitis (Croup)
- * Acute epiglottitis
- * Laryngomalacia
- * Foreign body aspiration
- * Retropharyngeal abscess
- * Laryngeal diphtheria
- * Bacterial tracheitis
- * Angioneurotic oedema of the upper respiratory tract

In this section acute laryngotracheobronchitis (Croup), laryngomalacia and acute epiglottitis will be discussed.

ACUTE LARYNGOTRACHEOBRONCHITIS (CROUP)

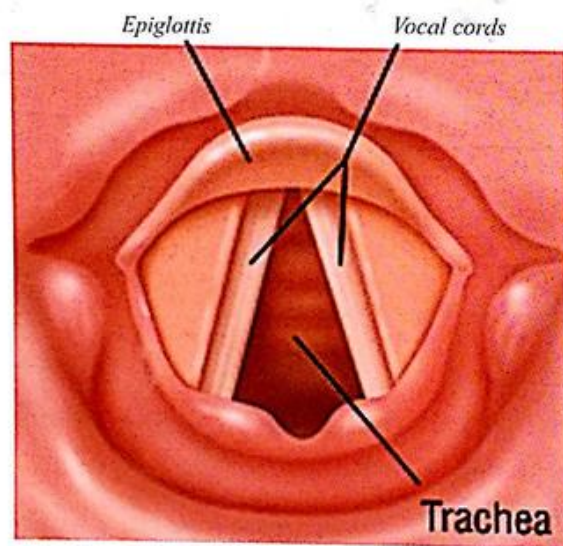
Croup is a viral inflammation of the upper airway. Children between 6 months and 3 years suffer more. It occurs mostly during early winter or late fall.

Aetiology

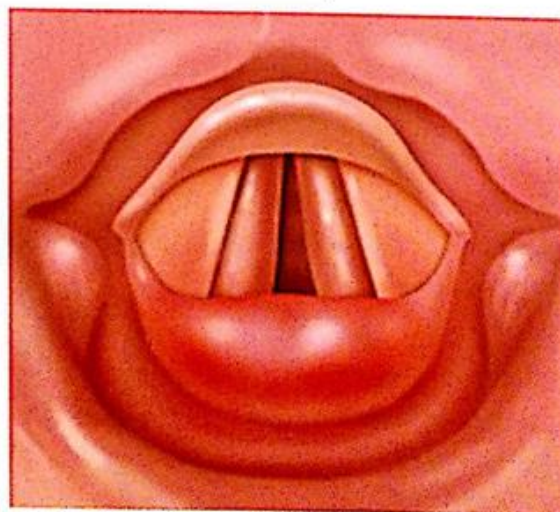
- Virus: Para influenza types 1 & 2 in most cases. Others are Influenza A & B, Adenovirus, RSV, Metapneumovirus
- Mycoplasma (rare)

Pathogenesis

In croup, tracheal wall becomes oedematous with profuse mucous secretion. This causes narrowing of the airway.



Normal larynx



Inflamed larynx

Source: Internet

Depending on the extent of inflammation, the clinical severity may be mild, moderate and severe. Sometimes patients may develop respiratory failure.

Cardinal features: Sudden onset of -

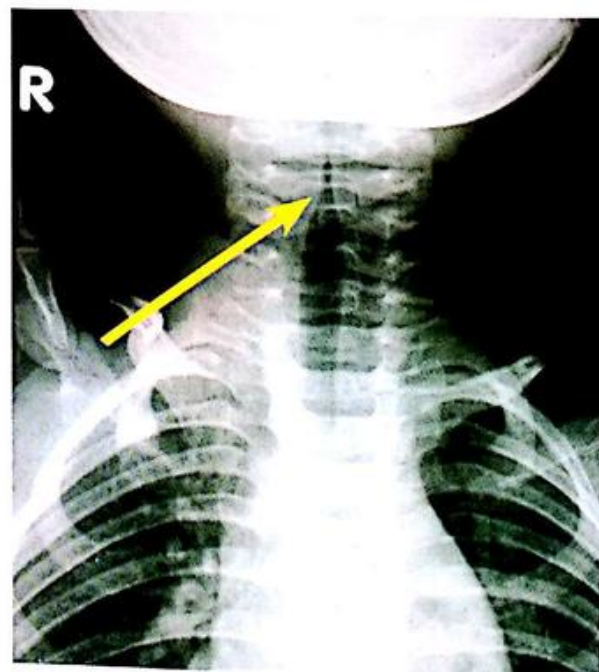
- * Characteristic barking cough
- * Inspiratory stridor
- * Hoarseness of voice
- * Respiratory distress
- * Suprasternal recession
- * Cyanosis (may be)

Diagnosis

Based on C/F and relevant investigations.

Investigations

- X-ray Neck: Steeple sign (Narrowing of air column) at trachea is characteristic
- CBC: Insignificant



X-ray neck showing narrow air column

Treatment

Mainly supportive

- Keep the child as comfortable as possible, allowing the patient to remain in parent's lap

- Avoid unnecessary painful interventions that may cause agitation and increased oxygen requirements by the child
- Oxygen inhalation by nasal cannula (2 L/min) or by face mask (3-5 L/min)
- Steroid: It reduces subglottic oedema and significant relief is obtained by 6 hours of administration. Single dose of either -
 - * Dexamethasone: 0.6 mg/kg or
 - * Prednisolone: 1 mg/kg or
 - * Nebulized Budesonide: 2 mg
- Adrenaline (1:1000): 4-5 ml of undiluted Adrenaline is given through nebulizer. Where possible, oxygen driven nebulization is preferable
- Antibiotic: Not indicated unless there is possibility of secondary bacterial infections
- Inhalation of mist (steam) or humidified air have failed to show any effectiveness
- Use of antitussive and decongestants are ineffective and not indicated
- Tracheostomy in refractory cases

ACUTE EPIGLOTTITIS

An acute inflammation of epiglottitis

Organism: *H. influenzae type b*

Clinical Manifestations

An otherwise healthy child suddenly develops

- High fever, toxic look
- Sore throat, drooling
- Dyspnoea and stridor
- Cyanosis may be present
- Rapidly progressing respiratory obstruction & within the hour, the affected child faces
 - * Swallowing difficulty
 - * Laboured breathing
- The affected child adopt tripod position (sitting upright & leaning forward with chin up and mouth open bracing on the arms)
- Neck found hyperextended

Throat examination hazardous. If examination is obligatory, then to be done cautiously with emergency preparation.

Diagnosis

Based on C/F & relevant investigations.

Investigation

- X-ray neck (lateral view) **thumb sign**
- Laryngoscopy - large "cherry red" swollen epiglottis



X-ray neck showing 'thumb sign'

Treatment

- Propped up position
- O₂ inhalation
- Antibiotics: Ceftriaxone/Cefotaxime 7-10 days
- Intubation may be required

Difference between Acute Epiglottitis and Croup

Parameters	Epiglottitis	Croup
Aetiology	Bacterial	Viral
Fever	High grade	Low grade
Drooling	Present	Absent
X ray neck	Thumb sign	Steeple sign
Treatment	Antibiotic (Ceftriaxone)	Steroid & Adrenaline nebulization

LARYNGOMALACIA

Another cause of stridor in children and is due to collapse of supraglottic structure during inspiration. Collapse may also occurs due to floppy arytenoid cartilage of larynx or floppy epiglottis.

Symptoms usually appear within first 2 weeks of life and may remain for a variable period.

Clinical Manifestations

Inspiratory stridor aggravated by any exertion *e.g. crying, agitation, feeding and when lies on his back*. Stridor decrease on prone or lateral position.

Sometimes, dyspnea, chest retraction, feeding difficulties-regurgitation, choking on feeding

Diagnosis

Based on C/F and relevant investigations *e.g. flexible laryngoscopy*

Treatment

- Counsel parents that it will resolve spontaneously within 18/24 months of age
- Show how to feed the child (Slow and careful feeding)
- Surgery *e.g. tracheostomy, endoscopic supraglottoplasty* in severe obstruction

References

1. UNICEF/WHO, Pneumonia: The forgotten killer of children; 2006.
2. World Health Organization. Pocket book of Hospital Care for Children, Guidelines for the Management of Common Illnesses with Limited Resources; 2013.
3. National guidelines for asthma, bronchiolitis and COPD. Asthma Association of Bangladesh, 3rd ed; 2005:137-43.
4. Kabir ARML, Mollah MAH et al. Management of bronchiolitis without antibiotics: a multi centre randomized control trial in Bangladesh. *Acta Paediatrica*, 2009; 98: 1593-1599.
5. Robert E Black et al, Global, regional, and national causes of child mortality in 2008: a systematic analysis; *Lancet* 2010; 375: 1969-87.
6. Bjornson C et al. Nebulized epinephrine for croup in children. *Cochrane Database of Systematic Reviews* 2011, Issue 2. Art. No.: CD006619.
7. Russell KF et al. Glucocorticoids for croup. *Cochrane Database of Systematic Reviews* 2011, Issue 1. Art. No.: CD 001955.
8. Mazza D et al. Evidence based guidelines for the management of croup, 2008; 37(5):14-20.
9. Cherry JD. Croup. *N Eng J*, 2008; 358(4): 384-91.
10. Everad ML. Acute bronchiolitis and croup. *Ped Clin North Am*, 2009; 56(1): 119-33.
11. Jacobs JD, Foster M, Wan J, Pershad J. 7% Hypertonic saline in acute bronchiolitis: a randomized controlled trial. *Pediatrics*. 2014;133(1).
12. Wu S, Baker C, Lang ME, et al. Nebulized hypertonic saline for bronchiolitis: a randomized clinical trial. *JAMA Pediatr*. 2014; 168(7):657-663
13. Florin TA, Shaw KN, Kittick M, Yakscoe S, Zorc JJ. Nebulized hypertonic saline for bronchiolitis in the emergency department: a randomized clinical trial. *JAMA Pediatr*. 2014;168 (7): 664-670.

SELF ASSESSMENT

Short answer questions [SAQ]

1. What are the organisms responsible for pneumonia in under 5 year old children?
2. What antibiotic will you administer or prescribe to a 3 year old child suffering from severe pneumonia and how long?

3. Write down the five signs of severe acute exacerbation of asthma.
4. What is the doses of nebulized Salbutamol in acute exacerbation of bronchial asthma?
5. Write down the definition of chest indrawing, stridor and grunting.
6. What are the signs of respiratory distress in children?
7. Write down the difference between bronchiolitis & pneumonia.
8. A 2 year old girl presented with high fever, cough and respiratory distress for 2 days. On examination you noted fast breathing, chest indrawing and coarse crepitations in both lung fields.
 - a) What is the probable diagnosis?
 - b) Write down the relevant investigations and treatment of this child.
9. A 5 year old boy had history of recurrent wheeze. From early morning he developed severe respiratory distress and wheeze. How will you assess the case clinically? Please write down the steps of management.
10. Write short note on: a) Croup

Multiple choice questions [MCQ]

1. Conditions can give rise to stridor are-

☐ a) acute laryngotracheobronchitis	☐ b) acute bronchiolitis	☐ c) diphtheria
☐ d) pneumonia	☐ e) acute epiglottitis	
2. The cardinal physical findings of consolidation are-

☐ a) shifting of trachea	☐ b) prominent vocal resonance	☐ c) coarse crepitations
☐ d) dullness on percussion	☐ e) vesicular breath sounds with prolonged expiration	
3. The characteristic radiologic features of acute bronchiolitis are-

☐ a) hypertranslucency	☐ b) horizontal ribs	☐ c) cardiomegaly
☐ d) shifting of trachea	☐ e) depression of domes of diaphragm	
4. The following drugs are recommended for treatment of acute severe asthma-

☐ a) salbutamol	☐ b) prednisolone	☐ c) ipratropium bromide
☐ d) fluticasone	☐ e) beclomethasone	
5. A 2 years old boy with cough and difficult breathing will be classified as pneumonia if the following are present-

☐ a) grunting	☐ b) chest indrawing	☐ c) barking cough
☐ d) stridor	☐ e) respiratory rate 52/min	
6. Vesicular breath sound with prolong expiration is noted in-

☐ a) pneumonia	☐ b) bronchiolitis	☐ c) croup
☐ d) asthma	☐ e) pneumothorax	
7. Common radiological features of acute bronchiolitis include

☐ a) cardiomegaly	☐ b) shifting of trachea	☐ c) hyper translucency
☐ d) overcrowding of ribs	☐ e) low flat diaphragm	
8. The most common organism responsible for pneumonia in between 1-12 months are

☐ a) <i>S. pneumoniae</i>	☐ b) <i>H. influenzae</i>	☐ c) <i>C. pneumoniae</i>
☐ d) RSV	☐ e) <i>S. aureus</i>	
9. The cardinal features of croup are -

☐ a) stridor	☐ b) thumb sign	☐ c) drooling
☐ d) Steeple sign	☐ e) high fever	
10. The following drugs are used in persistent asthma

☐ a) Beclomethasone	☐ b) Salbutamol	☐ c) Salmeterol
☐ d) Montelukast	☐ e) Nedocromil Sodium	

CHAPTER 11

DIARRHOEA

ACUTE DIARRHOEA	104
PERSISTENT DIARRHOEA	105
DYSENTERY	105

Diarrhoea is one of the important cause of deaths in children under 5 years of age. Each year about 10% under 5 children die from diarrhoea.

WHO defined diarrhoea as the frequent passage of loose stools.

Pathological Consequences

During diarrhoea, 3 important clinico-pathological consequences occur. These are

- * **Increased loss of water and electrolytes** (sodium, potassium and bicarbonate) in the liquid stools. This may lead to dehydration and dyselectrolytaemia
- * **Loss of greater quantity of zinc** in the loose stool which delays recovery of patients from the disease and make the child vulnerable to suffer afterwards
- * **Weight loss** due to decreased intake of food, decreased nutrient absorption and increased nutrient requirements

Types

- Acute watery diarrhoea
- Persistent diarrhoea
- Dysentery

ACUTE DIARRHOEA

When diarrhoea persists <14 days. Patient passes loose watery stool several times (≥ 3 times) daily that do not contain blood. Sometimes, patients may have associated vomiting and low-grade fever.

Common organisms: *Rota virus*, *V. cholera 01*, *0139*, *Enterotoxigenic E.coli*, *Enteropathogenic*

E. coli, *Enteroadherent E.coli*, *Campylobacter jejuni*, *Cryptosporidium*.

Clinical assessment

History

- Stools (frequency, duration of diarrhoea, and presence of blood etc.)
- Vomiting, attacks of crying with pallor
- Fever
- History of last urine output and amount
- History about foods and fluid intake
- History related to use of recent antibiotic or other drugs
- H/O diarrhoea or diarrhoeal deaths in the family or neighbourhood

Physical examination: in particular to look for-

- Signs of dehydration
- Abdominal distension
- Signs of severe malnutrition

Signs of Dehydration & its Classification

- If ≥ 2 of the following signs are present -

- * Lethargy/unconscious
- * Sunken eyes
- * Unable to drink or drinks poorly
- * Skin pinch goes back very slowly (≥ 2 sec)

Then the child will be classified as Severe dehydration and will be managed as Plan C.



Unconsciousness & sunken eyes of a severely dehydrated child



Skin pinch goes back very slowly

- If ≥ 2 of the following signs are present -

- Restless, irritable
- Drinks eagerly, thirsty
- Sunken eyes
- Skin pinch goes back slowly



Irritable child



Sunken eye

Then the child will be classified as some dehydration and will be managed as plan B.

If the child has not enough signs to classify some or severe dehydration, he will be classified as no dehydration and will be managed as plan A.

PERSISTENT DIARRHOEA

Diarrhoea that begins acutely and lasts for ≥ 14 days. It is of 2 types -

- Severe persistent diarrhoea: When associated with signs of dehydration. It usually requires hospitalization
- Non-severe persistent diarrhoea: Not associated with dehydration. It can be managed at home with special diets and extra fluids

Clinical assessment

- Assessment like that of acute diarrhoea
- Evidence of dehydration
- Evidence of any non-intestinal infections *e.g. pneumonia, sepsis, UTI, oral thrush etc.*
- Associated malnutrition

DYSENTERY

Passage of frequent loose stools containing blood. In addition patients may have fever, abdominal cramps, tenesmus and pallor

Organisms

Shigella spp., Salmonella spp., Enteroinvasive E.Coli, Enterohaemorrhagic E.Coli, Campylobacter spp.

Complications

- * Electrolyte imbalance *e.g. hypokalaemia, metabolic acidosis, hyponatraemia*
 - * Paralytic ileus
 - * Acute renal failure
 - * Growth failure/Malnutrition
 - * Guillain-Barré Syndrome from *C. Jejuni*
- In addition, dysentery can lead to -
- * Rectal prolapse
 - * Convulsions
 - * Haemolytic uraemic syndrome (HUS)

Diagnosis

Based on the C/F and relevant investigations.

Investigations

<u>Stool for R/M/E</u>	To look for RBC, pus cells & macrophage
Stool for C/S	To identify the organism and drug sensitivity
Blood for Hb, TC, DC, PBF	To assess anaemia, neutrophilic leukocytosis
Serum Electrolytes	Hypokalaemia, Hyponatraemia
<u>Arterial blood gas (ABG)</u>	Metabolic acidosis
To evaluate complications <i>e.g. S. creatinine</i>	May be raised in acute renal failure/HUS

Treatment

The essential elements of treatment are-

- * Rehydration
- * Continued feeding
- * Zinc supplementation

A. Rehydration

Signs	Classification	Treatment															
Plan C																	
≥ 2 of the following signs * Lethargy/ unconsciousness * Sunken eyes * Unable to drink or drinks poorly * Skin pinch goes back very slowly (≥ 2 sec)	Severe dehydration	* <u>Choice of fluid: Cholera saline, Ringer's lactate.</u> If not available: DNS or Normal Saline <u>Never use - 5% Dextrose in Aqua (DA)</u> * Amount of fluid: 100 ml/kg * Route of rehydration: Intravenous <i>Duration of rehydration as per age of the child</i> <table><tr><th>Age of the child</th><th>First, give 30 ml/kg over</th><th>Then, give 70 ml/kg over</th></tr><tr><td>< 12 months</td><td>1 hour</td><td>5 hours</td></tr><tr><td>≥ 12 months</td><td>$\frac{1}{2}$ hour</td><td>2 $\frac{1}{2}$ hours</td></tr></table> <u>During rehydration, foods other than breast milk should be withheld</u>	Age of the child	First, give 30 ml/kg over	Then, give 70 ml/kg over	< 12 months	1 hour	5 hours	≥ 12 months	$\frac{1}{2}$ hour	2 $\frac{1}{2}$ hours						
Age of the child	First, give 30 ml/kg over	Then, give 70 ml/kg over															
< 12 months	1 hour	5 hours															
≥ 12 months	$\frac{1}{2}$ hour	2 $\frac{1}{2}$ hours															
Monitoring Reassess the child every 15-30 minutes until a <u>strong radial pulse is present</u> . When full amount of IV fluid has been given, reassess the child's hydration status fully and decide accordingly – • If signs of severe dehydration still present: Repeat IV fluid as outlined in Plan C • If signs of some dehydration: Discontinue IV fluid and give ORS for 4 hours as in Plan B • If no signs of dehydration: Advise mother to give ORS after each loose stool as in Plan A																	
Plan B																	
≥ 2 of the following signs - * Restless, irritable * Sunken eyes * Drinks eagerly, thirsty * Skin pinch goes back slowly	Some dehydration	* Choice of fluid: Oral rehydration solution * Amount of fluid: 75 ml/kg * Route of rehydration: Oral <i>Duration of rehydration: 4 hours</i> ORS may be given as follows- <table><tr><th>Age</th><th>Up to 4 mo</th><th>4 -12 mo</th><th>12 mo up to 2 yrs</th><th>2 yrs upto 5 yrs</th></tr><tr><td>Wt</td><td>< 6 kg</td><td>6-<10 kg</td><td>10-<12 kg</td><td>12-19 kg</td></tr><tr><td>ml</td><td>200-400</td><td>400-700</td><td>700-900</td><td>900-1400</td></tr></table> <i>During rehydration, foods other than breast milk should be withheld</i>	Age	Up to 4 mo	4 -12 mo	12 mo up to 2 yrs	2 yrs upto 5 yrs	Wt	< 6 kg	6-<10 kg	10-<12 kg	12-19 kg	ml	200-400	400-700	700-900	900-1400
Age	Up to 4 mo	4 -12 mo	12 mo up to 2 yrs	2 yrs upto 5 yrs													
Wt	< 6 kg	6-<10 kg	10-<12 kg	12-19 kg													
ml	200-400	400-700	700-900	900-1400													
Monitoring * Reassess child's hydration status after 4 hours of oral rehydration and decide accordingly – * If no signs of dehydration: Advise mother to give ORS after each loose stool as in Plan A * If signs of some dehydration: Rehydrate with ORS for another 4 hours as in Plan B * If signs of severe dehydration present: Rehydrate with IV fluid as in Plan C																	
Plan A																	
Not enough signs to classify as some or severe dehydration	No dehydration	• <u>Choice of fluid :</u> * Oral rehydration solution * Others - <u>chira pani, cooked rice water, yogurt</u> <i>Amount of fluid after each stool</i> * Less than 2 years: 50-100 ml * 2 years and above: 100-200 ml <i>Avoid - very sweet tea, soft drinks, & sweetened fruit drinks</i>															

After rehydration, advice mother -

- To continue home treatment
- To continue feeding at home
- Come for routine follow up in 5 days and

When to return immediately

If baby

- * Drinks poorly or unable to drink or breastfeed
- * Becomes sicker
- * Develops fever, or
- * Blood appears in stool

B. Zinc supplementation

Age	Dose	Duration
< 6 months	10 mg/day	10-14 days
≥ 6 months	20 mg/day	10-14 days

C. Continue Feeding

Age	Foods
< 6 Months	Breast feeding
> 6 Months	Breast feeding + freshly prepared energy dense complementary foods like khichuri, mashed banana, fresh fruit juice etc.

The child should be encouraged to eat at least 6 times a day. The same food should be continued with an extra meal a day for 2 weeks after cessation of diarrhoea.

Treatment of Severe Persistent Diarrhoea

Children with severe persistent diarrhoea should be managed at hospital. Treatment includes -

A. Rehydration: Plan B or C (See page 106)

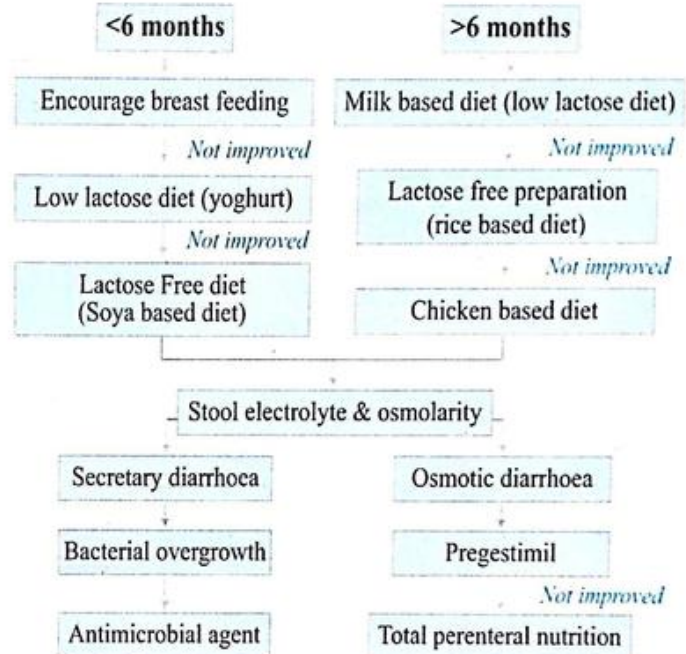
B. Feeding

Recommended special diets -

- * Low lactose diet: Made from full fat milk, rice, vegetable oil, cane sugar and water

- * Lactose free diet: Made from whole egg/ cooked chicken, rice, vegetable oil, glucose and water

Dietary manipulation (According to age)



C. Micronutrients & Vitamin Supplementations

Folate, Zinc, Vitamin A, Iron, Copper, Magnesium.

D. Antimicrobial therapy

- * Cholera
 - Tetracycline (12.5 mg/kg 6 hourly for 3 days)
 - Doxycycline (2-5 mg/kg/day 12 hourly for 3 days)
 - Cotrimoxazole (TMP 10 mg/kg/day 12 hourly for 3 days)
- * Amoebiasis /giardiasis: Metronidazole (35-50 mg/kg/day 8 hourly -10 days)
- * Shigella: Ciprofloxacin, Pivmecillinam and Nalidixic acid (dose given below)

E. Treatment of non-intestinal infection

e.g. pneumonia, sepsis, UTI, oral thrush, otitis media, if any.

Treatment of Dysentery

- Antibiotics:
 - * Ciprofloxacin (20 mg/kg/day 12 hourly for 5 days)
 - * Pivmecillinam (40 mg/kg/day 6-8 hourly for 5 days)
 - * Nalidixic acid (50 mg/kg/day 6 hourly for 5 days)
- Diet: Usual family diet.
- Rehydration: Plan A, B or C
- Zinc supplementation as outlined before
- Others like Paracetamol for fever etc.

References

1. World Health Organization. Pocket book of Hospital Care for Children, Guidelines for the Management of Common Illnesses with Limited Resources; 2013.
2. Baqui AH et al. Effect of zinc supplementation started during diarrhea on morbidity and mortality in Bangladeshi children: community randomized trial. *BMJ* 2002; 325(7372): 1059.
3. Roy SK et al. Zinc supplementation in the management of shigellosis in malnourished children in Bangladesh. *European journal of Clinical Nutrition* 2008; 62: 849-55.
4. Roy SK et al. Zinc supplementation in children with cholera in Bangladesh: randomized controlled trial. *British Medical Journal* 2007 :1-6.
5. Khan MR, Rahman ME. *Essence of Pediatrics*. 4th ed. New Delhi: Elsevier; 2011. Chapter 8, Diseases of Gastrointestinal System; p. 130-151.
6. Kabir ARML. *Pediatric Practice on Parents Presentation*, 1st ed. Dhaka: Asian Colour Printing; 2011.

SELF ASSESSMENT

Short answer questions [SAQ]

1. Define & classify diarrhoea. What parameters you look to assess dehydration?
2. What are the pathological consequences of diarrhoea?
3. What complication may develop if a severely dehydrated child is not adequately rehydrated?
3. i) Define Persistent diarrhoea & Severe persistent diarrhoea.
ii) What amount of fluid you should give in first hour to a child weighing 15 kg suffering from severe dehydration?

- iii) What advice you will give to mother of child suffering from diarrhoea with no dehydration?
4. A 12 months old child weighing 10 kg admitted in a hospital with frequent loose motions & persistent vomiting for last three days.
- a) How will you assess his state of dehydration according to IMCI?
- b) How will you rehydrate the child if he is severely dehydrated?

Multiple choice questions [MCQ]

- A child is said to suffer from severe dehydration if he has –

☐ a) lethargy	☐ b) sunken eyes	☐ c) increased thirst
☐ d) slow return of skin pinch	☐ e) depressed anterior fontanelle	
- Organisms responsible for acute dysentery are –

☐ a) <i>C. jejuni</i>	☐ b) <i>V. cholera</i>	☐ c) <i>S. typhi</i>
☐ d) <i>S. dysentery</i>	☐ e) <i>E. coli</i>	
- Electrolyte abnormalities commonly found in acute diarrhoea are-

☐ a) hypocalcaemia	☐ b) hypokalaemia	☐ c) metabolic acidosis
☐ d) hyponatraemia	☐ e) hypomagnesaemia	
- In plan A for the management of acute watery diarrhoea with no dehydration the following fluid should be used –

☐ a) ORS	☐ b) soft drinks	☐ c) cooked rice water
☐ d) chira pani	☐ e) sweetened fruit juice	
- The IV fluids recommended for rehydration in severe dehydration are-

☐ a) Cholera saline	☐ b) Ringer's lactate	☐ c) 5% dextrose in normal saline
☐ d) Normal saline	☐ e) Dextrose in aqua	
- A 2 years old boy weighing 10 Kg is brought to you with H/O loose motion for last 2 days. If the child is not managed properly, the following immediate complications may develop-

☐ a) acute renal failure	☐ b) hypovolaemic shock	☐ c) pneumonia
☐ d) jaundice	☐ e) malnutrition	
- Complications that may arise from acute dysentery are-

☐ a) rectal prolapse	☐ b) haemolytic uraemic syndrome	☐ c) hypokalaemia
☐ d) shock	☐ e) malnutrition	
- The pathophysiological consequences of acute diarrhoea are-

☐ a) loss of Na^+	☐ b) loss of Zn^{++}	☐ c) loss of HCO_3^-
☐ d) loss of Mg^{++}	☐ e) loss of Ca^{++}	
- Antibiotics effective against the organisms responsible for acute dysentery are-

☐ a) Ciprofloxacin	☐ b) Amoxicillin	☐ c) Pivmecillinam
☐ d) Erythromycin	☐ e) Ampicillin	
- Causes of vomiting in a neonate-

☐ a) congenital adrenal hyperplasia	☐ b) oesophageal atresia	☐ c) duodenal atresia
☐ d) infantile HPS	☐ e) congenital malrotation of gut	

VOMITING

VOMITING

110

Whenever a child presents with vomiting, one should consider the probable cause is in gastrointestinal and hepatobiliary system like -

- Acute gastritis/
Gastroenteritis
- Acute hepatitis
- Acute appendicitis
- Acute pancreatitis
- Food poisoning
- Intestinal
obstruction
- Acute cholecystitis, etc.



Apart from GI tract disorders, other causes of vomiting are -

- Acute tonsillitis
- Renal problems *e.g. pyelonephritis, chronic kidney disease, acute kidney failure*
- CNS diseases *e.g. meningitis, brain tumor, hydrocephalus*
- Metabolic *e.g. diabetic ketoacidosis*
- Cyclic vomiting syndrome
- Inborn errors of metabolism

However, the cause of vomiting in neonates are different and these are-

- * Duodenal atresia
- * Infantile hypertrophic pyloric stenosis
- * Intestinal obstruction
- * Congenital malrotation of gut
- * Congenital adrenal hyperplasia

Patho-physiological consequences

a) Metabolic

- * Fluid loss *e.g. dehydration, shock*
- * HCl loss in vomitus *e.g. alkalosis, hypochloraemia*
- * Na, K loss in vomitus *e.g. hyponatraemia, hypokalaemia*

b) Nutritional

- * Failure to thrive due to loss of calories and nutrients

c) Others

- * Oesophagitis due to exposure of lower end of esophagus to acid
- * Pneumonia due to aspiration of vomitus
- * Mallory-Weiss tear at lesser curve of gastroesophageal junction due to forceful vomiting

Approach to a patients with vomiting

Relevant History

- Frequency of vomiting
- Amount of vomitus
- Colour & content *e.g. blood in vomitus*
- Associated loose motion or absolute constipation
- Abdominal pain and site of pain
- Urine output, *e.g. colour, amount and when last urine passed*
- Headache/vertigo/convulsion/vision
- Fever present or not
- Pain in ear or sore throat present or not

Clinical Assessment

- State of consciousness *e.g. alert, drowsy*
- State of hydration *e.g. general condition, sunken eyes, skin pinch, thirst*

- Haemodynamic status *e.g. pulse, BP, pulse pressure, capillary refill time (CRT)*
- Any features suggesting underlying pathology *e.g. abdominal distension, tenderness & absent bowel sounds, body temperature, jaundice, neck rigidity, convulsion, pupils, tonsillitis/ulceration*

D/D based on characteristics of vomitus

Materials	Sources	Diagnoses
Undigested food particles	Oesophageal	Oesophageal stricture, achalasia
Bile: green/yellow	Post-ampullary (distal to ampulla of Vater)	Small bowel obstruction <i>e.g. malrotation</i> , Prolonged vomiting of any cause
Digested food, milk curds	Stomach proximal to pylorus	Pyloric stenosis
Blood: red (fresh blood) or brown (old blood)	Lesion above ligament of Treitz: Stomach, oesophagus	Gastritis, oesophagitis, bleeding diathesis
Clear large volume	Increased gastric secretions	Peritonitis, Zollinger-Ellison syndrome
Malodorous/feculent	Distal or Colonic obstruction	Malrotation, appendicitis, stasis syndrome
Mucus	Respiratory mucus, gastric	URI, sinusitis, eosinophilic oesophagitis

Investigations

- S. electrolytes, arterial blood gas (ABG)
- S. bilirubin, SGPT, Alk. phosphatase
- S. amylase, lipase
- S. creatinine
- Complete blood count, Peripheral blood film
- Urine R/M/E
- Random blood glucose
- S. ketone bodies
- Radiology
 - * X-ray abdomen in erect posture
 - * USG of abdomen
 - * Contrast X-ray of upper GI
 - * CT scan of abdomen/brain
- Metabolic screening (should be done during acute episode only) *e.g. blood pH, ammonia, lactate, ketones, urine ketones and electrolytes, porphyrins and reducing substances*

Red flag signs

- Altered sensorium (cause or effect)
- Toxic/septic/apprehensive look
- Bilious or bloody vomiting
- Presence of inconsolable cry or excessive irritability (meningitis, intussusception)
- Signs of severe dehydration
- Bent-over posture (*drawing of legs up to the chest*), and avoidance of unnecessary movement typical of peritoneal irritation (*peritonitis, intussusception*)

Management

- Fluid Replacement according to diarrhoea *as mentioned in page 106*
- Antiemetic *e.g. Domperidone, Ondansetron, Granisetron, Metoclopramide*
 - * Ondansetron, dose (0.2 mg/kg, oral and 0.15 mg/kg parenteral; maximum 4 mg.
- Treatment of underlying cause

References

1. Kliegman RM, Stanton BF, Geme III JWS, Schor NF, Behrman RE. Editors. Nelson Textbook of Pediatrics, 20th Edition. New Delhi: Elsevier; 2016
2. Moreno-Villares JM, Isabel Polanco I. An Atlas of Investigation and Management Paediatric Gastroenterology. Oxford: Atlas Medical Publishing Ltd; 2009.
3. Kabir ARML. Pediatric Practice on Parents Presentation, 1st ed. Dhaka: Asian Colour Printing; 2011.
4. Fedorowicz Z et al. Antiemetics for reducing vomiting related to acute gastroenteritis in children and adolescents. Cochrane Database of Systematic Reviews 2011, Issue 9. Art.No.: CD005506. DOI: 10.1002/14651858.CD005506.pub5.
5. Marchetti et al. Oral ondansetron versus domperidone for symptomatic treatment of vomiting during acute gastroenteritis in children: multicentre randomized controlled trial. BMC Pediatrics 2011 11:15.
6. Katie Allen. The vomiting child: What to do and when to consult. Australian Family Physician 2007 September; 36 (9): 684-7.
7. Singhi SC. et al, Management of a Child with Vomiting, Indian J Pediatr (April 2013) 80(4):318–325.

SELF ASSESSMENT

Short answer question [SAQ]

1. Write down 5 important causes of vomiting.
2. What investigations will you plan to send for a child with severe vomiting ?
3. Name 5 common anti-emetics.

Multiple choice questions [MCQ]

1. Fluid recommended for rehydration in a child with vomiting includes
☐ a) 10% dextrose in aqua ☐ b) 5% dextrose in 0.45% NaCl ☐ c) ORS
☐ d) 5% dextrose in 0.225% NaCl ☐ e) water
2. The following condition commonly cause vomiting in neonates -
☐ a) duodenal atresia ☐ b) congenital adrenal hyperplasia ☐ c) acute appendicitis
☐ d) meningitis ☐ e) brain tumor
3. The following are the red flag sign of vomiting
☐ a) blood in vomitus ☐ b) bile with vomitus ☐ c) shunken eyes
☐ d) CRT < 2 sec ☐ e) altered sensorium

ABDOMINAL PAIN

ABDOMINAL PAIN

113

Pain in abdomen is a frequent complaints of children. This pain may be acute or chronic and recurrent in nature. Most of the causes of acute abdominal pain are surgical and medical disorders contribute only about 10% of cases. On the other hand, **recurrent abdominal pain** (at least one episode of abdominal pain for consecutive 3 months severe enough to interfere with routine functioning) is amongst the most common complaint presented by school children. These are mostly functional and organic disorders involve only a small proportion of children.

The common differential diagnosis of acute and recurrent abdominal pain are given below -

Acute abdominal pain	Recurrent abdominal pain
• Acute appendicitis • Intussusception • Intestinal obstruction • Renal calculus • Acute pancreatitis • Acute cholecystitis • Pyelonephritis • Basal pneumonia	• Helminthiasis • Meckel's diverticulitis • Cholelithiasis • Chronic pancreatitis • Inflammatory bowel disease • Peptic ulcer • Giardiasis

Cardinal features of conditions commonly causing acute abdominal pain

Diseases	Clinical features	Investigations	Treatment
Acute appendicitis	* Abdominal pain * Anorexia, nausea, vomiting * McBurney's point tenderness * Rebound tenderness * Rovsing sign * Psoas sign (retrocaecal appendix) * Obturator sign (pelvic appendix)	* CBC: Leukocytosis * USG of abdomen: Wall thickness > 6 mm, a compress mass	* Surgery * Conservative with NPO, Suction, IV fluid and antibiotic
Intussusception	* Classical triad-colicky pain, palpable sausage shaped abdominal mass and bloody or red currant jelly stool	* USG: Tubular mass * Barium enema: Filling defect/cupping in the head of barium, coilspring sign	* Conservative with NPO, Suction, IV fluid and antibiotic * Hydrostatic reduction * Surgery
Intestinal obstruction	* Proximal obstruction - large volume, frequent, bilious emesis, little or no abdominal distension, pain is intermittent and relieved by vomiting * Distal obstruction - moderate or marked abdominal distension, vomiting.	* X-ray abdomen: Multiple air fluid level * USG of abdomen	* Conservative with NPO, Suction, IV fluid and antibiotic * Surgery * Treatment of the cause

Cardinal features of conditions commonly causing acute abdominal pain

Diseases	Clinical features	Investigations	Treatment
Acute pyelonephritis	* Abdominal pain * Fever, malaise, nausea, vomiting * In case of newborn: Poor feeding, irritability, jaundice, weight loss	* Urine R/M/E * Urine C/S * CBC, CRP, PBF * USG of abdomen	* Antibiotics according to C/S
Acute pancreatitis	* Severe abdominal pain * Persistent vomiting * Fever, shock * Cullen sign: Bluish discoloration around umbilicus * Grey Turner sign: Bluish discoloration in flanks	* Serum amylase, lipase-high * Leucocytosis-high * RBS-high	* Conservative - fluid, electrolytes, anti emetics, antibiotics to prevent infected pancreatic necrosis

Cardinal features of conditions commonly causing recurrent abdominal pain

Diseases	Characteristics features	Investigations	Treatment
Helminthiasis (discussed in chapter 35)	* Abdominal pain, distension, bloating, gas, malabsorption, growth failure, intestinal obstruction	* Stool R/M/E - to see ova and egg * CBC with PBF	* Albendazole * Mebendazole * Healthy measures <i>e.g. personal hygiene, hand washing, use of sanitary latrine, etc.</i>
Meckel's diverticulum	* Painless per rectal bleeding, brick colour/ currant jelly stool * Intestinal obstruction, vomiting	* Meckel scan with Tc99 pretechnetate isotope	* Surgery
Peptic ulcer disease	* Burning epigastric pain, worse on awaking or before meal * Relieved with antacid, vomiting, haemorrhage	* Endoscopy of upper GIT	* Proton pump inhibitor, H₂ blocker * Treatment of <i>H. Pylori</i> with proton pump inhibitor, Clarithromycin, Amoxicillin for 2 weeks
Inflammatory bowel disease	* Abdominal pain, nausea, vomiting, diarrhoea, per rectal bleeding, tenesmus, urgency	* X-ray of abdomen * USG of abdomen * Colonoscopy	* Prednisolone * Sulfasalazine * Azathioprine * Monoclonal antibody * Surgery

References

1. Kliegman RM, Stanton BF, Geme III JWS, Schor NF, Behrman RE. Editors. Nelson Textbook of Pediatrics, 20th Edition. New Delhi: Elsevier; 2016
2. Kabir ARML. Pediatric Practice on Parents Presentation, 1st ed. Dhaka: Asian Colour Printing; 2011.
3. Marchetti et al. Oral ondansetron versus domperidone for symptomatic treatment of vomiting during acute gastroenteritis in children: multicentre randomized controlled trial. BMC Pediatrics 2011 11:15.
4. Katie Allen. The vomiting child: What to do and when to consult. Aus Family Phys 2007 Sept; 36 (9): 684-7.

SELF ASSESSMENT

Short answer question [SAQ]

1. What are the common causes of acute abdominal pain?
2. How will you diagnose a child with acute appendicitis?
3. Write down the clinical features of acute pancreatitis
4. A 5 years old boy fever & acute abdominal pain for 1 day
 - a) Write down 4 important differential diagnoses
 - b) How will you investigate & treat the boy
5. A 7 years old girl presented with recurrent abdominal pain for 6 months
What are the important differentials?

Multiple choice question [MCQ]

1. Common causes of recurrent abdominal pain

☐ a) renal calculus	☐ b) peptic ulcer	☐ c) helmentheasis
☐ d) Meckel's diverticulitis	☐ e) pyelonephritis	
2. In acute appendicitis-

☐ a) McBurney's point tenderness	☐ b) Obturator sign	☐ c) sausage shape abdominal mass
☐ d) Grey turner sign	☐ e) Rovsing sign	
3. Characteristic findings of Intussusception

☐ a) Red currant jelly stool	☐ b) colicky abdominal pain	☐ c) Rebound tenderness
☐ d) CBC- leukocytosis	☐ e) Barium enema-filling defect/cupping in the head of barium	
4. Acute pancreatitis

☐ a) persistent vomiting	☐ b) hypoglycaemia	☐ c) high serum amylase
☐ d) X-ray abdomen - calcification	☐ e) CT - Pseudocyst	
5. Treatment of acute pancreatitis

☐ a) IV fluid	☐ b) correction of electrolyte imbalance	
☐ c) antibiotics	☐ d) surgery	☐ e) oral pancreatic enzyme

CONSTIPATION

CONSTIPATION

116

Constipation may be defined as passage of hard stool with difficulty in every 3rd day. It may arise from defects either in feeling or emptying the rectum.

Aetiology

Non organic (functional)	Organic
* Idiopathic * Acute febrile illness * Low fiber diet * Transition from breast milk to cow's milk * Forceful potty training	* Anatomic e.g. anal stenosis, Anal fissure * Abnormal musculature e.g. Down syndrome * Intestinal nerve abnormality e.g. Hirschsprung disease * Intestinal disorders e.g. cow's milk protein intolerance * Metabolic disorder e.g. hypothyroidism * Drugs e.g. Phenytoin, anticholinergics * Psychiatric disorder e.g. anorexia nervosa

Approach to a patient with constipation

History

- History of delayed passage of meconium e.g. Hirschsprung disease
- History of prolonged jaundice in the neonatal period e.g. congenital hypothyroidism
- Painful passage of stool e.g. anal fissure
- History of passage of stool in inappropriate places e.g. encopresis
- Dietary history e.g. low fiber diet, change of diet from breast milk to cow's milk

- Family history of constipation e.g. parental habit
- Forceful potty training

Physical Examination

- Appearance: Coarse facies, hair line, protruded tongue (congenital hypothyroidism)
- Abdomen: Distended or not (Hirschsprung disease)
- Perianal region: To check for anal fissures
- Back: To check for meningocele/ myelomeningocele
- Digital rectal examination
 - * To check for tone of sphincter (Hirschsprung disease)
 - * Whether explosive diarrhoea on withdrawal of finger present or not (Hirschsprung disease)
- Muscle tone: hypotonic in (hypothyroidism, Down syndrome), hypertonic (meningocele/ myelomeningocele)

Diagnosis

Based on C/F and relevant investigations.

Investigations	Results
Plain x-ray of abdomen	To look for evidence of bowel obstruction e.g. presence of multiple air-fluid levels
Barium enema x-ray of large gut	Presence of normally dilated proximal colon and a smaller calibre constricted distal colon as seen in Hirschsprung disease
Serum TSH, FT ₄	High TSH & low FT ₄ level indicate congenital hypothyroidism
Karyotyping	Presence of extra copy of chromosome on 21 as seen in Down syndrome

Treatment

A. Supportive

- * Counseling
- * Diet
 - Encourage more liquid/fluid intake
 - Encourage high fiber diet *e.g. vegetables*
 - Avoid excessive consumption of milk, meat
- * Toilet training: Regular toilet sitting for 10 minutes twice a day after meal

* Drugs

- Osmotic laxative (lactulose)
- Bulk forming laxatives (Ispaghula husk)
- Stool softeners (liquid paraffin)

* Others

- Enema simplex
- Manual evacuation under G/A

B. Specific

Treatment of the underlying cause, if any.

References

1. Kliegman RM, Stanton BF, Geme III JWS, Schor NF, Behrman RE. Editors. Nelson Textbook of Pediatrics, 20th Edition. New Delhi: Elsevier; 2016

SELF ASSESSMENT

Short answer question [SAQ]

1. Define constipation. Write down the common causes of constipation
2. What clinical findings will you search during examination of a child with constipation?
3. A 1 year old child presented with constipation since his early infancy
 - a) What are the important differentials?
 - b) What history will you take to diagnose this patient?
 - c) How to investigate the child?
 - d) Write down the management plan.

Multiple choice question [MCQ]

1. Common organic causes of constipation

☐ a) hypothyroidism	☐ b) Hirschsprung disease	☐ c) low fiber diet
☐ d) spinal cord defect	☐ e) transition from breast milk to cow's milk	
2. Patients with constipation may have-

☐ a) recurrent abdominal pain	☐ b) coarse facies	☐ c) myelomeningocele
☐ d) recurrent UTI	☐ e) abdominal distension.	
3. Treatment of constipation

☐ a) high fiber diet	☐ b) GIT stimulant	☐ c) Osmotic laxative
☐ d) excessive consumption of milk	☐ e) enema simplex	

SORE THROAT & DIFFICULTY IN SWALLOWING

VIRAL PHARYNGITIS	118
ACUTE BACTERIAL PHARYNGOTONSILLITIS	118

Soreness in throat is a common presentation of throat infection and is one of the major cause of health-care seeking in children.

The common causes of sore throat are -

- * Viral pharyngitis
- * Acute bacterial pharyngotonsillitis
- * Diphtheria
- * Infectious mononucleosis

In this section, viral pharyngitis, acute bacterial pharyngotonsillitis will be discussed.

VIRAL PHARYNGITIS

Organisms: *Adenovirus*, *Coxsackie virus*, *EBV*, *Herpes simplex virus*.

Clinical Manifestations

Sore throat, runny nose, red eye, hoarseness, cough, low grade fever. Throat examination may reveal redness of fauces & tonsil, but no pus point.

Treatment: Supportive

- * Analgesic *e.g.* *paracetamol*
- * Saline gargling
- * Lemon tea to soothe the throat
- * Feeding: as usual

ACUTE BACTERIAL PHARYNGOTONSILLITIS

Organisms: *Group A beta haemolytic Streptococci* is the predominant organism. Other organisms are *Staph. aureus*, *gram-negative organism* and *Mycoplasma*.

Clinical Manifestations

Symptoms

- Sudden onset of high fever
- Severe sore throat
- Difficulty in deglutition
- Refusal to feed



Inflamed tonsils with pus in the crypts

- Drooling of saliva
- Cough is characteristically absent

In addition, headache, vomiting and abdominal pain may be present.

Physical examination

- Throat is seen red and congested
- Tonsils are enlarged and pus points in the crypts (*white patch*)
- Anterior cervical lymph nodes are enlarged and tender

Other causes of white patches over tonsil

- | | |
|----------------------|-----------------|
| * Faucial diphtheria | |
| * Oral thrush | mononucleosis |
| * Vincent angina | * Scarlet fever |
| * Infectious | * Moniliasis |

Complications

Following 2 complications may occur if the cases of acute streptococcal pharyngotonsillitis are not adequately treated -

- Acute rheumatic fever
- Acute glomerulonephritis

Diagnosis

Based on C/F & relevant investigations.

Investigations

Investigations	Results
CBC	Polymorphonuclear leukocytosis
ASO titre	Raised
Culture of throat swab	May be positive for <i>beta haemolytic streptococcus</i>

Treatment

A. Specific: Either of the following

- Penicillin
 - * Phenoxymethyl penicillin 50 mg/kg/day, 6 hourly for 10 days or

- * Benzathine penicillin 600,000 unit deep IM (< 30 kg) and 1200,000 unit (> 30 kg) single dose

- Erythromycin 40-50 mg/kg/day in 4 divided doses (penicillin hypersensitivity) for 10 days
- Cefpodoxime proxetil 8 mg/kg/day twice daily for 5 days
- Azithromycin 10 mg/kg/day for 5 days

B. Supportive

- Analgesic/antipyretic
- Warm saline gargling
- Feeding: as usual, better to choose with child's desire and conditions

References

1. Shulman ST. Group A streptococci. In: Kliegman RM, Stanton BF, Geme III JWS, Schor NF, Behrman RE. Editors. Nelson Textbook of Pediatrics, 20th Edition. New Delhi: Elsevier; 2016: 1327-1337
2. Kabir ARML. Pediatric Practice on Parents Presentation, 1st ed. Dhaka: Asian Colour Printing; 2011.

SELF ASSESSMENT

Short answer questions [SAQ]

1. What are the complications of streptococcal tonsillitis?
2. How to differentiate streptococcal tonsillitis from diphtheria on examination of throat?

Multiple choice questions [MCQ]

1. The causes of white patches on throat are-
 - ___ a) acute follicular tonsillitis
 - ___ b) diphtheria
 - ___ c) viral pharyngitis
 - ___ d) Vincent's angina
 - ___ e) oral thrush.
2. Organisms commonly cause acute tonsillitis are-
 - ___ a) β haemolytic Streptococcus
 - ___ b) Staphylococcus aureus
 - ___ c) Herpes simplex
 - ___ d) Haemophilus influenza
 - ___ e) Adeno virus
3. Common causes of sore throat in children are-
 - ___ a) viral pharyngitis
 - ___ b) acute tonsillitis
 - ___ c) herpes gingivo-stomatitis
 - ___ d) infectious mononucleosis
 - ___ e) moniliasis

UNDUE EXHAUSTION TO NORMAL ACTIVITIES

• CONGENITAL HEART DISEASES	120
• VENTRICULAR SEPTAL DEFECT	120
• ATRIAL SEPTAL DEFECT	122
• PATENT DUCTUS ARTERIOSUS	123
• TETRALOGY OF FALLOT	125
• HEART FAILURE	129
• INFECTIVE ENDOCARDITIS	130

Undue exhaustion of a child to normal activities (**effort intolerance**), shortness of breath and palpitation with failure to thrive are the usual presentations of underlying heart diseases.

However, apart from heart diseases, conditions causing chronic hypoxaemia *e.g. thalassaemia major, chronic lung diseases* and neuromuscular disorders may also give rise to undue exhaustion.

Heart diseases among children are mostly congenital, in contrast to adults who usually suffer from acquired heart diseases *like coronary heart diseases, rheumatic valvular heart diseases etc.*

In this chapter we will discuss the common congenital heart diseases, heart failure and infective endocarditis.

CONGENITAL HEART DISEASES (CHD)

Prevalence: 8 per 1000 live births.

Aetio-pathogenesis

- Unknown mostly
- Chromosomal anomalies *e.g. Down syndrome, Turner syndrome*
- Antenatal illness of mothers, *e.g. diabetes mellitus, rubella infection, radiation etc.*

Classification

Broadly based on the presence or absence of cyanosis in the affected child.

Cyanotic CHD	Acyanotic CHD
• Tetralogy of Fallot (TOF) • Transposition of great arteries (TGA) • Total anomalous pulmonary venous drainage (TAPVD) • Persistent truncus arteriosus • Tricuspid atresia • Ebstein anomaly	• With left to right shunts * Ventricular septal defect (VSD) * Atrial septal defect (ASD) * Patent ductus arteriosus (PDA) • Without shunt * Coarctation of aorta * Pulmonary stenosis * Aortic stenosis

VENTRICULAR SEPTAL DEFECT (VSD)

The commonest congenital cardiac disease. Here the defect is the interventricular septum. It can occur as an isolated problem or as a component of more complex congenital heart disease such as TOF.

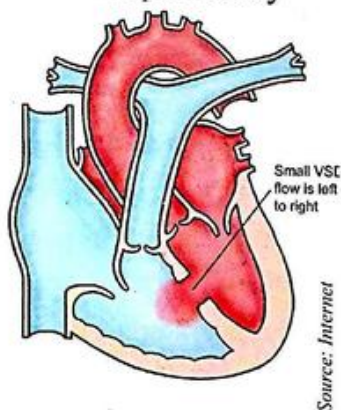
The defect may occur anywhere in the interventricular septum but in about 80% cases it occurs in the membranous part.

VSD is classified according to its size, as

Small	< 5 mm
Moderate	5-10 mm
Large	> 10 mm VSD

Haemodynamics

During ventricular systole oxygenated blood shunts from the left ventricle to right ventricle (*left to right shunt*) through VSD and adds with the deoxygenated blood there. As pulmonary vascular resistance decreases after birth this excess blood then pass to the pulmonary vascular bed. The cycle continues again and again. With continued exposure of the pulmonary vascular bed to high blood flow, pulmonary hypertension and later pulmonary vascular obstructive disease develops resulting in right to left shunt (*Eisenmenger syndrome*). This reversal of shunt direction results in appearance of cyanosis.



Clinical Manifestation

Small defect

- Patients usually remain asymptomatic with normal growth and development
- Incidental detection of a pansystolic murmur at left 3rd and 4th intercostal spaces

Large defect

- * Dyspnoea at rest or on exertion
- * Poor feeding/interrupted feeding
- * Poor weight gain (failure to thrive)
- * Easy fatigability
- * Profuse perspiration (diaphoresis) *e.g.* head sweating
- * Recurrent respiratory tract infections
- * Cyanosis is usually absent

General physical examination

- Appearance: Sick looking, often malnourished
- Respiratory rate: Increased
- Pulse: Rate: Increased, Volume: Good

- Blood pressure: Normal
- Jugular venous pressure: May be raised
- Pedal oedema: Absent but may be present in heart failure

Precordium

- Inspection: Hyperdynamic, may be bulged
- Palpation
 - * Apex beat is shifted to left (due to cardiomegaly) and is thrusting
 - * Left parasternal heave may be present
 - * Thrill may be present in tricuspid area (related to grading of murmur)
 - * P2 (pulmonary component of 2nd heart sound) may be palpable in pulmonary area
- Auscultation
 - * 1st and 2nd heart sounds are audible in all 4 areas
 - * A harsh pansystolic murmur (grade 4/6) best heard at lower left sternal border at the 3rd, 4th & 5th intercostal spaces. The murmur may radiate to the right lower sternal border. Intensity varies based on the size of the VSD and pulmonary vascular resistance

Diagnosis

Based on C/F and relevant investigations.

Investigations

- Chest X-ray
 - * Cardiomegaly (*cardiothoracic ratio* > 60%)
 - * Increased pulmonary vascular markings



Cardiomegaly

- * CXR may be normal in small defects
- ECG
 - * Normal in small defect

- * Left ventricular hypertrophy in large VSD
- * Biventricular hypertrophy when associated with pulmonary hypertension
- * P waves may be notched or peaked
- Echocardiogram with color Doppler is diagnostic. It shows location and size of the defect

Treatment

Counsel the parents about the disease, its complications and prognosis.

A. Medical

Small defects

Parents should be reassured of the relatively benign nature of the lesion, and the child should be encouraged to live a normal life, with no restrictions on physical activity.

Moderate to Large defects

The goals of treatment are to -

- Ensure adequate growth of the patient
- Prevent the development of pulmonary vascular obstructive disease *e.g. Eisenmenger syndrome*
- To control congestive heart failure

B. Supportive

- Nutrition: High calorie diet (add fat and sugar) to ensure adequate weight gain. Occasionally, oral feeds must be supplemented with tube feeds
- Diuretics: Frusemide (1-3 mg/kg/day divided in 2 or 3 doses) and/or Spironolactone may be used to relieve pulmonary congestion
- Afterload reducing agents: ACE inhibitors
 - a) Enalapril (0.1-0.5 mg/kg/day – 12 hourly/once daily)
 - b) Captopril (0.05-0.1 mg/kg/dose – 8 hourly) may be used
- Digoxin (5-10 µg/kg/day) may be indicated if diuresis and afterload reduction do not relieve symptoms of heart failure adequately

B. Surgical

Indications

- Surgical closure at any age for large VSD where clinical symptoms and failure to thrive cannot be controlled medically
- Surgical closure between 6-12 months of age large VSD with pulmonary hypertension, even if symptoms controlled by medication
- Children older than 24 months with a Qp:Qs ratio > 2:1 (Pulmonary-Systemic Flow Ratio high i.e. large left to right shunt)

Contraindication

- Severe pulmonary vascular disease, non responsive to pulmonary vasodilators

Prognosis

- 30-50% of defects close spontaneously during the first year of life
- Children with small VSD have excellent long-term prognosis

ATRIAL SEPTAL DEFECT (ASD)

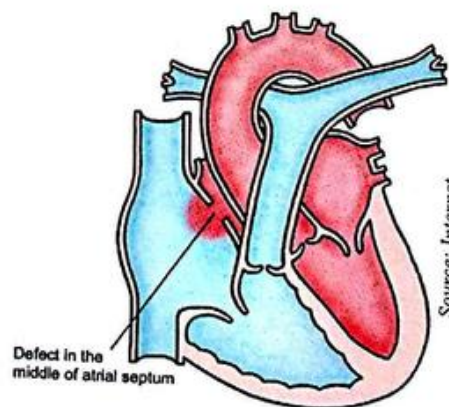
Atrial septal defect is an abnormal communication between the atria due to a defect in the interatrial septum.

Types of ASD

Ostium secundum	60%
Ostium primum	30%
Sinus venosus	10%

Haemodynamics

In ASD there is shunting of oxygenated blood from the left to the right atrium where it is added to the usual venous return (*volume overload*). The blood is then passed to the right ventricle and pumped to the lungs.



As the pressure difference between the 2 atria is low; the amount of blood shunting through the defect is not as high as that of other high pressure gradient *e.g.* VSD. As a result, the pulmonary circulation & pulmonary artery pressure as well as pulmonary vascular resistance remains normal throughout the childhood although, it may begin to increase in adulthood and may eventually result in reversal of the shunt and clinical cyanosis.

Clinical Manifestations

Vary with the size of defect.

- Small defect: Asymptomatic and is usually diagnosed during a routine health check-up
- Large defect: Symptomatic & patients usually present with –
 - * Easy fatigability
 - * Increased perspiration
 - * Poor weight gain (failure to thrive)
 - * Recurrent respiratory tract infections

General Physical Examination

- Appearance: Usually normal
- Heart rate: Normal
- Respiratory rate: Normal
- Weight & height: Age appropriate

Precordium

- Inspection: Usually normal
- Palpation
 - * Apex beat may be shifted to left
 - * P2 may be palpable
 - * Left parasternal heave may be present
- Auscultation
 - * S1 is normal
 - * S2 is widely splitted and fixed
 - * Added sound. An ejection systolic murmur best heard at the upper left sternal edge (in pulmonary area)

Diagnosis

Based on C/F and relevant investigations.

Investigation	Results
Chest X-ray	Normal or may show cardiomegaly. There may be increased pulmonary vascular markings
ECG	May be normal, especially in small defects. In large defects there may be right-axis deviation, right ventricular hypertrophy
Echo-cardiogram	Shows location and size of the defect

Treatment

Counsel the parents about the disease, treatment options and prognosis.

A. Medical

- Aimed to reduce volume overload and to strengthen functions of heart muscles
 - * Diuretics: Frusemide, Thiazide or combination to remove excess fluid from the body through urine
 - * Digoxin: Helps to strengthen the heart muscle, enabling it to pump more efficiently

B. Surgical

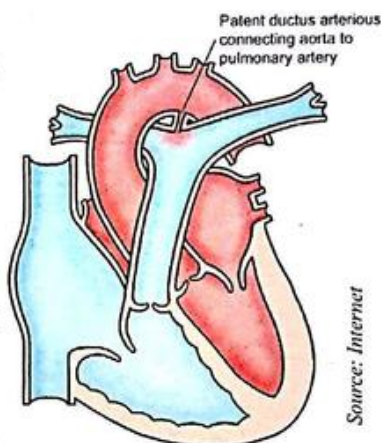
Closure of the defect

PATENT DUCTUS ARTERIOSUS (PDA)

PDA is a type of acyanotic congenital heart disease where the abnormal communication persists as such between aorta (systemic) and pulmonary tract. This results from failure of complete closure of fetal ductus arteriosus.

Haemodynamics

During ventricular systole, blood flows from aorta to the pulmonary trunk through this patent ductus because of high pressure gradient. This blood is then added with the deoxygenated blood in pulmonary trunk, coming from right ventricle. As a result, there is pulmonary congestion, pulmonary hypertension and ultimately pulmonary vascular obstructive disease and reversal of shunt (*Eisenmenger syndrome*).



Source: Internet

Clinical Manifestations

Vary with the size of defect.

- Small defect may be asymptomatic
- Moderate to large defect: Generally results in –

- * Poor feeding
- * Poor weight gain (failure to thrive)
- * Dyspnoea
- * Profuse sweating with crying and feeding
- * Recurrent respiratory tract infections

General Physical Examination

- Appearance: May be normal or distressed
- Heart rate: Increased (tachycardia)
- Respiratory rate: Increased (Tachypnoea)
- Pulse: **High volume and collapsing pulse** with wide pulse pressure

Precordium

- Inspection: Hyperdynamic
- Palpation
 - * Apex beat is shifted to left, heaving in character
 - * A thrill may be palpable at 2nd left intercostal space

Auscultation

- * S1 is usually normal
- * S2 is often obscured by the murmur
- * Added sound
Continuous machinery murmur at 2nd left intercostal space near the sternum (maximal at mid clavicular line) is the classic finding

Diagnosis

Based on C/F and relevant investigations.

Investigations	Results
Chest X-ray	Cardiomegaly (left or biventricular enlargement) Increased pulmonary vascular markings
ECG	May be normal or left atrial enlargement Biventricular hypertrophy in later stage
Echocardiogram	Diagnostic

Treatment

- Counsel the parents about the disease, treatment options and prognosis.

A. Medical

Any of the following drugs is found effective in closing PDA, if given within 72 hours of age particularly for premature babies.

- **Indomethacin:** Given IV slowly over 30 minutes in the following dosage –
 - * 1st dose: 0.2 – 0.3 mg/kg
 - * 2nd dose: 0.2 mg/kg, 12–24 hours after 1st dose if PDA persists.
 - * 3rd dose: 0.2 mg/kg, 12–24 hours after 2nd dose if PDA persists
- **Ibuprofen:** Given orally
 - * Day 1 : 10 mg/kg
 - * Day 2: 5 mg/kg
 - * Day 3: 5 mg/kg

B. Percutaneous closure with devices

C. Surgical

Surgical closure done before 1 year age.

TETRALOGY OF FALLOT (TOF)

[Etienne L A Fallot 1850-1911]

Commonest congenital cyanotic cardiac lesion, accounts for 10% of all congenital heart diseases.

Pathology: Four components -

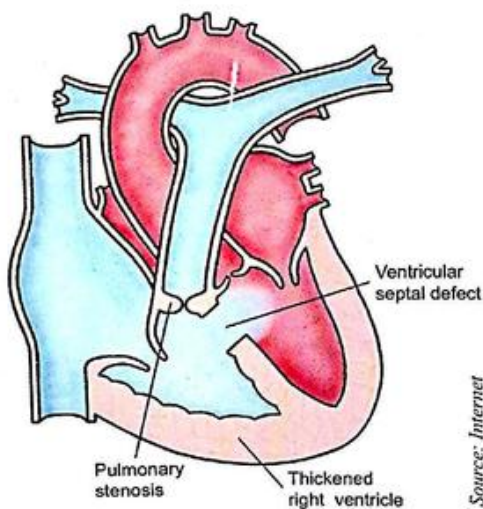
- Obstruction to right ventricular outflow tract (pulmonary infundibular stenosis)
- Ventricular septal defect
- Overriding of aorta (over the septal defect)
- Right ventricular hypertrophy

When additionally ASD is present along with other defects, it is called pentalogy of Fallot.

Haemodynamics

Owing to right ventricular outflow obstruction, during ventricular systole deoxygenated blood of right ventricle shunts through VSD to left ventricle, mix with oxygenated blood there and then this mixed blood passes through the aorta to different parts of the body.

Therefore, the net pathological effects of these events are -



Source: Internet

- Persistently less blood in pulmonary circulation (*oligaemic lung fields*)
- Persistently low O₂ saturation of blood in systemic circulation (*chronic hypoxaemia & cyanosis*)
- Polycythaemia *due to chronic hypoxaemia*
- Growth failure *due to chronic hypoxaemia*

Clinical Manifestations

Clinical findings are variable and mainly depends on the *degree of right ventricular outflow obstruction*.

- Cyanosis
 - * Patients with mild obstruction are minimally cyanotic or even acyanotic (pink TOF)
 - * Those with maximal obstruction are deeply cyanosed since birth
 - * Most have progressive cyanosis by 4 months of age



Clubbing and Blue tongue (central cyanosis)

- Paroxysmal hypercyanotic attacks (Hypoxic spells, blue spells, Tet spells)

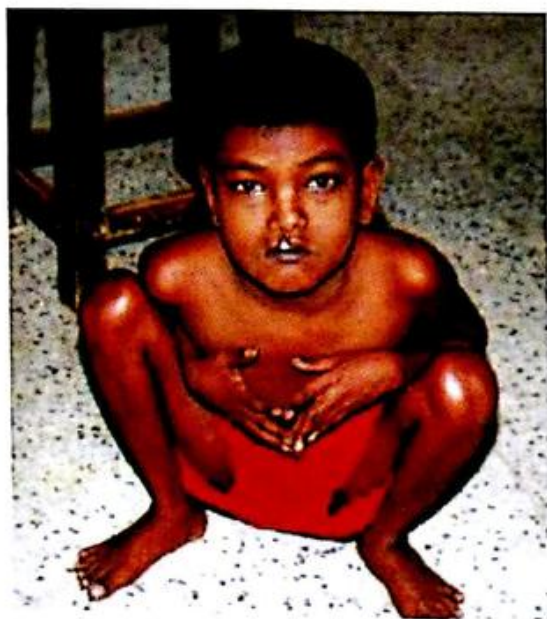
This is the hallmark of severe TOF and usually occurs during first 2 years of life, most commonly 4-6 months of age. The attacks are associated with further reduction of an already compromised pulmonary blood flow & more severe systemic hypoxia and metabolic acidosis. Spells occur most frequently in the morning on awakening or after episodes of vigorous cry.

Precipitating factors are -

- * Exertion
- * Upsetting due to any cause
- * Sleeplessness
- * Irritation to the baby
- * Vigorous crying

Cyanotic spells are characterized by-

- * Sudden onset of dyspnoea. Sometimes gasping respiration and syncope
 - * Sudden deepening of cyanosis
 - * Alterations in consciousness, sometimes convulsions and hemiparesis
 - * Temporary disappearance or decrease in the intensity of the systolic murmur at pulmonary area
 - * Metabolic acidosis
- Easy fatigability and dyspnoea on exertion. The affected child tires easily (easy fatigability) and begins panting with any form of exertion (dyspnoea on exertion). Sometimes, because of sudden dyspnoea, the affected child adopts *squatting position* till dyspnoea improves and then the child resumes physical activity. *Squatting is of diagnostic significance and is highly typical of infants with TOF.*



A TOF child in squatting position

Squatting increases peripheral systemic vascular resistance and thereby decreases right-to-left shunt across the VSD. This ultimately improves pulmonary circulation, better oxygenation and relieves the child from dyspnoea and episodes of cyanotic spells.

- Failure to thrive (slow or not gaining weight)

General Physical Examination

- Appearance: Cyanosis (skin, lips, and mucous membranes inside the mouth and nose looks blue)



Conjunctival congestion



Clubbing of fingers

- Conjunctiva: Congested
- Fingers and toes: Clubbing
- Pulse and blood pressure: Normal
- Oedema: Absent
- Anthropometry: Stunting

Precordium

- Inspection: may be bulged due to right ventricular hypertrophy
- Palpation
 - * Apex beat is tapping in character, not shifted
 - * P2 is not palpable
 - * Left parasternal heave may be present.
 - * A systolic thrill may be felt at left upper intercostals spaces
- Auscultation
 - * S1 is normal
 - * S2 is loud & single
 - * Added sound: A loud ejection systolic murmur is heard at pulmonary area originating from the turbulence at right ventricular outflow tract obstruction

Complications

- Hypercyanotic spells
- Severe polycythaemia
- Cerebral abscess as deoxygenated blood enters the systemic circulation and brain, bypassing lungs without clearing the germs by pulmonary scavenger cells
- Cerebral thromboembolism and stroke
- Infective endocarditis
- Delayed growth, development and puberty
- Delayed puberty
- Others: Hyperuricaemia & gout, relative IDA, bleeding disorders/coagulopathy

Heart failure is uncommon in classical TOF.

Diagnosis

Based on C/F and relevant investigations.

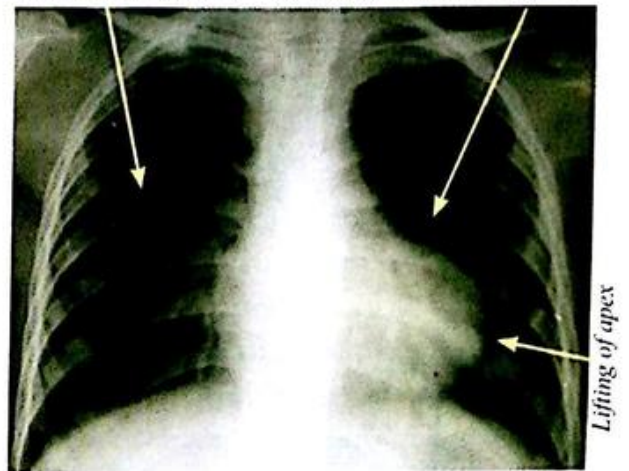
Investigations

- Complete blood counts
 - * Haemoglobin and haematocrit values are usually elevated which is proportion to the degree of cyanosis

- * TC & DC of WBC, Platelet counts: Normal
- * PBF shows microcytic hypochromic anaemia

- X-ray chest

Oligaemic lungs field Concavity at pulmonary area



Boot shaped heart and oligaemic lungs fields

- * Heart
 - Size: Not enlarged
 - Shape: Boot shaped (coeur-en-sabot) due to concavity at pulmonary conus (because of low pressure of pulmonary artery) and upturning of cardiac apex (by the hypertrophied right ventricle)
- * Lung fields: Looking black due to decreased pulmonary vascularity (oligaemia)
- ECG: Right ventricular hypertrophy and right axis deviation
- Echocardiography: Confirms the diagnosis

Treatment

- Counsel the parents about the disease, treatment options and prognosis

A. Medical

- *Neonates with severe cyanosis* is treated with IV infusion of Prostaglandin E1 (0.05 to 0.1 µg/kg/min IV) to keep the ductus arteriosus open/patent and thereby to improve pulmonary circulation and is life saving

- *Treatment of cyanotic spells*

- * Place the infant in a knee-chest position (older children usually squat spontaneously and do not develop cyanotic spells)
- * Give O₂: 3 - 5 L/min through face mask/head box
- * Establish a calm environment by isolating the patient

If the spell persists, give the following:

- * **Intravenous fluids:** 10 ml/kg bolus normal saline followed by maintenance fluids
- * **Morphine:** 0.1 - 0.2 mg/kg SC for keeping the child calm and for muscle relaxation
- * **NaHCO₃:** 1 mEq/kg IV to correct acidosis
- * **Propranolol:** 0.1 mg/kg IV which relaxes the infundibular muscle and thereby reduces spasm

If these measures do not control the spell, then take measure to raise systemic BP as well as systemic vascular resistance. This will promote pulmonary blood flow.

- * **Phenylephrine:** 10-20 µg/kg bolus IM or SC then 0.1- 0.5 µg/kg/min infusion IV titrated according to heart rate and blood pressure

If the preceding steps do not relieve the spell or if the infant is rapidly deteriorating, intubation and ventilator support should be given.

- *Treatment at home*

- * Propranolol: 0.25 - 1 mg/kg/day orally to be continued to prevent cyanotic spells
- * Fluid & Nutrition
 - High calorie diets should be given to ensure growth
 - Iron supplementation: 3 - 6 mg/kg/day elemental iron orally
 - Vitamins and minerals supplementation

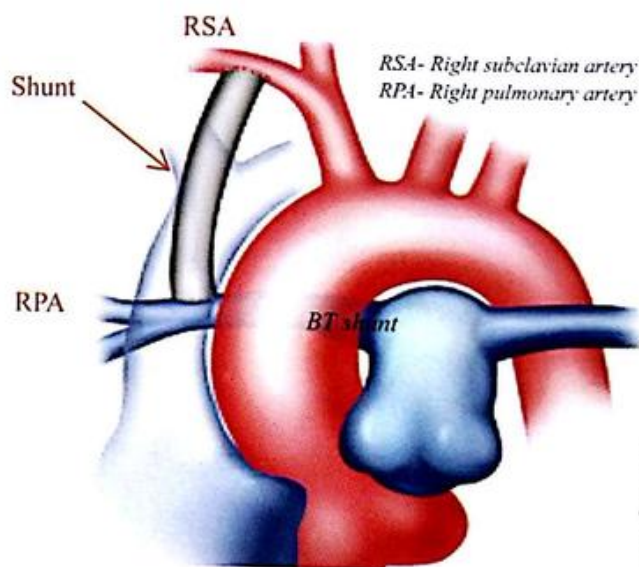
- Counsel parents to pay special attention to fluid intake so as to prevent dehydration, haemoconcentration and thereby to reduce thromboembolism. **Dehydration of child with TOF should be referred to rehydrate promptly**

B. Surgical

- **Total correction:** Is the treatment of choice, can be done as early as 1 month of age (electively in between 4-6 months of age)

- **Palliative surgery (Blalock Taussig Shunt)**

This is done between Subclavian artery (systemic) and pulmonary artery (pulmonary circulation) to increase circulation to the lungs. This will improve tissue oxygenation, relieves cyanosis and allow the child to grow good enough to do complete surgical repair. This procedure is reserve for TOF with associated comorbidities e.g. other congenital anomalies or prematurity



Source: Internet

Prophylaxis against infective endocarditis:
Recommended.

Prognosis

The long-term outcome of treatment of TOF depends primarily on the size and anatomy of the pulmonary arteries.

Clinico-pathological differences between TOF and VSD

Traits	TOF	VSD
Direction of shunt	* Right to left	* Left to right
Nature of defect	* Multiple	* Single
Status of pulmonary circulation	* Less entry of blood from right ventricle to pulmonary circulation * Low pulmonary pressure	* More blood into pulmonary circulation * High chance of developing pulmonary hypertension and pulmonary edema in untreated cases
Cyanosis	* Present	* Absent
Complications	Mostly extra-pulmonary and related to * Hyperviscosity of blood, thromboembolism, stroke * Direct entry of venous blood to systemic circulation bypassing lungs may lead to brain abscess * Heart failure (uncommon)	* Pulmonary congestion and recurrent pneumonia * Cardiac overload - CCF * Turbulence and infective endocarditis
Chest X-ray findings	* Boot shaped heart * Depression at pulmonary conus * Oligaemic lung fields	* Cardiomegaly * Normal or prominent pulmonary conus * Prominent pulmonary vascular markings

HEART FAILURE (HF)

It is a clinical situation where heart fails to pump blood to meet the circulatory or metabolic needs of the body.

Aetiology

Cardiac causes	Congenital heart diseases	VSD, TGA, TAPVD, PDA, Coarctation of Aorta (CoA)
	Acquired heart diseases	• Valvular heart diseases <i>e.g. mitral, aortic etc.</i> • Infective endocarditis • Hypertensive heart diseases <i>e.g. acute glomerulonephritis</i> • Viral myocarditis etc.
Non-cardiac causes	Fluid overload, septicaemia, asphyxial cardiomyopathy, severe anaemia, wet beriberi, thyrotoxicosis	

Ischaemic heart disease and cardiomyopathies are less common causes of heart failure in children.

Pathophysiology

When heart fails to pump out its blood, it dams either in pulmonary or in systemic circulations or both.

Features of pulmonary overload (LHF)	Features of systemic overload (RHF)
* Respiratory distress * Cough with frothy sputum * Tachypnoea * Basal crepitations	* Upper abdominal pain * Dependent oedema * Tender hepatomegaly * Raised JVP

Clinical Manifestations

Symptoms

- Infants: Non specific *e.g. irritability, excessive sweating, poor feeding & difficult feeding, respiratory distress*
- Older children: Effort intolerance, dyspnoea on exertion, diaphoresis, cough, abdominal pain

Signs

A. General examination

- | | |
|----------------------|--------------------------------------|
| * Tachypnoea | * Prolonged capillary refilling time |
| * Tachycardia | * Dependent oedema |
| * Cold peripheries | * Raised JVP |
| * Weak thready pulse | * Cyanosis may be |
| * Low blood pressure | |

B. Chest examination

- | | |
|-----------------|---------------------|
| * Cardiomegaly | * Wheeze |
| * Gallop rhythm | * Basal crepitation |
| * Murmurs | |

C. Other features

- * Tender hepatomegaly
- * Positive hepatojugular reflux

Diagnosis

Based on C/F & relevant investigations.

Investigations

- X-ray Chest: Cardiomegaly (Cardiothoracic ratio- the ratio between maximum diameters of chest and the heart; *normal ratio - new born 60%, children - 55%, adult- 50%*), pulmonary vascular congestion



Cardiothoracic Ratio > 50%

Source: Internet

ECG: Not diagnostic but can say the primary heart defects

- Echocardiography: Demonstrate structural pathology
- Complete blood counts: Hb may be reduced if HF is related to severe anaemia

Treatment

- Counseling parents about the problem
- General measures
 - * Decubitus: Upright position
 - * O₂ inhalation: Humidified oxygen by hood box, mask or nasal prongs
 - * Bed rest & restriction of physical activities.
 - * Maintenance of body temperature
 - * Feeding: Breast feeding or nasogastric tube feeding of foods rich in calorie and low in sodium
- Control of fluid overload by -
 - * Fluid restriction: By 25-30%
 - * Salt restriction: Avoiding table salt and salt rich foods
 - * Diuretics *e.g. Frusemide, Thiazide or K⁺ sparing diuretics*
- Augmentation of myocardial contractility by inotropic agents *e.g.*
 - * Cardiac glycosides (Digoxin) Total digitalization dose: 0.02-0.04 mg/kg
 - * Sympathomimetic amines *e.g. Dopamine, Dobutamine*
 - * Phosphodiesterase inhibitors *e.g. Bipyridines, Amrinone and Milrinone*
- Afterload reducing agents: ACE inhibitors *e.g. Captopril, Enalapril* is given to reduce the impedance to left ventricular ejection.
- Correction of underlying causes and precipitating factors

INFECTIVE ENDOCARDITIS

It is one of the most serious of all infections and is characterized by colonization or invasion of the heart valves or the endocardium by a microbial agent, leading to formation of bulky, friable vegetation laden with organism.

Clinical Types

Types	Natural history	Prognosis
Acute By virulent organism	Produce destructive infections usually to a previously normal heart valve	High mortality
Subacute By low virulent organism	Less destructive infection particularly on deformed valves	Low mortality, good recovery

The vegetations are composed of fibrin, inflammatory cells and micro organisms.

Risk Factors

- Congenital heart disease; particularly those creating high velocity jet streams *e.g. small VSD, PDA or TOF*
- Valvular defects *e.g. valvular stenosis*
- Artificial valves and vascular grafts
- Normal heart with indwelling vascular catheter
- Immunodeficiency *e.g. HIV, therapeutic immune suppression, DM, IV drug users*

Micro-organisms

- *Streptococci* and *Staphylococcus aureus* cause 80% to 90% of infections
- Enterococci, gram-negative bacilli, HACEK (*H=Haemophilus, A=Actinobacillus, C=Cardiobacterium, E=Eikenella, K=Kingella*) and fungi cause the rest

Pathophysiology

Patients with high-velocity flow congenital heart lesions cause turbulence and this promotes formation of a sterile network of platelets and fibrin on the endocardial surface. Subsequently this is colonized by microorganisms and forms vegetations. These vegetations may sometimes become large enough to cause obstruction in blood circulation within heart or may break away as emboli and deposit in different organs. Sometimes, there may be manifestation of immune mediated vasculitis.

Clinical Manifestations

- Long continued fever with chills and night sweat
- Non specific manifestations
 - * Anorexia
 - * Weight loss
 - * Malaise
 - * Headache
 - * Myalgias
 - * Cough
 - * Shortness of breath

A. General Features

- Appearance: Sick looking, pale
- Body temperature: Raised in 90% of patients
- Heart rate: Increased
- Respiratory rate: May be increased
- Oedema: May present if associated CCF

B. Cutaneous manifestations

Petechiae	* Found on the palpebral conjunctiva, buccal or palatal mucosa
Splinter haemorrhages	* Dark red linear lesions in the nail beds
Osler's nodes	* Small red to purple, tender nodules found in pulp spaces of the terminal phalanges, soles of the feet, thenar and hypothenar eminences
Janeway lesions	* Nontender maculae on the palms and soles
Clubbing	* Fingers and toes
Roth's spots	* Retinal haemorrhages with pale centers

Cutaneous lesions represent vasculitis produced by circulating antigen-antibody complexes.



Splinter haemorrhage



Janeway lesion



Roth spot



Osler's node

Source: Internet

C. Systemic Manifestations

CVS	* Change in a pre-existing murmur or development of a new murmur * Tachycardia * Features of congestive cardiac failure
CNS	* Embolic stroke * Intracerebral haemorrhage and multiple microabscesses
Joints	* Arthritis
Renal	* Flank pain and haematuria due to renal emboli
Spleen	* Splenomegaly and left upper quadrant pain in splenic emboli

Revised Duke Clinical Diagnostic Criteriae for Infective Endocarditis

Major Criteriae	Minor Criteriae
1. Positive blood cultures (2 separate cultures for a usual pathogen, 2 or more for less-typical pathogens), and 2. Evidence of endocarditis on echocardiography * Intracardiac mass on a valve or other site, * Regurgitant flow near a prosthesis * Abscess, partial dehiscence of prosthetic valves, or * New valve regurgitant flow	• Predisposing heart conditions • Fever • Embolic-vascular signs <i>e.g. arterial embolism, septic pulmonary embolism, mycotic aneurysm, intracranial haemorrhage, conjunctival petechiae, Janeway lesions</i> • Immune complex phenomena <i>e.g. glomerulonephritis, arthritis, rheumatoid factor; Osler nodes, Roth spots</i> • A single, positive blood culture or serologic evidence of infection, and • Echocardiographic signs not meeting the major criteria • Presence of newly diagnosed clubbing • Splenomegaly • Splinter hemorrhages, and petechiae • A high erythrocyte sedimentation rate • A high C-reactive protein level • The presence of central nonfeeding lines, peripheral lines, and • Presence of microscopic hematuria.

Definite diagnosis: 2 major criteria or 1 major + 3 minor criteria or 5 minor criteria

Possible diagnosis: 1 major + 1 minor criteria or 3 minor criteria

Adapted from Kliegman RM, Stanton BF, Geme III JWS, Schor NF, Behrman RE. Editors. Nelson Textbook of Pediatrics, 20th Edition. New Delhi: Elsevier; 2016

Complications

- * Myocardial infarction, pericarditis, cardiac arrhythmia
- * Cardiac valvular insufficiency
- * Congestive heart failure
- * Sinus of Valsalva aneurysm
- * Aortic root or myocardial abscesses
- * Arterial emboli, infarcts, mycotic aneurysms
- * Arthritis, myositis
- * Glomerulonephritis, acute renal failure
- * Stroke syndromes
- * Mesenteric or splenic abscess or infarct

Diagnosis

Based on C/F and relevant investigations.

Investigations	Results
Complete blood counts	Anaemia: present in 70-90% of patients and is usually normocytic and normochromic. Leukocytosis: noted in <50% of patients
Acute phase reactants (ESR, CRP)	Raised
Blood culture	It should be done in all patients who have a pathologic heart murmur, a history of heart disease, or previous endocarditis. * 3 separate samplings (3 ml each) within 1-24 hours should be obtained from different peripheral sites * Cultures should be grown aerobically and anaerobically for at least 1 week * If no growth is observed by 48 hours of incubation, 2 more blood cultures should be obtained
Echocardiography	Typical findings include vegetations, abscesses, and valvular insufficiency
Urinalysis	May reveal proteinuria (50-60%) and/or microscopic haematuria (30-50%)
Immune assays	Increased Ig, circulating immune complexes and rheumatoid factor

Treatment

Parenteral antibiotics

- Penicillin (200,000 U/kg/day in 4-6 divided doses) + Gentamicin (3 mg/kg/day in 1 dose or 3 divided doses) or
- Ceftriaxone (100 mg/kg/day once daily) plus Gentamicin

- * For β -lactam resistant cases: Vancomycin (40 mg/kg/day in 2-3 equally divided doses) and/or Gentamicin.
- * For *Staphylococcus aureus*: Flucloxacillin or Oxacillin (50 mg/kg/dose every 6 hourly) and/or Gentamicin.

Duration of antibiotic treatment

- At least for 4 weeks or fever free for 3 weeks
- If prosthetic valve IE, highly virulent or relatively resistant organism, 6 weeks treatment is required

Dual or more combination of antibiotics is given for synergistic action.

Prophylaxis

Prevention of bacterial endocarditis is key to their long-term survival and quality of life.

- Guidelines suggest that the patients who are at the highest risk should receive antibiotic

prophylaxis prior to *dental procedures involving manipulation of gingival tissue, periapical region of the teeth, or perforation of oral mucosa*

- Antibiotic prophylaxis is reasonable for procedures on respiratory tract or infected skin, skin structures, or musculoskeletal tissue

only for patients with underlying cardiac conditions associated with the highest risk of IE

- Antibiotic prophylaxis solely to prevent IE is not recommended for GU or GI tract procedures

Antibiotic prophylaxis options include the following:

Situations	Drug	Route	Regimen: Single dose 30 to 60 min before procedure
Can take orally & not allergic to Penicillins or Ampicillin	Amoxicillin	Oral	50 mg/kg
Unable to take oral medication	Ampicillin, or Cefazolin or Ceftriaxone	Parenteral	50 mg/kg IM or IV 50 mg/kg IM or IV
Can take orally but allergic to Penicillins or Ampicillin	Cephalexin*†, or Clindamycin, or Azithromycin or Clarithromycin	Oral	50 mg/kg 20 mg/kg 15 mg/kg
Allergic to Penicillins or Ampicillin and unable to take oral medication	Cefazolin or Ceftriaxone†, or Clindamycin	Parenteral	50 mg/kg IM or IV 20 mg/kg IM or IV
* Or other first or second generation Cephalosporin in equivalent dose † Cephalosporin should not be used in a child with history of anaphylaxis, angioedema or urticaria with Penicillin or Ampicillin			

References

1. Daniel Bernstein. Congenital Heart Disease. In: Kliegman RM, Stanton BF, Geme III JWS, Schor NF, Behrman RE. Editors. Nelson Textbook of Pediatrics, 20th Edition. New Delhi: Elsevier; 2016: 2182-2249
2. Kitchner DJ. Cardiovascular Diseases. In: Forfar & Arneil's Text Book of Pediatrics. 7th ed. London; 2008.
3. Gewitz MH, Woolf PK. Cardiac Emergencies. In: Fleisher GR, Ludwig S, editors. Textbook of Pediatric Emergency Medicine. 6th ed. Philadelphia: Lippincott Williams & Wilkins; 2010.
4. Sondheimer HM, et al. Cardiovascular diseases. In: Hay WW, Levin MJ, Sondheimer JM, Deterding RR, editors. Current diagnosis & Treatment in pediatrics. 18th ed. NY: McGraw-Hill; 2007. p 542-604.
5. Sondheimer JM. Cardiovascular Diseases. In: Current Essentials: Pediatrics. 1st ed. USA: McGraw-Hill; 2008.
6. Prevention of Infective Endocarditis: Guidelines from the American Heart Association. Circulation. 2007; 116:1736-1754.
7. Driscoll, David J. Left-to-Right Shunts. In: Fundamentals of Pediatric Cardiology. 1st ed. USA, Lippincott Williams & Wilkins; 2006.
8. Michael R Carr, Steven R Neish, Pediatric Atrial Septal Defects. [Internet]. 2011 [updated Jun 21, 2010; cited 2011 May 30]. Available from: <http://emedicine.medscape.com/article/889394>.
9. Kahan S, Tietdum JE, DeAntonis KO. Cardiology. In: In a page Pediatrics, 2nd ed. Philadelphia : Lippincott Williams & Wilkins; 2008.
10. Khan MR, Rahman ME. Essence of Pediatrics. 4th ed. Elsevier; 2011. Chp 9, CVS; p. 152-194.
11. Beerman LB Tetralogy of Fallot, The Merck Manual. [Internet]. 2010 [updated March 21, 2010; cited 2011 May15]. Available from: http://www.merckmanuals.com/professional/pediatrics/congenital_cardiovascular_anomalies/tetralogy_of_fallot.html.
12. Edward F. Bell, Jeffrey L. Segar, MD, Pharmacologic Closure of PDA, Iowa Neonatology Handbook: Pharmacology. [Internet]. 2011 [updated Jun 2008; cited 2011 May 18]. Available from: <http://www.uihealthcare.com/depts/med/pediatrics/iowanonatologyhandbook/pharmacology/closurePDA.html>.

SELF ASSESSMENT

Short answer questions [SAQ]

1. What are the findings in hand of child suffering from infective endocarditis?
2. Write down the treatment of heart failure in children.
3. Classify congenital heart disease.
4. Write down the common presentations of Tetralogy of Fallot.

Multiple choice questions [MCQ]

- Cyanotic congenital heart diseases are-
☐ a) ventricular septal defect ☐ b) tetralogy of Fallot ☐ c) coarctation of aorta
☐ d) transposition of great arteries ☐ e) patent ductus arteriosus
- Common congenital heart disease having left to right shunt include
☐ a) VSD ☐ b) ASD ☐ c) Coarctation of aorta
☐ d) PDA ☐ e) Pulmonary stenosis
- Causes of heart failure in children are-
☐ a) COPD ☐ b) VSD ☐ c) AGN
☐ d) myocarditis ☐ e) TOF
- Tetralogy of Fallot includes following components-
☐ a) ventricular septal defect ☐ b) aortic stenosis ☐ c) overriding of aorta
☐ d) pulmonary hypertension ☐ e) right ventricular hypertrophy
- The recognized complications of TOF are-
☐ a) polycythaemia ☐ b) cerebral abscess ☐ c) thromboembolism
☐ d) heart failure ☐ e) hyperuricaemia
- Features of heart failure in infants and children are-
☐ a) dyspnoea ☐ b) gallop rhythm ☐ c) cardiomegaly
☐ d) enlarged tender liver ☐ e) crepitations at lung bases
- The characteristic chest X-ray findings of TOF are-
☐ a) cardiomegaly ☐ b) concavity at pulmonary conus ☐ c) oligemic lung field
☐ d) upturned apex of heart ☐ e) prominent pulmonary vascular markings
- Organisms commonly responsible for infective endocarditis are-
☐ a) *Staphylococcus aureus* ☐ b) *Streptococcus viridans* ☐ c) *Neisseria gonorrhoea*
☐ d) *Strept. pneumoniae* ☐ e) *Haemophilus influenzae*
- The major diagnostic criteria of infective endocarditis according to Duke's criteria are-
☐ a) positive blood culture ☐ b) Roth's spot ☐ c) fever
☐ d) Osler's nodes ☐ e) evidence of endocarditis on echocardiography
- Antibiotics recommended for treatment of infective endocarditis are-
☐ a) Benzyl Penicillin ☐ b) Ceftriaxone ☐ c) Gentamicin
☐ d) Vancomycin ☐ e) Amoxicillin
- Clinical features of pulmonary overload are-
☐ a) hepatomegaly ☐ b) palpitation ☐ c) raised JVP
☐ d) crackles in lung base ☐ e) cough with frothy sputum
- Measures taken to avoid hypercyanotic spell in TOF are-
☐ a) Propranolol ☐ b) Iron supplementation ☐ c) Morphine
☐ d) good hydration ☐ e) knee chest position
- The following is the characteristic murmur in mitral stenosis
☐ a) pansystolic murmur at the mitral area ☐ b) ejection systolic murmur
☐ c) mid diastolic murmur ☐ d) Austin flint murmur
☐ e) early diastolic murmur
- Patients with TOF usually present with
☐ a) pulmonary oedema ☐ b) brain abscess ☐ c) cardiomegaly
☐ d) high PCV ☐ e) low pulmonary vascular pressure

CHAPTER 17

JOINT PAIN AND SWELLING

ACUTE RHEUMATIC FEVER (ARF)	137
JUVENILE IDIOPATHIC ARTHRITIS (JIA)	141

Whenever a child presents with painful swollen joint, tenderness and limitation of movements, the following conditions should be considered-

- * Acute rheumatic fever (ARF)
- * Juvenile idiopathic arthritis (JIA)
- * Infection *e.g. septic or tubercular arthritis*
- * Haemarthrosis *e.g. haemophilia*
- * Reactive arthritis following enteropathic & urogenital infections
- * Systemic lupus erythematosus (SLE)
- * Trauma
- * Acute leukaemia

Many a times, children complaint of pain in the limbs but not truly in the joints, usually occurs at night and get relieved by gentle massage. These are probably related to **overuse of limbs or growing pain or non specific limbs pain** and should not be confused with arthritis.

Sometimes, thalassaemia major may present with pain in joints and limbs.

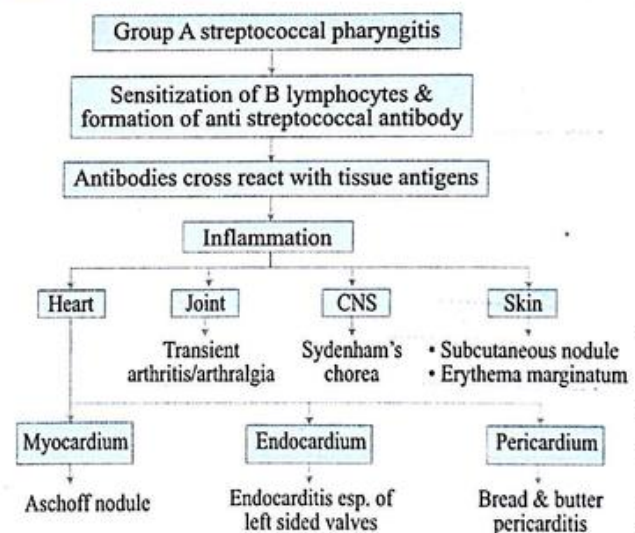
Acute rheumatic fever and Juvenile idiopathic arthritis are the 2 most common causes of arthritis in children and will be discussed in this chapter.

ACUTE RHEUMATIC FEVER (ARF)

It is a common problem in developing countries. The most important concern is that if the diagnosis of ARF is missed or if not treated properly, it may lead to development of rheumatic heart diseases *e.g. mitral valvular diseases* as well as neurological problem like *rheumatic chorea*.

Aetio-pathogenesis

Rheumatic fever develops 2-4 weeks after an acute episode of group A beta haemolytic streptococcal pharyngitis (at a time when clinical findings of pharyngitis are no longer present). However, in about one third of cases history of pharyngitis are absent. The disease is immune mediated and is related to immunogenic cross reactivity between streptococcal components *e.g. M protein, cell wall group A carbohydrate etc.* and tissues of heart, joints and brain.



Pathophysiology of ARF
(adopted from Robbin's & Cotran's pathology '2010)

Clinical Manifestations

Age: Children between 5-15 years of age have high risk of streptococcal pharyngitis and acute rheumatic fever.

As there is no clinical or laboratory findings pathognomonic for acute rheumatic fever, **T. Duckett Jones** in 1944 proposed a guideline (revised in 1992) for diagnosis and to limit over diagnosis of acute rheumatic fever. The Jones Criteria, as revised in 2015 by the American Heart Association, is now intended for diagnosis of the initial attack of acute rheumatic fever and recurrent attacks.

Courtesy: Dr. Jahanara Parveen

Major criteriae	Minor criteriae	Evidence of antecedent group A streptococcal infection
* Migratory polyarthriti * Carditis * Sydenham's chorea * Subcutaneous nodules * Erythema marginatum	* Clinical features: * Arthralgia Fever * Laboratory features: * Elevated acute phase reactants <i>e.g.</i> ESR, CRP * Prolonged P-R interval	* Microbiological: <u>Positive throat swab culture or rapid streptococcal antigen test, or</u> * Serological: Elevated or increasing streptococcal antibody titer - ASO
* <u>Low-Risk populations</u>: Incidence ≤ 2 per 100,000 school-age children per year or all-age rheumatic heart disease prevalence of ≤ 1 per thousand populations * <u>Moderate/High-Risk populations</u>: Those with higher incidence or prevalence rates		

- Initial attack: 2 major manifestations, or 1 major and 2 minor manifestations, plus evidence of recent GAS infection.
- Recurrent attack: 2 major, or 1 major and 2 minor, or 3 minor manifestations (the latter only in the Moderate/High-Risk population), plus evidence of recent GAS infection

Exception: There are 3 circumstances in which the diagnosis of acute rheumatic fever can be made without strict adherence to the Jones criteria:

1. Chorea occurs as the only major manifestation
2. Indolent carditis is the only manifestation, and
3. Recurrent RFin high-risk populations

Migratory polyarthriti

- Occurs in about 75% of patients
- Typically large joints *e.g. knees, ankles, wrists and elbows* are involved with pain and limitation of movements
- Affected joints are swollen, red, hot and exquisitely tender. A severely inflamed joint can become normal within 1-3 days, even without treatment



Swollen knee joints

- A dramatic response to oral aspirin is characteristic

Monoarthriti and involvement of spines, small joints of hands and feet and hip joints are uncommon in rheumatic fever. Rheumatic arthritis is typically not deforming.

Carditis

Occurs in 50-60% of cases. It involves all the 3 layers of heart i.e. endocardium, myocardium or pericardium (pancarditis).

Features of Pancarditis

- * Endocarditis: Murmurs due to valvular involvement
- * Myocarditis: Tachycardia, conduction defect, cardiomegaly
- * Pericarditis: Pericardial rub & effusion

As per revised Jones criteria '2015, subclinical carditis is also accepted as major criteria (defined as without a murmur valvuliti but echocardiographic evidence of carditis)

Commonly, mitral valves are involved. Sometimes along with mitral valves, aortic valves may be involved. But isolated aortic or right-sided valvular involvement is uncommon.

Common murmurs are-

- * High-pitched holosystolic murmur radiating to axilla because of mitral regurgitation
- * Apical mid diastolic murmur due to relative mitral stenosis
- * High pitched decrescendo diastolic murmur due to aortic insufficiency

Sometimes, carditis results in cardiomegaly and congestive heart failure with pulmonary and systemic congestion.

Sydenham's chorea

Occurs in about 10-15% of patients.

- Characteristic movements:

- * Milkmaids

grip

- * Spooning

and
pronation
of hands

when

patient's

arms are

extended

- * Wormian /darting movements of the tongue upon protrusion

- * Deterioration of handwriting

- Associated features: Emotional lability, incoordination, poor school performance and facial grimacing. These are exacerbated by stress and disappears with sleep



Sydenham's chorea

Subcutaneous nodules

These

are firm

non-tender

nodules

present along

the extensor

surfaces

of tendons

near bony

prominences.



Subcutaneous nodules

There is a

corelation between the presence of these nodules and rheumatic heart disease

Erythema marginatum (Rare.

Erythematous

macular rash,

which are

serpiginous

with pale

centers and are

non-pruritic.



Erythema marginatum

It occurs primarily over the trunk and extremities but not on the face. It is accentuated by warming the skin.

Complication

Rheumatic valvular diseases e.g. mitral (stenosis, regurgitation), aortic (stenosis, regurgitation) and involvement of other valves.

Diagnosis

Based on C/F & relevant investigations.

Investigations

- Complete blood counts and PBF: Hb% (normal), TC, DC (leukocytosis), PBF: Normal
- Acute phase reactants (ESR, CRP): Raised
- Chest X-ray: Normal or may have cardiomegaly in case of carditis
- ECG: Features of 1st degree heart block (prolonged P-R interval)



Source: Internet

- Echocardiography: To detect evidence of carditis
- Throat swab for culture: May reveal group A β haemolytic streptococci

Treatment

- Counsel parents about the disease, its complications & importance of strict adherence to Penicillin prophylaxis
- Supportive
 - * Bed rest
 - * Immobilization of affected joints

- * Close monitoring for features of carditis
- Antibiotics
 - * Phenoxymethyl Penicillin (50 mg/kg/day 6 hourly for 10 days) or
 - * Erythromycin (40 mg/kg/day PO 6 hourly for 10 days) or
 - * A single IM injection of Benzathine Penicillin (6 lacs unit for < 30 kg and 12 lacs unit for >30 kg)
- Anti-inflammatory drugs: Aspirin and steroids and the recommendations are:

Category	Anti inflammatory Agents	Dose & duration
Patients with * Polyarthrititis * Isolated carditis <u>without cardiomegaly or CCF</u>	Aspirin	<u>50-75 mg/kg/day in 4 divided doses for 3-5 days followed by 50 mg/kg/day in 4 divided doses for 3 weeks & 25mg/kg/day for another 2-4 weeks</u>
Patients with carditis and cardiomegaly or CCF	Prednisolone	<u>2 mg/kg/day in 4 divided doses for 2-3 weeks followed by 1 mg/kg/day for 2-3 weeks and then tapering of the dose by 5 mg/24 hr every 2-3 days.</u> When prednisone is being tapered, <u>aspirin should be started at 50 mg/kg/day in 4 divided doses for 6 wk to prevent rebound of inflammation.</u>

N.B. Digoxin may be used in heart failure of acute rheumatic carditis if needed. But with caution as it may precipitate arrhythmia

• Treatment of Sydenham's chorea

- * Phenobarbital (16-32 mg every 6-8 hour PO) is the drug of choice

If phenobarbital is ineffective, either of the following should be initiated

- * Haloperidol (0.01-0.03 mg/kg/24 hour PO in 2 divided doses)
- * Chlorpromazine (0.5 mg/kg every 4-6 hourly PO)
- * Antiinflammatory agents are usually not indicated
- * Duration of treatment: depends on the response. *Dose is increased until desired response is achieved then tapered gradually*

Prevention

Both initial and subsequent attacks of ARF can be prevented through Penicillin prophylaxis.

- Prevention of initial attack (Primary prevention): Phenoxymethyl Penicillin or

erythromycin orally for 10 days in any case of streptococcal sore throat

- Prevention of subsequent attacks (Secondary prevention): Penicillin or other drugs according to the following schedule-

Drug	Dose	Route
Benzathine Penicillin	1.2 million units for patients > 30 kg, 600,000 - 900,000 units for patients < 30 kg every 3-4 weekly	IM
Penicillin V	250 mg bd (weight > 30 kg) 125 mg bd (weight < 30 kg)	Oral
Erythromycin	250 mg bd (weight > 30 kg) 125 mg bd (weight < 30 kg)	Oral
Sulfadiazine/ Sulfisoxazole	0.5 gram once daily	Oral

Duration of Penicillin Prophylaxis

Category	Duration after last attack
Rheumatic fever without carditis	5 years or until 21 years of age whichever is longer
Rheumatic fever with carditis but no residual heart disease <i>i.e. no valvular disease</i>	10 years or until 21 years of age whichever is longer
Rheumatic fever with carditis and residual heart disease <i>i.e. persistent valvular disease</i>	10 years or until 40 years of age, whichever is longer; sometimes lifelong prophylaxis

JUVENILE IDIOPATHIC ARTHRITIS

(Synonyms: JRA, JCA) It is the most common chronic rheumatic illness of children.

Pathophysiology

It is characterized by synovitis of peripheral joints manifesting as soft tissue swelling and effusion.

Diagnostic Criteria of JIA

All three of the following must be met-

- Arthritis persisting for ≥ 6 weeks
- Onset of arthritis before 16 years of age
- Exclusion of other causes of arthritis

Arthritis is defined as -

- Swelling or effusion, or
- ≥ 2 of the following signs-
 - * Limitation of range of motion
 - * Tenderness or Pain on motion
 - * Increased temperature



Swollen knee joints with periarticular wasting

Classification of JIA

Based on the number of joints affected during the first 6 months of the disease and the presence of extra-articular manifestations, 7 categories of JIA are seen among children

1. Oligoarthritis (40-50%)

Arthritis affects 1-4 joints during the 1st 6 months of disease. Two subcategories are recognized -

- * Persistent oligoarthritis: affecting ≤ 4 joints throughout the disease course
- * Extended oligoarthritis: affecting >4 joints after the 1st 6 months of disease

2. Polyarthritis, Rheumatoid factor negative (20-35%)

Affects ≥ 5 joints during the 1st 6 months of disease. May be symmetric or asymmetric; Affects small and large joints; cervical spine; temporomandibular joint

3. Polyarthritis, Rheumatoid factor positive (<10%)

Affects ≥ 5 joints during the 1st 6 months of disease. Aggressive symmetric polyarthritis

4. Systemic arthritis (5-15%)

Along with joint manifestations, it has prominent extra-articular systemic manifestations *e.g. non remittent fever; rash, lymphadenopathy, serositis and hepatosplenomegaly.*

5. Enthesitis related arthritis (5-10%)

Inflammation at one or more of the entheses (site of insertion of tendons, ligaments or

fascia into bones). The common sites of inflammation are at insertion of planter fascia and at the insertions of tendo Achilles into calcaneum.

6. Psoriatic arthritis (5-10%)

Arthritis and psoriasis, or arthritis and at least 2 of the following

- Dactylitis

Nail

pitting and

onycholysis

relative



Source: Internet

Pitting of nails

- H/O Psoriasis in a 1st degree relative

7. Undifferentiated

It covers overall definitions of JIA but do not fulfill any specific category

Clinical Manifestations

Although variable, the usual presentations are- Persistent pain and swelling of joints, both small and large.

- Limping or refusal to walk or trying not to use the affected joints (guarding of joints)



Proximal interphalangeal (PIP) joints with deformity (spindle shaped)

- Involvement of PIP joints of hands gives rise to characteristic spindle shaped appearance
- Sometimes dysfunction noted in upper limbs, neck (torticollis)
- Joint stiffness following sleeping, rest or decreased activity (as morning stiffness)
- Presence of rheumatoid nodules on the extensor surface of elbow & over Achilles tendons
- Non-specific symptoms such as lethargy, high fever, poor appetite or irritability, sleep disturbances
- Presence of evanescent rash
- Occasionally, features of extra-articular manifestations *e.g. pericarditis, serositis, organomegaly, uveitis may be present*



*Evanescent rash on the inner aspects of knee joints
Courtesy: Dr. Anindita Bose*

Characteristics of arthritis in acute rheumatic fever and rheumatoid arthritis

Parameters	Acute Rheumatic fever	Rheumatoid arthritis
Types of joints involved	Large joints. Involvement of spines, small joints of hands and feet and hip joints are uncommon	Both large & small joints
Symmetry of involvement	Asymmetrical	Usually symmetrical
Onset of arthritis	Acute onset and lasts for shorter period	Insidious onset and arthritis remains for a longer duration
Characteristics of arthritis	Migratory polyarthritis with exquisite pain & tenderness. Monoarthritis unusual	Arthritis & joint symptoms are more marked early in the morning (morning stiffness) or after a period of rest
Response to aspirin	Dramatic	Not such
Chance of deformity	Typically non deforming disease	High
Preceding history	Sore throat 2-4 weeks prior to the onset of joint pain	Absent
Involvement of other organs	Heart (carditis/valvular lesions), Basal ganglia (chorea)	Uveitis, lymphadenopathy, hepatosplenomegaly

Diagnosis

Based on C/F & relevant investigations.

Investigations

• Blood

Investigations	Results
Complete blood counts	Hb (low), TC & DC (neutrophilic leukocytosis), platelets (thrombocytosis)
PBF	Non-specific
Acute phase reactants (ESR, CRP, ferritin)	Raised

Anti-Nuclear Antibody (ANA)	Positive in 40-50% of patients
Rheumatoid Factor (RF)	Only 5-10% patients are positive
Anti-cyclic citrullinated peptide (Anti-CCP) antibody	It is a highly specific serological marker for early diagnosis of <u>Rheumatoid arthritis</u>
Urinalysis	May reveal <u>proteinuria</u> (50-60%) and/or <u>microscopic haematuria</u> (30-50%)

- Radiology & Imaging

Investigations	Results
X-ray of affected joints	May show <u>soft tissue swelling, periarticular osteoporosis, periostitis, subchondral bony erosion, loss of cartilage, narrowing of joint space, osteopenia</u>
Ultrasonography of affected joints	May identify joint effusion
MRI of the affected joints	<u>More sensitive than X-ray to detect early changes</u>

- Synovial fluid analysis & synovial biopsy
- Arthroscopy, arthrography
- Others
 - * Slit lamp examination of the eyes to assess uveitis
 - * Urine R/M/E to exclude SLE *e.g. haematuria, proteinuria*

Complications

- | | |
|----------------------|----------------------------|
| * Joint contractures | * Chronic anterior uveitis |
| * Anaemia | * Growth disturbance |
| * Pericarditis | * Amyloidosis |
| * Myocarditis | |
| * Glomerulonephritis | |

Treatment

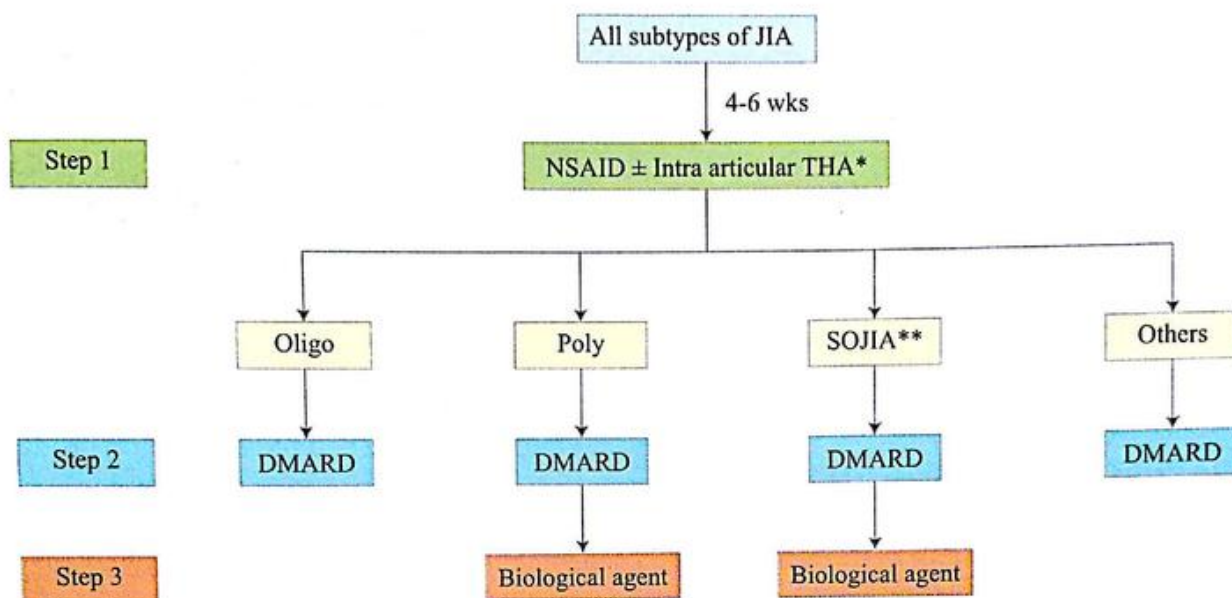
Treatment of JIA is multidisciplinary involving paediatrician, rheumatologist, physiotherapist and ophthalmologist. Treatment options as well as duration of treatment vary among different subtypes & from patient to patient.

Treatment should be started with NSAID and unless adversity noted, the drug should be continued for at least 4 to 6 weeks to allow sufficient time to assess clinical response. Sometimes, along with NSAID, other treatment options are added depending on response to drugs, types of arthritis, associated comorbidities and also stages of the disease.

A. Drugs

- NSAIDs: Commonly used are -
 - * Naproxen (15 mg/kg/day PO bid, maximum 1 gm/day) or
 - * Ibuprofen (40 mg/kg/day PO tid, maximum 2.4 gm/day) or
 - * Meloxicam (0.125 mg/kg/day PO once daily, maximum 15 mg/day)
- Disease modifying anti-rheumatic drugs (DMARDs): These drugs retard progression of the disease. They are considered for any form of arthritis that is not controlled by NSAID. The drugs include -
 - * Methotrexate, Oral/Subcutaneous (dose: 10 mg/m²/week)
 - * Sulfasalazine
 - * Leflunamide
- Corticosteroid: Used as an adjunct or bridging therapy -
 - * Systemic steroid *e.g. Prednisolone, Methyl prednisolone*
 - * Intra-articular steroid *e.g. Triamcinolone hexacetonide*
- Biological agents
 - * Tocilizumab
 - * Etanercept
 - * Infliximab
 - * Adalimumab
 - * Abatacept
 - * Rituximab
 - * Anakinra

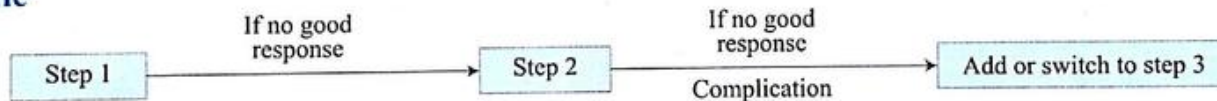
TREATMENT ALGORITHM FOR JIA AT A GLANCE



*THA - Triamcinolone hexacetonide
 **SOJIA - Systemic onset JIA

All subtypes of JIA

Rule



B. Physiotherapy

It preserves range of motion of the joints and muscular strength, and protects joint integrity.

Follow up

- To see improvement in activities of daily life and early detection of complications e.g. joint contractures, muscle wasting etc.
- Periodic slit-lamp ophthalmologic examinations to monitor for asymptomatic uveitis

References

1. Shulman ST. Rheumatic Fever. In: Kliegman RM, Stanton BF, Geme III JWS, Schor NF, Behrman RE. Editors. Nelson Textbook of Pediatrics, 20th Edition. New Delhi: Elsevier; 2016: 1332-1337.
2. Wu EY, Bryan AR, Rabinovich CE. Juvenile Idiopathic Arthritis. In: Kliegman RM, Stanton BF, Geme III JWS, Schor NF, Behrman RE. Editors. Nelson Textbook of Pediatrics, 20th Edition. New Delhi: Elsevier; 2016: 1160-1170.
3. Gerber MA et al. Prevention of rheumatic fever and diagnosis and treatment of acute streptococcal pharyngitis-endorsed by the American Academy of Pediatrics. Circulation. 2009;119: 1541-51.

4. Rheumatic fever expert committee guideline for diagnosis, prevention and follow up of streptococcal pharyngitis and rheumatic fever. Dhaka, Bangladesh 2000.
5. Rahman SA. Juvenile idiopathic arthritis: Most common rheumatic disorder in children-an overview. Journal of Bangladesh College of Physicians and Surgeons 2009; 27(2): 91-98.
6. Vossenaar ER, Venrooij WVJ. Anti-CCP antibodies, a highly specific marker for rheumatoid arthritis. Clin and App Immun Rev 2004; 4: 239-62.
7. Doherty M et al. Musculoskeletal Disorders. In: Boon NA, Colledge NR, Walker BR, Hunter JAA, editors. Davidson's Principles and Practice of Medicine. 20th ed. London: Churchill Livingstone; 2006: p.1065-1144
8. Acute Rheumatic Fever Presenting with Sydenham's Chorea. Woo CLF et al, HK J Paediatr 2003; 8:198-202

SELF ASSESSMENT

Short answer questions [SAQ]s

1. How will you diagnose a case of Rheumatic fever in children?
2. A 6 year old boy weighing 16 kg presented with fever and painful swelling of knee joint for 7 days. From yesterday, he developed breathlessness. He had history of similar joint pain 6 months ago. Examination of the precordium revealed a systolic murmur. i) What is the most likely diagnosis? ii) How will you investigate & treat this boy? iii) How will you plan to prevent further attacks?

Multiple choice questions [MCQ]

1. The major criteriae for diagnosis of acute rheumatic fever include-
☐ a) arthralgia ☐ b) fever ☐ c) Sydenham's chorea
☐ d) carditis ☐ e) subcutaneous nodules
2. Recommended drugs for prevention of rheumatic fever recurrences are-
☐ a) benzathine penicillin ☐ b) phenoxymethyl penicillin ☐ c) erythromycin
☐ d) benzyl penicillin ☐ e) sulfadiazine
3. The characteristic features of JIA are-
☐ a) migratory polyarthritis ☐ b) morning stiffness ☐ c) high chance of joint deformity
☐ d) symmetrical arthritis ☐ e) dramatic response to aspirin
4. Disease modifying anti-rheumatic agents are-
☐ a) naproxen ☐ b) sulfasalazine ☐ c) methotrexate
☐ d) etanercept ☐ e) indomethacin
5. Features of acute rheumatic carditis include-
☐ a) tachycardia ☐ b) arrhythmia ☐ c) pleural effusion
☐ d) mitral stenosis ☐ e) changing murmur
6. Major objectives of Penicillin prophylaxis in rheumatic fever are, prevention of-
☐ a) mitral valvular disease ☐ b) joint deformity ☐ c) infective endocarditis
☐ d) mental retardation ☐ e) nephropathy
7. The following drugs are DMARD
☐ a) Etanercept ☐ b) Leflunamide ☐ c) Methotrexate
☐ d) Meloxicam ☐ e) Rituximab

CHAPTER 18

FEVER AND RASH

DENGUE SYNDROME

147

When a child presents with fever and rash, the following conditions should be considered as the possible differential diagnoses-

- | | |
|---|---------------------------|
| * Measles | * Scarlet fever |
| * Dengue syndrome | * Kawasaki disease |
| * Rubella | * Chicken pox |
| * Idiopathic thrombocytopenic purpura (ITP) | * Meningococcal infection |
| * Henoch Schönlein purpura (HSP) | * Fifth disease |
| * Exanthem subitum (HSV 6 & 7) | * Chikungunya |

Of the different causes, dengue syndrome *e.g. dengue fever, dengue haemorrhagic fever and dengue shock syndrome* is highlighted in this section.

DENGUE SYNDROME

Organism: Dengue virus 4 serotypes *Den-1, Den-2, Den-3, Den-4*

Dengue fever			Dengue hemorrhagic fever			Dengue Shock syndrome
Suspected	Probable	Confirmed	Suspected	Probable	Confirmed	
Fever + Nonspecific features + High index of suspicion	Suspected DF + High dengue IgM titre ≥1280	Probable DF + Isolation of dengue virus/ Antigen from the body	DF + Evidence of hemorrhagic manifestation + Evidence of plasma leakage	Suspected DHF + High dengue IgM titre ≥1280	Probable DHF + Isolation of dengue virus/ Antigen from the body	

Spectrum of Dengue Syndrome

A. Dengue fever (DF)

Case definition:

Suspected dengue: Continued fever for 2-7 days, AND Two or more of the following features-

- | | |
|---------------------------------------|------------------------------|
| * Severe headache, rash | * Haemorrhagic manifestation |
| * Retro-orbital pain | * Leukopenia |
| * Severe myalgia/arthralgia/back pain | * Thrombocytopenia |
| * Nausea, vomiting/abdominal pain | * Raising Hct (5-10%) |

AND

High index of suspicion based on period, population and place

AND

Absence of convincing evidence of any other febrile illness.

- **Probable dengue:** Suspected dengue with supportive serology: Positive IgM, titre ≥ 1280
- **Confirmed dengue:** Probable dengue with one of the following-

- * Isolation of dengue virus
- * Detection of dengue virus or Ag in tissue, serum or CSF by ELISA, Immunofluorescence, PCR

B. Dengue Haemorrhagic Fever (DHF)

Case definition

• Suspected DHF

Features of dengue fever at the initial stage

AND

Evidence of one or more of the following haemorrhagic manifestations -

- * Positive tourniquet test
- * Petechiae, ecchymosis or purpura
- * Bleeding from mucosa (mostly epistaxis & gum bleeding)
- * Bleeding from injection sites
- * Haematemesis, melaena, haematuria, per vaginal bleeding
- * Thrombocytopenia (platelet count $\leq 100,000/\text{cmm}$)

AND

- Evidence of plasma leakage due to increased capillary permeability, manifested by one or more of the following-

- $\geq 20\%$ rise in haematocrit for age and sex
- $\geq 20\%$ drop in haematocrit following treatment with fluids as compared to baseline
- Pleural effusion/ascites/hypoproteinemia



Typical rash in dengue fever



Positive tourniquet test



Bleeding at injection site



Subconjunctival haemorrhage



Ascites, evidence of plasma leakage

Dengue Shock Syndrome (DSS)

Case definition

When a case of DHF manifests with one or more of the features of **circulatory failure** given alongside.

- Restlessness
- Hypotension for age
- Narrow pulse pressure (< 20 mmHg)
- Rapid weak pulse
- Cold clammy skin
- Profound shock

The major pathophysiologic abnormalities of DHF and DSS are-

- * Increased vascular permeability
- * Abnormal haemostasis
- * Thrombocytopenia

• Probable DHF

Suspected dengue Haemorrhagic Fever with serological evidence

• Confirmed DHF

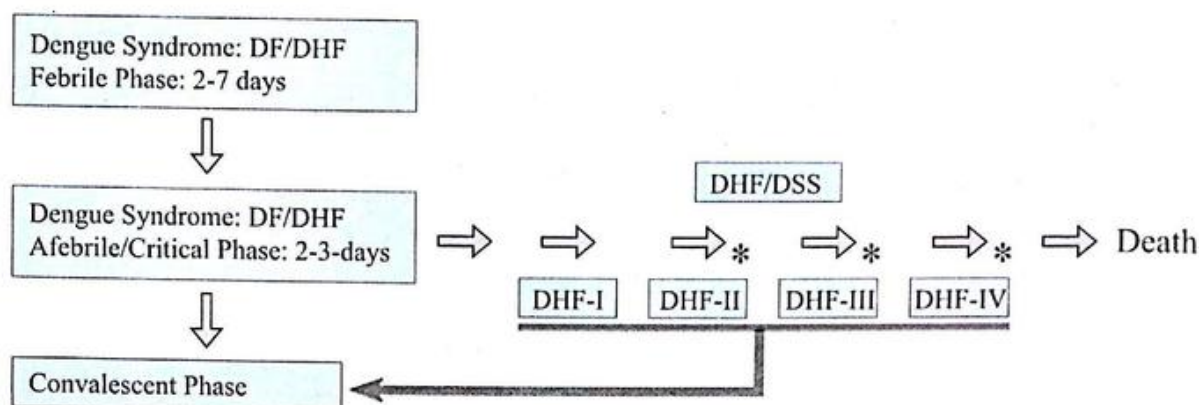
Probable DHF with virus isolation or detection of dengue antigen

The cut-off point between dengue fever and dengue shock syndrome is the evidence of plasma leakage, which will invariably be present in the later but absent in the former.

Severity grading of Dengue Shock Syndrome

Dengue Syndrome	Grade	Clinical Features	Laboratory Features
DF		Features as per case definition	Leukopenia $\pm$ Thrombocytopenia ($< 1,50,000/\text{cmm}$) 5-10% change in haematocrit
DHF	I	Features of DF or H/O features of DF + Positive tourniquet test	Thrombocytopenia ($< 1,00,000/\text{cmm}$) Haematocrit rise $\geq 20\%$
DHF	II	Features of DF or H/O features of DF + Spontaneous bleeding e.g. sub-conjunctival haemorrhage, bleeding from nose or gum, petechiae or purpura, tarry stool	Thrombocytopenia ($< 1,00,000/\text{cmm}$) Haematocrit rise $\geq 20\%$
DHF (DSS)	III	Features of DF or H/O features of DF + Features of circulatory failure e.g. restlessness, weak thready pulse, hypotension, narrow pulse pressure, cold clammy skin, fluid leakage	Thrombocytopenia ($< 1,00,000/\text{cmm}$) Haematocrit rise $\geq 20\%$
DHF (DSS)	IV	Features of DF or H/O features of DF + Profound shock with undetectable blood pressure and pulse	Thrombocytopenia ($< 1,00,000/\text{cmm}$) Haematocrit rise $\geq 20\%$

Clinical Course at A Glance



* If appropriate treatment is not provided then there is high risk of death.

Investigations

No appreciable change is seen in the laboratory tests except NS₁ within first 3 days of febrile phase. So no tests should be done before 3 days if not otherwise indicated *e.g. unusual haemorrhage*

- Complete blood counts: Total leukocyte count (reduced), platelet count (reduced) and haematocrit (raised)
- Blood for NS₁ (Non Structural protein of dengue): may be positive as early as day 1 of illness. It becomes negative on 4-5th day of illness
- Dengue antibodies (IgG & IgM): Positive
- Chest X-ray right lateral decubitus view or Ultrasonography of chest & abdomen: for detection of pleural effusion or ascitis
- Serum albumin: May be reduced
- Prothrombin time: May be elevated
- Serum electrolytes: May be altered
- Others: MP to exclude malaria in malaria endemic zone

Serial leukocyte counts, haematocrit level and platelet count are very important for prognostic purpose.

Leukocyte count has a very important prognostic guide in early phase of dengue infection. Leukopenia <5000 cells/mm³ indicates that within the next 24 hours the patient will have subsidence/defervescence of fever and he will be entering the critical phase.

Management

A. Dengue Fever

Supportive management at home -

- Rest
- Antipyretics: Only Paracetamol
- Fluid: More, including ORS
- Foods: Usual family diet
- Investigations: Blood counts particularly leukocyte, platelet counts and haematocrit
- Referral knowledge to parents: If any of the following signs is noted, then the patient should be taken to hospital -

- * Abdominal pain
- * Passage of black tarry stool
- * Bleeding in the skin/nose/gums
- * Excessive sweating
- * Cold skin

B. DHF and DSS

Patients should be managed in the hospital.

Objectives of Management are -

A. Maintenance of -

- * Circulatory volume & haemodynamic status
- * Blood osmolality
- * Fluid & electrolytes balance

B. Prevention & treatment of complications**Assessment (Clinical & Laboratory)**

Check & keep records of -

- Haemodynamic status *e.g. pulse, blood pressure, pulse pressure, capillary refilling time every 4-6 hours*

- Evidence of bleeding
- Evidence of pleural effusion or ascites
- Intake-output chart
- Platelet count and haematocrit, twice daily

Treatment

Meticulous fluid replacement

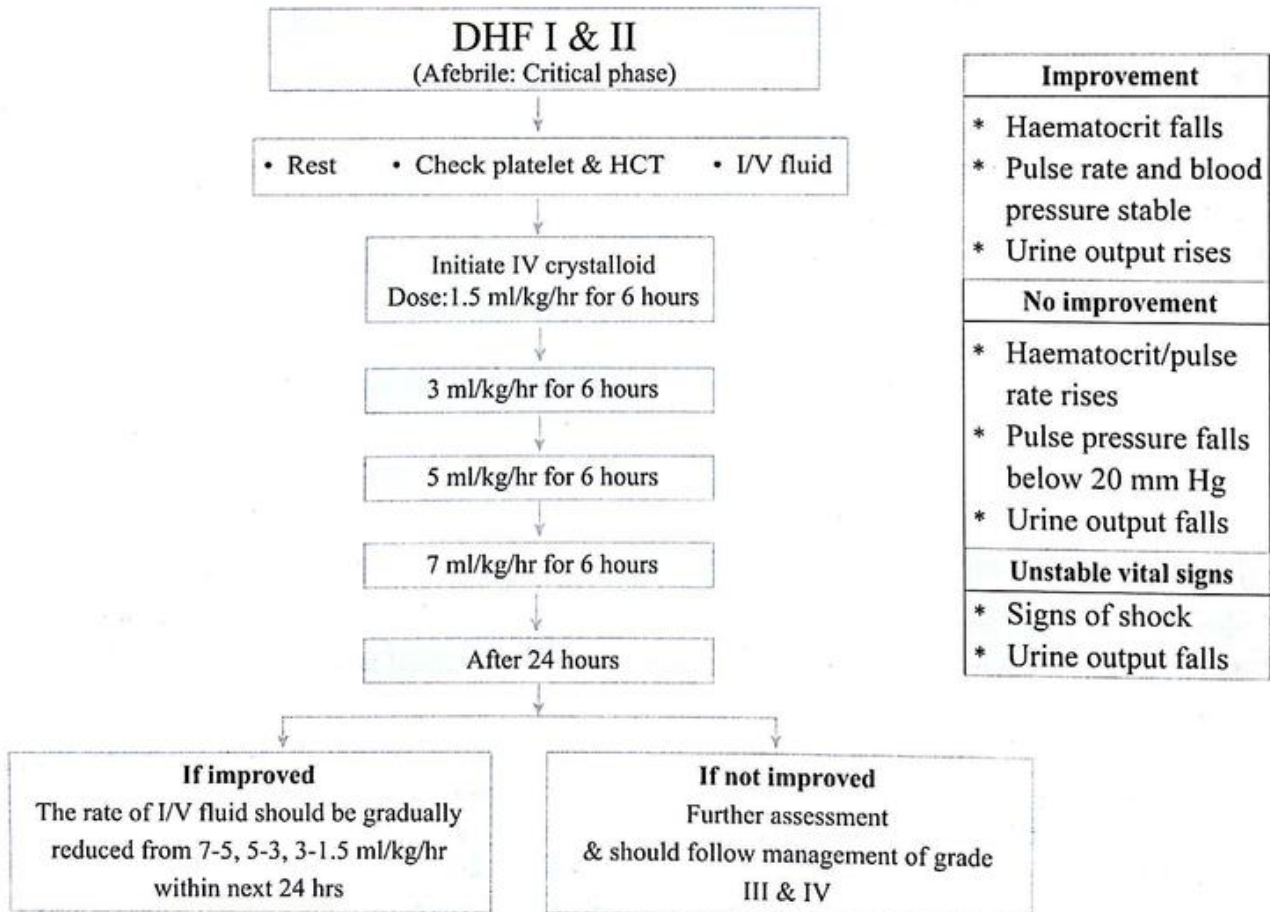
Recommended fluids are -

Crystalloids

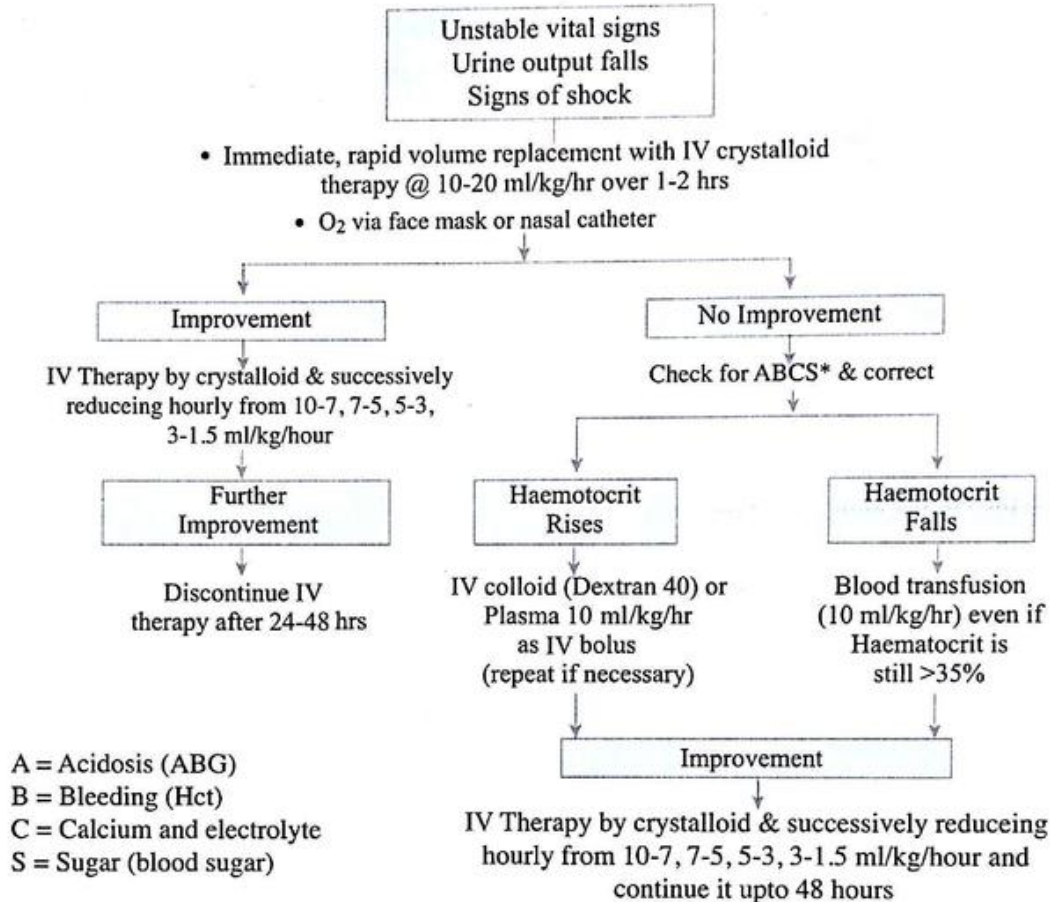
- * 5% dextrose in isotonic normal saline
- * 5% dextrose in half strength normal saline
- * 5% dextrose in Ringer's lactate solution

Colloids

- * Dextran 40
- * Plasma expander *e.g. Haemaccel*
- * Plasma

Fluid (volume) Replacement Algorithm

DHF Grades III & IV



Signs of circulatory failure

- * Restlessness
- * Rapid and weak pulse
- * Hypotension
- * Narrow pulse pressure (≤ 20 mmHg)
- * Cold clammy skin
- * Capillary refill time >2 seconds

Shock

- * Undetectable pulse and blood pressure

DON'TS in Dengue

- * Give aspirin or NSAID
- * Give antibiotic
- * Give steroid
- * Change the rate of infusion
- * Give transfusion unless indicated
- * Insert NG tube to determine concealed bleeding

When to stop fluid

- Signs of cessation of plasma leakage
- Stable BP, pulse & peripheral perfusion
- Fall of Haematocrit towards normal in the presence of good pulse volume
- No fever for 24-48 hours without antipyretics
- Restoration of bowel and abdominal function
- Improving urine output

Criteria for Discharging Patients

- Absence of fever for at least 24 hours
- Minimum 3 days after recovery from shock
- Presence of signs of recovery *e.g.*
 - * Stable Vital signs
 - * Normal temperature without Paracetamol
 - * No evidence of bleeding
 - * Return of appetite
 - * Good urine output
 - * Stable haematocrit
 - * Platelet count $\geq 50,000/\text{cmm}$

References

1. Directorate General of Health Services. Ministry of Health and Family Welfare. Dhaka, Bangladesh. Government of the People's Republic of Bangladesh. National Guidelines for Clinical Management of Dengue Syndrome, 3rd edition 2013.
2. Center for disease control, dengue home page, Laboratory Guidance and Diagnostic Testing, website accessed on 28.12.14, <http://www.cdc.gov/dengue/clinicalLab/laboratory.html>

SELF ASSESSMENT

Short answer questions [SAQ]

1. Write down the case definition of dengue haemorrhagic fever.
2. i) What is the cut off point of dengue fever and dengue haemorrhagic fever?
ii) When patient should be taken to hospital in dengue haemorrhagic fever?
3. When plasma or blood should be given to a patient with dengue haemorrhagic fever?
4. What are the causes of fever with rash in children?

Multiple choice questions [MCQ]

1. The case definition of dengue shock syndrome (DSS) are-
☐ a) hypertension ☐ b) narrow pulse pressure ☐ c) rapid weak pulse
☐ d) ascites ☐ e) subconjunctival haemorrhage
2. The recommended fluid for managing DSS are-
☐ a) dextrose in normal saline ☐ b) dextrose in acqua ☐ c) colloid
☐ d) plasma ☐ e) normal saline
3. The evidence of plasma leakage in dengue fever are-
☐ a) pleural effusion ☐ b) ascites ☐ c) capillary refill time < 2 seconds
☐ d) narrow pulse pressure ☐ e) decreased haematocrit
4. In dengue fever
☐ a) retro-orbital pain is common ☐ b) relative bradycardia is found ☐ c) Saddle back fever is unusual
☐ d) rash spread centrifugally ☐ e) Leukopenia is uncommon
5. The following are the signs of circulatory failure
☐ a) restlessness ☐ b) convulsion ☐ c) capillary refill time > 2 sec
☐ d) narrow pulse pressure ☐ e) petechiae
6. The don't's in dengue are
☐ a) use of steroid ☐ b) use of NSAID ☐ c) whole blood transfusion
☐ d) antibiotics ☐ e) use of DA

PROLONGED HIGH FEVER

ENTERIC FEVER	154
MALARIA	156
KALA-AZAR	160

Many a times, children are brought with history of fever for longer time e.g. for 2-3 weeks or even more with severe prostration despite getting the first line management. In such situation the following clinical conditions should be considered

- * Enteric fever
- * Malaria
- * Kala-azar
- * Malignancy e.g. leukaemia, lymphoma
- * Connective tissue diseases e.g. JIA, SLE
- * Infective endocarditis
- * Typhus
- * Liver abscess

In this chapter, we will highlight enteric fever, malaria and Kala-azar. Lymphoma, leukaemia, JIA, infective endocarditis are discussed in other chapters.

ENTERIC FEVER

It is a common illness in this part of world. In this condition children usually suffers from fever for more than 7 days with significant sickness and prostration.

Aetio-pathogenesis

Organisms: *Salmonella typhi*, *S. paratyphi A, B, C*.

Incubation period: 7-14 days.

The organisms enter the body through ingestion of contaminated foods or drinks. The organisms, after passing through the intestinal mucosa enter the mesenteric lymphoid system and then into the blood via lymphatics. This is called **Primary Bacteraemia** and at this stage the patient remains asymptomatic. The organisms then disseminate throughout the body, colonize and multiply in the reticuloendothelial system. After replication, organisms again enter the blood causing **Secondary Bacteraemia**, which coincides with the onset of symptoms and marks the end of incubation period.

Clinical Manifestations

- **Fever:** Prolonged high-grade fever is the main symptom. Fever rises gradually but the classical step-ladder pattern is rare
- **Non specific symptoms:** Anorexia, generalized myalgia
- **Abdominal symptoms:** Abdominal pain, diarrhoea or constipation

In the second week of illness, patients become acutely ill, lethargic and abdominal symptoms increase in severity. Vomiting and meningism may be prominent in infants and young children in this stage.

Physical examination reveals-

- | | |
|-------------------------|-------------------|
| * High body temperature | * Splenomegaly |
| * Pallor | * Jaundice |
| * Coated tongue | * Paralytic ileus |
| * Hepatomegaly | * Rose spots |

Sometimes, patients may present with irritability, confusion, delirium, stupor (encephalopathy).

Complications

Gastro - intestinal system	Intestinal haemorrhage, perforation, peritonitis, paralytic ileus, cholecystitis, hepatitis, hepatic abscess, splenic abscess
Central nervous system	Encephalopathy, cerebral oedema, subdural empyema, cerebral abscess, meningitis, ventriculitis
Cardio - vascular system	Endocarditis, myocarditis, pericarditis, arteritis, congestive heart failure
Respiratory system	Pneumonia, empyema, bronchopleural fistula
Bone and joint	Osteomyelitis, septic arthritis
Genito-urinary system	Urinary tract infection, renal abscess, pelvic infections, testicular abscess, prostatitis, epididymitis
Soft tissue infections	Psoas abscess, gluteal abscess, cutaneous vasculitis

Multidrug-resistant Typhoid Fever (MDRTF)

Typhoid fever resistant to the first-line recommended drugs such as *e.g.* Chloramphenicol, Ampicillin and Trimethoprim-Sulfamethoxazole.

Diagnosis

Based on C/F and relevant investigations.

Investigations

- Blood culture: It is positive in 40-60% of cases and yield is highest during the 1st week of illness

Stool and urine cultures become positive after the 1st week.

In addition, other supportive investigations are-

- Complete blood counts
 - * Haemoglobin is normal but may drop.
 - * WBC count is mostly normal though leukopenia may be present

- * Differential count is unremarkable except eosinopenia, that is present in about 80% cases

- * Platelet counts usually normal though thrombocytopenia may be present

- Widal test: It measures antibodies against O and H antigens of *S. typhi* and *S. paratyphi* and becomes positive after 5-7 days of fever. Because of many false-positive and false-negative results, diagnosis of typhoid fever by Widal alone is prone to error. Titers of TO -1:160 or TH -1:320 is considered significant if clinical features are consistent
- Bone marrow culture: It is a highly sensitive method for bacteriological confirmation of typhoid fever even in late stage of illness or with prior antibiotics

Treatment

- Counsel parents about the natural history of the disease, treatment and complications
- Supportive measures:
 - Antipyretic *e.g.* Paracetamol
 - Adequate hydration *e.g.* more fluid intake
 - Correction of fluid and electrolyte imbalance, if present
 - Adequate nutrition by soft, easily digestible nutritious diet
- Specific treatment: Appropriate antibiotics

	Uncomplicated Typhoid	Severe Typhoid
Fully sensitive cases	Amoxicillin (75-100 mg/kg/day)	Ceftriaxone (80-100 mg/kg/day)
MDR cases	Cipro/Oxofloxacin (15 mg/kg/day) or Cefixime (15-20 mg/kg/day)	Ciprofloxacin, Ofloxacin
Quinolone resistant cases	Azithromycin (8-10 mg/kg/day) or Ceftriaxone (80-100 mg/kg/day)	Ceftriaxone (80-100 mg/kg/day)

Duration of Treatment

- Variable, but usually about 10-14 days depending on the clinical status

Treatment of Complications

When a typhoid child become severely ill or presents with shock or neurological complication, dexamethasone should be added along with specific antibiotics.

- Dexamethasone (3 mg/kg initial dose, followed by 1 mg/kg every 6 hour for 48 hours)
- For intestinal perforation, Surgery

MALARIA

Malaria is a major parasitic problem throughout the world as well as in Bangladesh. The disease kills a million of children worldwide each year and they are mostly due to *Plasmodium falciparum*.

In Bangladesh approximately 33.6% of the total population are at risk of malaria. Majority of malaria cases are reported from the following 13 districts.

Malaria Risk	Districts
High endemic	Rangamati, Khagrachari, Bandarban
Moderate endemic	Cox's Bazar
Low endemic	Hobigonj, Kurigram, Moulavibazar, Mymensingh, Netrokona, Sherpur, Sylhet, and Sunamgonj, Chittagong

Aetio-pathogenesis

Agent: *Plasmodium* (*P. falciparum*, *P. vivax*, *P. ovale* and *P. malariae*)

Vector: Female anopheles mosquito

Host: Human being

Incubation period

Ranges from 10-35 days (*P. falciparum*, *P. vivax*, *P. ovale*: 10-14 days and *P. malariae*: 25-35 days).

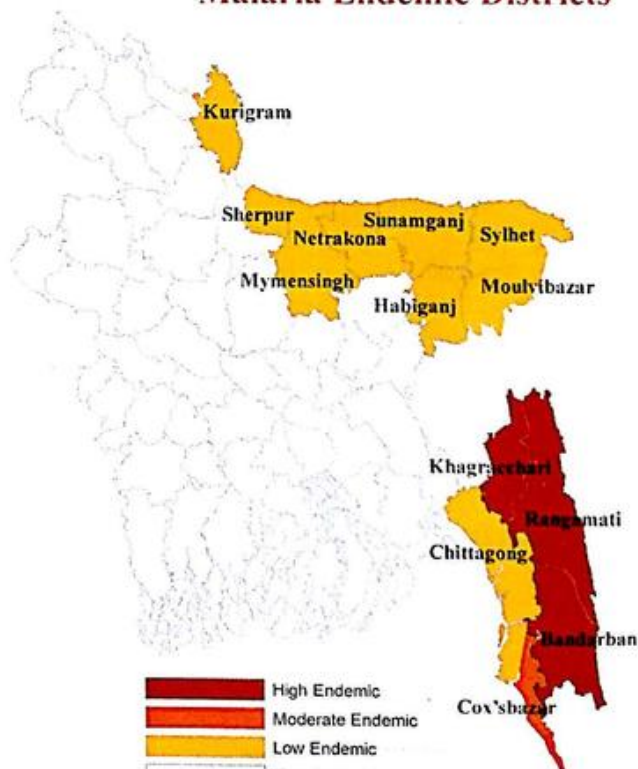
Transmission: Through -

- Bite of female anopheles mosquito
- Blood transfusion
- Rarely affect foetus through placenta

Symptoms of malaria results when erythrocytes of the hosts are invaded by merozoite (the intermediary stage of any of 4 species of plasmodium).

Apart from invasion of RBC and consequent high fever, the parasitized RBC (in case of *P. falciparum*) also causes microvascular blockade and anoxic damage of different organs particularly brain (cerebral malaria), kidney (acute tubular necrosis), lungs (pulmonary oedema), gut (algid malaria) etc. In addition, the parasite can also give rise to severe anaemia and hypoglycaemia.

Malaria Endemic Districts



Clinical Manifestations

Vary according to species, strain and host immunity.

Infant: Recurrent bouts of fever, irritability, poor feeding, vomiting, jaundice and splenomegaly.

Older Children: Fever may be cyclic (every 48 hours for all but *P. malariae* infection, in which it occurs every 72 hours) or irregular (most commonly in *P. falciparum* infection).

- The classical cold stage (feeling of chills & rigor), hot stage (dry flushed skin, rapid respiration and marked thirst) and sweating stage (temperature falls by crisis) may not always be present. Between attacks, patients may look quite well
- Sometimes patients with *P. falciparum* infection present with -
 - * Change of behaviour, convulsion and unconsciousness (cerebral malaria)
 - * Cold skin, profound weakness, and severe diarrhoea and sometimes circulatory collapse (algid malaria)
 - * Intravascular haemolysis, haemoglobinuria and renal failure (black water fever)
 - * Respiratory distress due to acute pulmonary oedema or acute respiratory distress syndrome (acidotic breathing)
 - * Severe prostration, i.e. extreme generalized weakness so the patient cannot walk, stand or sit without assistance and in small child failure to feed
 - * Severe vomiting
 - * Bleeding tendency or spontaneous bleeding
 - * Oliguria or acute renal failure (<17 ml/hour or <400 ml/24 hours)
 - * Other features e.g. confusion or drowsiness, jaundice, severe anaemia (haematocrit <15%, Hb% <5 gm/dl)
- Apart from fever, patients may have headache, backache, myalgia and fatigue.
- Clinical examination may reveal hepatomegaly and or splenomegaly

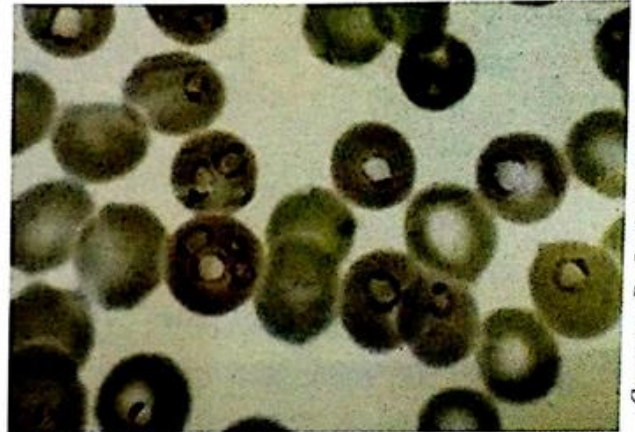
Rash is usually absent in malaria, which helps distinguishing it from viral infections.

Diagnosis

Basically clinical. The possibility of malaria is high, if a febrile child comes from any high risk area for malaria and who has no convincing evidence of other febrile illness.

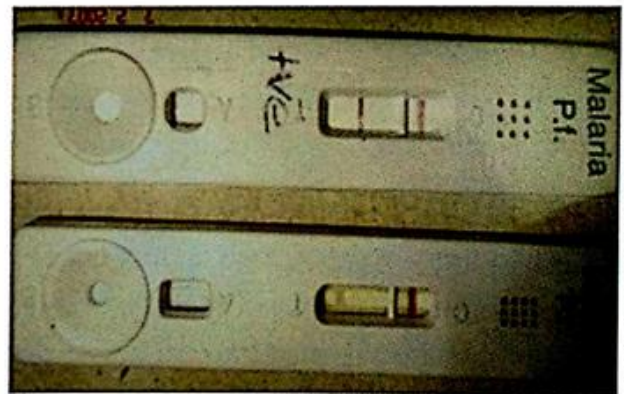
Investigations

- Blood slide examination (thick & thin film) for detection of plasmodia in blood smear



Courtesy: Dr Rasheda Samad

- ICT for malaria (Rapid Diagnostic Test -RDT): Similar diagnostic accuracy like that of blood slide examination for *P. falciparum*



Courtesy: Dr Rasheda Samad

- Complete blood counts: Hb (low), TC, DC (leukocytosis), platelet count (low), reticulocyte count (high) and findings related to the severity of haemolysis

Classification (according to National Guideline '2010)

In an endemic area, malaria is classified as-

- Falciparum malaria (Uncomplicated or severe)
- Vivax malaria

I. Falciparum malaria (FM)**a. Uncomplicated malaria (UM)**

Fever or history of fever within last 48 hours
and

Absence of convincing evidence of any other
febrile illness

and

High index of suspicion based on time,
place and person (endemic zone, susceptible
population, transmission season)

and

Diagnosis is confirmed by presence of
asexual form of *P. falciparum* in Blood Slide
Examination (BSE) or Rapid Diagnostic Test
(RDT) +ve for *P. falciparum*

b. Severe malaria (SM)

Fever or history of fever within last 48 hours
and

One or more of the following clinical or
laboratory features of severity

Other manifestations of severe Falciparum malaria

- Change of behaviour, convulsion and unconsciousness (cerebral malaria)
- Cold skin, profound weakness, and severe diarrhoea and sometimes circulatory collapse (algid malaria)
- Intravascular haemolysis, haemoglobinuria and renal failure (black water fever)
- Respiratory distress due to acute pulmonary oedema or acute respiratory distress syndrome (acidotic breathing)
- Clinical jaundice
- Severe prostration, i.e. extreme generalized weakness so the patient cannot walk, stand or sit without assistance and in small child failure to feed
- Severe vomiting
- Bleeding tendency or spontaneous bleeding
- Severe anaemia (haematocrit <15%, Hb% <5 gm/dl)
- Oliguria or acute renal failure (<17 ml/hour or <400 ml/24 hours)

Laboratory findings of severe**Falciparum malaria**

- Hyperparasitaemia (> 5% or 250000/ μ L)
- Hypoglycaemia (<2.2 mmol/L or < 40 mg/dl)
- Severe normocytic anaemia (Hb <5 gm/dl, PCV <15%)
- Fluid and electrolyte disturbance (hyponatraemia)
- Haemoglobinuria
- Metabolic acidosis (plasma bicarbonate <15 mmol/L)
- Hyperlactataemia (>5 mmol/L)
- Renal impairment (serum creatinine > 265 μ mol/L or > 3 mg/dl) And
- Presence of asexual form of *P. falciparum* in BSE or +ve RDT for *P. falciparum*

II. Vivax malaria (VM)

Fever or history of fever within last 48 hours
and

Absence of convincing evidence of any
other febrile illness

and

High index of suspicion based on time, place
and person

and

Diagnosis is confirmed by presence of
asexual form of *P. vivax* in Blood Slide
Examination (BSE) or Rapid Diagnostic Test
(RDT) +ve for *P. vivax*

Malaria Chemoprophylaxis

Chemoprophylactic drugs should be started one week before travel to endemic zone, continued during the stay and for 4 weeks after returning.

Drugs used for chemoprophylaxis

- * Chloroquine plus Proguanil or
- * Mefloquine or * Doxycycline

NB: Doxycycline should be given for 1 day before travel

TREATMENT OF MALARIA

FALCIPARUM MALARIA

a. Uncomplicated Falciparum Malaria (UM) Pre referral Treatment

First line treatment

Drug	Day	No of dose	Time	5- <15 kg	15- <25 kg	25- <35 kg	>35 kg
Artemether + Lumefantrine combination (ACT)	D 1	1st	0 hour	1	2	3	4
		2nd	8 hour	1	2	3	4
	D 2	3rd	24 hour	1	2	3	4
		4th	36 hour	1	2	3	4
	D 3	5th	48 hour	1	2	3	4
		6th	60 hour	1	2	3	4

IM Quinine (20 mg salt/kg stat IM – half dose in each thigh) or
Artesunate rectal capsule 10 mg/kg

Hospital Treatment

- IV Artesunate (2.4 mg/kg stat followed by 2.4 mg/kg daily until the patient can tolerate oral medication)
or
- IM Artemether (3.2 mg/kg stat followed by 1.6 mg/kg until patient can tolerate oral anti malarial)
or
- IV Quinine hydrochloride (20 mg/kg salt in drip followed by 10 mg/kg 8 hourly. Should be given in Glucose containing fluid in drip over 4 hours)
or
- IM Quinine to the anterior thigh (diluted 1:1 in sterile water for injection: the first 20 mg/kg dose is splitted; 10 mg/kg to each thigh)

Follow on Treatment

Once patient tolerates oral therapy it is essential to continue and complete the treatment like that of uncomplicated falciparum malaria.

Total duration of treatment: 7 days.

Gametocytocidal drug

At the end of treatment, a single dose of Primaquine (0.75 mg/kg) should be given.

(not recommended in children <4 yrs and in pregnancy)

Alternative therapy

- Quinine (10 mg/kg 8 hourly) 7 days + Tetracycline (250 mg 6 hourly) 7 days (Q7+T7)
or
- Quinine 7 days + Doxycycline (100 mg/day) 7 days (Q7+D7) or
- Quinine 7 days + Clindamycin (10 mg/kg twice daily) 7 days (Q7+C7) or
- Other WHO recommended ACT e.g. *Artesunate - Mefloquine*, *Artesunate - Amodiaquine*

Tetracycline and Doxycycline are contraindicated in children < 8 years old and pregnant & lactating mother

b. Severe Falciparum Malaria

Refer urgently to the hospital with pre referral treatment.

VIVAX MALARIA

Chloroquine 3 days + Primaquine 14 days (CQ3+PQ14)

Chloroquine: 10 mg/kg (Day 1 and Day 2). 5 mg/kg (Day 3) + Primaquine : 0.3 mg/kg daily for 14 days

Supportive

- Give Paracetamol & tepid sponging for fever
- Maintain fluid and nutrition

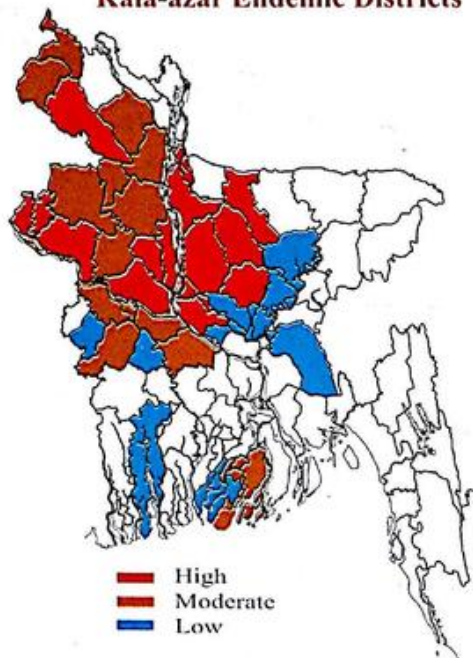
Treatment of Complications

- Correct
 - * Fluid & electrolyte imbalance, acidosis, dehydration
- Transfuse packed cell in severe anaemia

KALA-AZAR (KA)

Kala-azar (Black sickness) or visceral leishmaniasis is a parasitic disease. The Government of Bangladesh declared the disease reportable since 1987.

Kala-azar Endemic Districts



Kala-azar endemic districts in Bangladesh

Pabna, Sirajgonj, Rajshahi, Dinajpur, Natore, Naogaon, Thakurgaon, Mymensingh, Tangail, Jamalpur and Gazipur.

Aetio-pathogenesis

Agent: *Leishmania donovani* (India, Bangladesh)

Host: Humans

Vector: Sandfly (*Phlebotomus argentipes*)

Sandfly breed in the corners of soil floors of rooms, cattle sheds, damp places (rural areas). But in urban areas they breed in cracks and crevices of human dwellings, between bricks holes.

Transmission

- Bite of sandfly: Only females bite, mainly during nocturnal feeding
- Other possible ways of transmission are through:
 - * Blood transfusion
 - * Placenta
 - * Inoculation from cultures in the laboratory

Peak seasonal incidence

Three months after the onset of rain (August to October).

Incubation period

Ranges from 10 days to 2 years, but usually 3-6 months.

Clinical Manifestations

There are variable presentations. The disease may be asymptomatic, oligosymptomatic (sub-acute) or symptomatic

• Fever

- * Commonly: Long standing intermittent with a characteristic double diurnal periodicity.
- * Sometimes
 - Gradual onset of low-grade fever with malaise, or
 - Very acute high grade remittent associated with prostration and features of toxemia

• Appetite is usually good with normal digestive functions

• Epistaxis and bleeding from gum may be present

• Skin change: Gradual blackening (Black sickness or Kala-azar)

Physical Examination

- Appearance: Sick, wasted, cachectic. Patients are usually mentally clear and alert
- Pallor: Usually moderate to severe
- Jaundice: May be present
- Oedema: May be present
- Lymphadenopathy: Usually absent
- Skin: Dry, rough earthy grey colour
- Tongue: Clear
- Marked splenomegaly and hepatomegaly (spleen size > liver size). Spleen is soft and non-tender



Gross splenomegaly in Kala-azar

In terminal stage, there may be severe anaemia,

heart failure, jaundice, oedema, ascites, septicaemia and bleeding manifestations.

Differential Diagnoses

Malaria, typhoid, leukaemia, tuberculosis and lymphoma.

Complications

- * Secondary bacterial infection *e.g.* pneumonia, bacillary dysentery, TB, measles
- * Haemorrhage
- * Cancrum oris
- * Post Kala-azar Dermal Leishmaniasis (PKDL)

Diagnosis

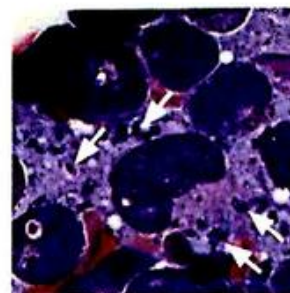
Based on C/F & relevant investigations.

Investigations

- Complete blood counts: Hb (reduced to 5-8 gm/dl), TC (leukopenia), DC (relative increase of lymphocytes, moderate increase in monocytes, absence of eosinophils), platelets (thrombocytopenia), ESR (high)
- Serum albumin: (low), Serum globulin (hyperglobulinaemia, mostly IgG)
- Immunological tests for indirect evidence of Kala-azar
 - * Direct agglutination test (DAT): Become positive (Titer $\geq 1:3200$) as early as 2 weeks after infection and remain so for many years irrespective of treatment
 - * Immuno Chromatographic Test (ICT): A simple, rapid test based on rK39 antigen derived from *L. chagasi*. It has the highest sensitivity & specificity for Kala-azar. Become positive within 2 weeks after infection and remain so for 2 years
 - * Other tests: Aldehyde test, Complement Fixation Test (CFT), Immuno-Fluorescent Antibody Test (IFAT) etc. may also be done
- Tests for direct evidence of parasites
 - * Detection of LD bodies (amastigote form) in tissue smears prepared from bone

marrow, splenic aspirates or lymph node aspirates.

Among these, splenic puncture has the highest rate of yielding LD bodies



LD bodies in bone marrow

Source: Internet

- * Detection of promastigotes in the culture of aspirates (Novy-Macneal-Nicolle media)
- * Detection of DNA of parasite by PCR

Case Definitions

KALA-AZAR (KA)

- History of fever for more than 2 weeks
- Residing/traveling in endemic areas
- Any one of the following symptoms and signs
 - Splenomegaly • Weight loss • Anaemia
- And positive 'rk39' test

Treatment

Recommended drugs, dose and duration.

1ST LINE DRUGS

Drug of choice: Liposomal Amphotericin B (10 mg/kg single dose), IV drip very slowly

Alternative 1st line drugs

- Miltefosine: 2.5 mg/kg/day, orally in two divided doses after meal for 28 days
- Paromomycin (15 mg/kg/day, IM, OD~21 days)
- Combination treatment
 - * Combination of Miltefosine and Paromomycin will be 1st choice
 - * Other alternative combinations will be
 - Liposomal Amphotericin B + Miltefosine
 - or
 - Liposomal Amphotericin B + Paromomycin

2ND LINE DRUGS

- Amphotericin B deoxycholate: 1 mg/kg daily or on alternate day in IV infusion (5% Dextrose solution 500 ml) for total 15 doses
- Sodium Stibogluconate (SSG): 20 mg/kg body weight, daily IM injection for 30 days

KALA-AZAR TREATMENT FAILURE

- A case earlier diagnosed as Kala-azar and
- Took complete treatment within 1 year and
- Reappearance of symptoms of Kala-azar and
- Any positive lab evidence of parasite from bone marrow or splenic aspirate

POST KALA-AZAR DERMAL LEISHMANIASIS (PKDL)**Diagnostic clue**

- Residing/travelling in the endemic areas
- History of treatment of Kala-azar any time in the past
- Suggestive skin lesion **without loss of sensation**, which may be macular, papular, nodular or mixed



Skin lesions of PKDL
Courtesy: Dr Shahriar, MMC

- Exclusion of other causes of skin disease *e.g. leprosy, vitiligo, pityriasis, ring worm etc.*
- 'rk39' positive/Slit skin smear positive/PCR positive
- In rare instances rk39 may be negative and PKDL should be diagnosed by slit skin smear

The close differential diagnosis of PKDL is leprosy

Treatment of PKDL**Drugs, dose & duration****1st line****Miltefosine**

- 2.5 mg/kg body weight/day in two divided doses, not exceeding 50 mg/day for 12 weeks

2nd line

Duration: Total 6 cycles (an interval of 10 days between cycles) of treatment will be given with any one of the following drugs -

- **Sodium Stibogluconate**: 20 mg/kg body weight daily for 20 days per cycle IM
- **Amphotericin B Deoxycholate**: 1 mg/kg daily or on alternate days IV (in 500 ml of 5% DA) for 15 doses per cycle

Supportive treatment

- Maintenance of adequate nutrition
- Controlling superadded infections
- Correction of anaemia with blood transfusion

Follow up

Regularly for 6-12 months, as a small minority may have a relapse of disease during this period, irrespective of treatment regimen.

Relapse is indicated by -

- Enlargement of spleen
- Return of fever
- Weight loss and
- Decline in blood counts

References

1. The Diagnosis and Management of Severe Malaria, Learners Guide; 2010. DGHS, Bangladesh
2. National guidelines and training module for Kala-azar elimination in Bangladesh; 2013, DGHS, Bangladesh
3. Infectious Diseases. In: Kliegman RM, Stanton BF, Geme III JWS, Schor NF, Behrman RE. Editors. Nelson Textbook of Pediatrics, 20th Edition. New Delhi: Elsevier; 2016: 1231-1756
4. Khan MR, Rahman ME. Essence of Pediatrics. 4th ed. New Delhi: Elsevier; 2011. Chapter 21, Immunization and Infectious Disease; p. 370-422.
5. Kabir ARML. Pediatric Practice on Parents Presentation, 1st ed. Dhaka: Asian Colour Printing; 2011.
6. Ogle JW et al. Infections: Bacterial & Spirochetal. In: Current Diagnosis and Treatment in Pediatrics. Editors, Hay WW et al. 18th edition, New York: McGraw Hill; 2007 p. 1152-1213.

SELF ASSESSMENT

Short answer questions [SAQ]

1. Write down the specific treatment of enteric fever.
2. Classify malaria and write down the treatment of severe malaria.
3. What is PKDL? Enumerate its clinical forms.
4. How Kala-azar is diagnosed?
5. What are the complications of enteric fever and when those usually develop?

Multiple choice questions [MCQ]

1. Organs affected by *P. falciparum* are-
☐ a) brain ☐ b) kidney ☐ c) lungs
☐ d) gut ☐ e) heart
2. Drugs recommended to treat cerebral malaria are-
☐ a) Quinine ☐ b) Artemether ☐ c) Chloroquine
☐ d) Tetracycline ☐ e) Artesunate
3. The recognized complications of Kala-azar are-
☐ a) hypersplenism ☐ b) cancrum oris ☐ c) PKDL
☐ d) heart failure ☐ e) secondary bacterial infections
4. The recommended drugs to treat Kala-azar are-
☐ a) Stibogluconate ☐ b) Miltefosine ☐ c) Liposomal Amphotericin B
☐ d) Ketoconazole ☐ e) Paromomycin
5. In Kala-azar
☐ a) promastigote is the infective form ☐ b) culture is not possible in artificial media
☐ c) screening test can be done by rK39 ☐ d) opportunistic infection can lead to fatality
☐ e) anaemia is common
6. Enteric fever
☐ a) step-ladder pattern of fever is common ☐ b) jaundice ☐ c) hepatosplenomegaly
☐ d) bleeding manifestation ☐ e) perforation is common in children
7. Multidrug resistance enteric fever is resistance to

- ☐ a) Amoxicillin ☐ b) Ciprofloxacin ☐ c) Azithromycin
☐ d) Chloramphenicol ☐ e) Ceftriaxone
8. Appropriate antibiotics for uncomplicated enteric fever
- ☐ a) fully sensitive cases - Cefixime ☐ b) MDR cases- Ceftriaxone
☐ c) Quinolone resistance cases- Azithromycin ☐ d) fully sensitive cases- Ceftriaxone
☐ e) MDR cases - Ciprofloxacin
9. Complications of severe Falciparum Malaria
- ☐ a) circulatory collapse ☐ b) hypersplenism ☐ c) acute respiratory distress syndrome
☐ d) severe prostration ☐ e) secondary bacterial infection
10. Lab findings of severe falciparum malaria-
- ☐ a) hyperglycaemia ☐ b) hyperparasitaemia (>5%/microL) ☐ c) metabolic alkalosis
☐ d) hypernatraemia ☐ e) haemoglobinuria
11. Relapse of Kala-azar is indicated by -
- ☐ a) Enlargement of spleen ☐ b) Enlargement of liver
☐ c) Return of fever ☐ d) Weight loss and ☐ e) Decline in blood count
12. Complete blood count of a kala-azar patient shows
- ☐ a) normal hemoglobin ☐ b) lymphopenia ☐ c) eosinophilia
☐ d) thrombocytopenia ☐ e) raised ESR
13. Immunological tests for Kala-azar
- ☐ a) Direct agglutination test ☐ b) VDRL ☐ c) anti-ds DNA
☐ d) PCR ☐ e) IFAT
14. Differential diagnosis of Kala-azar include
- ☐ a) malaria ☐ a) typhoid ☐ a) leukaemia
☐ a) tuberculosis ☐ a) HIV
15. Tests for direct evidence of parasites in Kala-azar include
- ☐ a) detection of LD bodies* in tissue smears
☐ b) culture of aspirates ☐ c) detection of DNA of parasite by PCR
☐ d) Aldehyde test ☐ e) Complement Fixation Test
16. Kala-azar can be transmitted by
- ☐ a) blood transfusion ☐ b) placenta ☐ c) inoculation from cultures in the laboratory
☐ d) breast feeding ☐ e) mosquito bite
17. Kala-azar endemic districts in Bangladesh are
- ☐ a) Pabna ☐ b) Sirajgonj ☐ c) Moulavibazar
☐ d) Gazipur ☐ e) Barisal

CHAPTER 20

JAUNDICE

ACUTE VIRAL HEPATITIS	165
FULMINANT HEPATIC FAILURE	166
CHRONIC LIVER DISEASE	168

Whenever a child presents with jaundice, one should consider the following possibilities -

Hepato-cellular disease

- * Viral hepatitis (HAV, HBV, HCV, HEV)
- * Chronic liver disease e.g. decompensated cirrhosis
- * Autoimmune hepatitis
- * Drug-induced e.g. *paracetamol overdose*

Pre-hepatic

- * Genetic diseases e.g. *Gilbert's syndrome, Crigler-Najjar syndrome*
- * Haemolytic anaemias e.g., *thalassaemia, spherocytosis, autoimmune haemolytic anaemia*

Post hepatic

- * Biliary atresia
- * Idiopathic neonatal hepatitis
- * Bile duct strictures
- * Stone in common bile duct
- * Choledocal cyst

Jaundice during neonatal period has different aetiology, pathophysiology as well as different management and are discussed in chapter 8.

In this section acute viral hepatitis and chronic liver diseases particularly cirrhosis of liver will be discussed.

ACUTE VIRAL HEPATITIS

Actio-pathogenesis

Organisms: Six hepatotropic viruses (Hepatitis A, B, C, D, E, and G). All are RNA viruses except B which is DNA virus. Hepatitis A and E viruses cause acute hepatitis only, whereas B, C, D causes chronic liver diseases, though acute presentation may occur.

Clinical Manifestations

- **Asymptomatic:** Only rise in serum transaminases (SGPT, SGOT)
- **Anicteric:** Patients have no jaundice but suffer from anorexia, nausea, vomiting and influenza like symptoms.
- **Classical presentation:** Occurs in 3 phases:
 - * **Prodromal phase:** This phase precedes the icteric phase by 1-2 weeks with non-specific symptoms like malaise, anorexia, nausea, vomiting, fever, headache, myalgia, arthralgia etc.
 - * **Icteric phase:** This phase is characterized by yellow sclera, tender hepatomegaly with right hypochondriac or epigastric pain. Stool often turn pale and urine becomes high coloured
 - * **Recovery phase:** In this phase, constitutional symptoms disappear but mild hepatomegaly and biochemical abnormalities may persist



Yellow sclerae

Diagnosis

Based on C/F & relevant investigations.

Investigations

Liver function tests	* S. Bilirubin * SGPT * Prothombin time * Alk phosphatase	All markers are elevated
Viral markers	* Anti HAV IgM * Anti HEV IgM * Anti HCV * HBsAg	Any one or more may be positive
USG of whole abdomen		To assess hepatic echogenecity & appearance of ascitis

Treatment

Counseling the parents about the natural history of the disease.

No specific treatment, only supportive. These includes -

- Rest: Outdoor activities should be restricted as much as possible but forced and prolonged bed rest is not essential
- Diet: Normal. High calorie diet is desirable. Traditional low fat, high carbohydrate diet has no beneficial effect. IV fluid may be required for cases with persistent vomiting or those who cannot tolerate oral feeding
- Vitamin K₁: If prothrombin time is high (>15 sec/ $INR > 1.5$). [Normal INR (International Normalized ratio): 0.8-1.2]
(Harrison's Internal Med, 17th ed, 2008)
- Purgatives, gut sterilizers or lactulose: No therapeutic benefit in uncomplicated cases

Prevention

By vaccination with hepatitis B and A vaccines.

FULMINANT HEPATIC FAILURE

It is a clinical syndrome in children characterized by

- Biochemical evidence of acute liver injury (usually of <8 weeks duration)
- No evidence of chronic liver disease
- Hepatic based coagulopathy

Hepatic based coagulopathy is defined as prothrombin time(PT) >15 sec or $INR > 1.5$ not corrected by Vitamin K₁ in the presence of clinical hepatic encephalopathy or a PT >20 sec or $INR > 2$ regardless of the presence of clinical hepatic encephalopathy.

Aggravating factors

- | | |
|-----------------------------------|---------------------|
| * GIT bleeding | * Uraemia |
| * Hypovolaemia | * Sepsis |
| * Hypokalaemia | * High protein diet |
| * Hypoglycaemia | * Constipation |
| * Drugs e.g. sedatives, diuretics | * Paracentesis |

Clinical Manifestations

Patient usually presents with features of either encephalopathy and/or coagulopathy.

Features of encephalopathy

- * Drowsiness
- * Altered sleep pattern
- * Agitation
- * Disorientation, convulsion, coma

Features of coagulopathy

- Bleeding**
- * Haematemesis & melaena
 - * Haematuria
 - * Intracranial

Stages of Hepatic encephalopathy

Stages	Symptoms	Signs	EEG
I	Periods of lethargy, euphoria; reversal of day-night sleeping; may be alert	Trouble drawing figures, performing mental tasks	Normal
II	Drowsiness, inappropriate behavior, agitation, wide mood swings, disorientation	Asterixis, fetor hepaticus, incontinence	Generalized slowing, q waves
III	Stupor but arousable, confused, incoherent speech	Asterixis, hyperreflexia, extensor reflexes, rigidity	Markedly abnormal, triphasic waves
IV	Coma IVa: Responds to noxious stimuli IVb: No response	Areflexia, no asterixis, flaccidity	Markedly abnormal bilateral slowing, d waves, electro-cortical silence

Diagnosis

Based on C/F & relevant investigations.

Investigations

Investigations	Results
S. bilirubin, SGPT, SGOT	Raised
Prothrombin time	Prolonged (INR >2.0)
Blood ammonia	Raised
Blood glucose	Low
CBC & PBF	May show anaemia, leukocytosis and thrombocytopenia
Blood urea, S creatinine	Altered
Serum electrolytes	Hypokalaemia, hyponatraemia
Arterial blood Gas	Metabolic acidosis or respiratory alkalosis
Serum Calcium, Magnesium, Phosphate	May be altered

Treatment

- Counsel the parents about nature and prognosis of the disease
- Manage the patient in intensive care unit

A. Supportive

- Open an IV line and give suitable IV fluid for nutritional support
- Restrict fluid: Give 75% of daily requirement.
- Correct -
 - * Hypovolaemia (with Normal saline)
 - * Hypoglycaemia (Inj 10% DA-2 ml/kg)
- Treat coagulopathy with -
 - * Inj. Vitamin K₁ - IV for 3 days
 - * Fresh frozen plasma transfusion
 - * Whole blood transfusion
 - * Platelet transfusion (to maintain a platelet count >50,000/cmm)
- Give Inj. Ranitidine, 1-3 mg/kg 8 hourly to prevent GI bleeding.
- Treat infection with non hepatotoxic antibiotics (Ampicillin 200 mg/kg/day, 6 hourly and Gentamicin 5 mg/kg/day 8 hourly)
- Give parenteral supplement with calcium, magnesium and phosphorus, if any deficiency
- Identify & treat the precipitating factors
- Empty the bowel of nitrogen containing material, blood (100 ml = 14-20 gram protein) etc. in the following ways -
 - * Insert an NG tube and ensure NG suction
 - * Give Lactulose orally or via NG tube (1-2 ml/kg 2- 4 hourly) until diarrhoea occurs. Then adjust the dose to produce several loose bowel movements per day
 - * Lactulose enema (1-2 ml/kg diluted with 1-3 volumes of water) may be given
- Give oral Neomycin or Metronidazole to reduce enteric bacteria responsible for ammonia production
- Give IV mannitol (2.5-5 ml/kg/dose) for raised ICP and cerebral oedema
- Mechanical ventilation may be needed

B. Specific: Liver transplantation

CHRONIC LIVER DISEASE

(Cirrhosis of Liver)

Many a times, children present with distension of abdomen (ascites) and wasting who may either have associated jaundice or history of jaundice before. They are perhaps suffering from chronic liver disease particularly cirrhosis of liver, the end stage of many forms of liver injury.

Aetiology

- * Idiopathic
- * Chronic hepatitis *e.g. HBV & HCV infection*
- * Metabolic *e.g. Wilson's Disease, alpha -1 antitrypsin deficiency, haemochromatosis*
- * Autoimmune liver disease
- * Biliary atresia

Pathogenesis

- Diffuse destruction of hepatocytes
- Replacement of normal hepatic structure by regenerative nodules
- Formation of fibrous tissue
- Disorder of hepatic vasculature leading to increased resistance to blood flow, porto-systemic anastomosis, portal hypertension and their consequences

Clinical Manifestations

- Non specific symptoms: Weakness, loss of appetite
- Gradual distension of abdomen due to ascites
- Dilated veins on the abdominal wall due to engorgement of venous collaterals sometimes, *Caput medusae*
- Failure of general health as manifested by generalized wasting of muscles



Wasted child with ascites and engorged abdominal vessels

In addition to the above presentations, these patients may have other features (*stigmata*) like-

General	Malaise, loss of appetite, nausea
GIT	Gastro intestinal haemorrhage in the form of haematemesis or melaena
Spleen	Splenomegaly
Liver	Hepatomegaly (firm) or small liver
Skin & nail changes	Skin: Palmar erythema, spider naevus, white spots on skin Nails: White nails, clubbing
Palm	Wasting of thenar and hypothenar muscles
Endocrine	Male: Gynaecomastia and soft, small testes (testicular atrophy) Female: Infertility and amenorrhoea
Encephalopathy	Altered sleep rhythm, irritability, altered consciousness, constructional apraxia, flapping tremor, exaggerated deep tendon reflexes, planter extensor, foetor hepaticus or deep coma



Palmar erythema



Spider naevus

Source: Internet

Complications

- * Hepatic encephalopathy
- * Portal hypertension
- * Progressive nutritional disturbances
- * Hormonal disturbances
- * Hepatocellular carcinoma

Diagnosis

Based on C/F & relevant investigations.

Investigations

Liver function tests	* Serum bilirubin (may be increased) * SGPT (normal or increased) * Prothrombin time (prolonged) * Serum albumin (decreased) * Gamma globulins (increased)
Endoscopy of upper GIT	Different grades of oesophageal varices
Complete Blood count	Pancytopenia if hypersplenism
USG of hepatobiliary system	To see hepatic size, architecture, echogenecity etc.
Viral markers B, C, D	May be positive
Serum ceruloplasmin	Low in Wilson's disease
24 hours urinary copper level (Penicillamine challenge test)	High in Wilson's disease (> 1600 is diagnostic)
* ANA * Anti liver kidney microsomal antibody * Antineutrophilic cytoplasmic antibody	Positives in autoimmune hepatitis
Liver biopsy	Confirmatory of CLD
S. electrolytes S. creatinine	Altered

Treatment

A. Supportive

- Counseling about nature & future of the disease
- Diet: Rich in medium chain triglyceride.
- Supplementation of fat soluble vitamin e.g. A, D, E, K
- Supplementation of Calcium and Zinc, if required
- Treatment of ascites
 - * Fluid & salt restriction
 - * Diuretics: Combination of Spironolactone & Frusemide
- Treatment of spontaneous bacterial peritonitis: I/V broad spectrum antibiotic
- Treatment of encephalopathy

B. Specific

- Chronic hepatitis B: Combination therapy with Interferon and Lamivudine
- Chronic hepatitis C: Combination therapy with INF- α and Ribavirine
- Autoimmune hepatitis: Single or combination therapy with Prednisolone and Azathioprine
- Wilson's disease: Copper chelators such as
 - * Penicillamine (drug of choice)
 - * Trientine
 - * Aluminium tetrathiomolibdate & Zinc (prevents copper absorption from GIT)
- Biliary atresia: Kasai portoenterostomy
- Liver transplantation may increase the chance of survival

Prognosis

- Patients with a rising bilirubin, a vitamin K-resistant coagulopathy, or ascites refractory to diuretic usually survive less than 1–2 years
- Without transplantation, affected patients may die from liver failure within 10–15 years
- With liver transplantation, the long-term survival rate is 70–90%

References

1. Suchy FJ. Fulminant hepatic failure. Nelson Textbook of Pediatrics. 19th ed. 2011, p 1412-1414.
2. Sokol RJ, Narkewicz MR. Liver and pancreas. In: Hay WW, Levin MJ, Sondheimer JM, Deterding RR, editors. Current diagnosis & Treatment in Pediatrics. 18th ed. New York: McGraw-Hill; 2007. p 638- 680.
3. Sheila Sherlock S, Diseases of the liver and biliary system. 11th ed. Blackwell Science; 2002.
4. Boon NA et al. Davidson's Principles and Practice of Medicine. 20th ed. Churchill Livingstone; 2006.
5. Khan MR, Rahman ME. Essence of Pediatrics. 4th ed. 2011. Chapter 8, Diseases of GI; p.130-151.
6. Burra P. Liver abnormalities and endocrine diseases. Best Pract Res Clin Gastroenterol. 2013 Aug;27(4):553-63. doi: 10.1016/j.bpg.2013.06.014.

SELF ASSESSMENT

Short answer questions [SAQ]

1. What are the factors aggravating hepatic encephalopathy?
2. What are the features of hepatic encephalopathy?
3. Write down the treatment of hepatic encephalopathy.
4. What happens in cirrhosis of liver?
5. What is Chronic liver disease? What are the stigmata of chronic liver disease?
6. Write down the pathogenesis of cirrhosis of liver.

Multiple choice questions [MCQ]

1. Viruses responsible for chronic hepatitis are-
☐ a) hepatitis A ☐ b) hepatitis B ☐ c) hepatitis C ☐ d) hepatitis D ☐ e) hepatitis G
2. Features of hepatocellular failure are-
☐ a) jaundice ☐ b) haematemesis ☐ c) palmar erythema
☐ d) gynaecomastia ☐ e) splenomegaly
3. Patients with biliary cirrhosis may have-
☐ a) jaundice ☐ b) dark urine ☐ c) pruritus ☐ d) hepatomegaly ☐ e) xanthoma
4. Management of acute viral hepatitis includes-
☐ a) rest ☐ b) low calorie diet ☐ c) vitamin K ☐ d) vitamin C ☐ e) purgative
5. The following biochemical changes are characteristic of Wilson's disease
☐ a) low ceruloplasmin ☐ b) high Cu level in blood ☐ c) high Cu level in urine
☐ d) low S. albumin level ☐ e) high S. Alk. phosphatase level
1. Complications of chronic liver disease include
☐ a) Hepatic encephalopathy ☐ b) Portal hypertension ☐ c) Ammonia intoxication
☐ d) Hormonal disturbances ☐ e) Hepatocellular carcinoma
2. Liver function tests in a patient with CLD shows
☐ a) very high serum bilirubin ☐ b) high SGPT ☐ c) prolonged Prothrombin time
☐ d) normal serum albumin ☐ e) raised alkaline phosphatase
3. Treatment options for Wilson disease include
☐ a) Penicillamine ☐ b) Trientine ☐ c) Lamivudine ☐ d) Zinc ☐ e) Azathioprine
4. Features of hepatic encephalopathy include
☐ a) variceal bleeding ☐ b) Altered sleep pattern
☐ c) intracranial bleeding ☐ d) Agitation ☐ e) convulsion
5. Treatment options for coagulopathy in a patient with fulminant hepatic failure include
☐ a) Vitamin K1 ☐ b) Fresh frozen plasma ☐ c) Factor VIII
☐ d) Platelet transfusion ☐ e) Cryoprecipitate

BLOOD VOMITING

PORTAL HYPERTENSION

171

Whenever a child presents with blood vomiting (haematemesis) one should always consider portal hypertension leading to rupture of oesophageal varices as the possible cause. The other causes are -

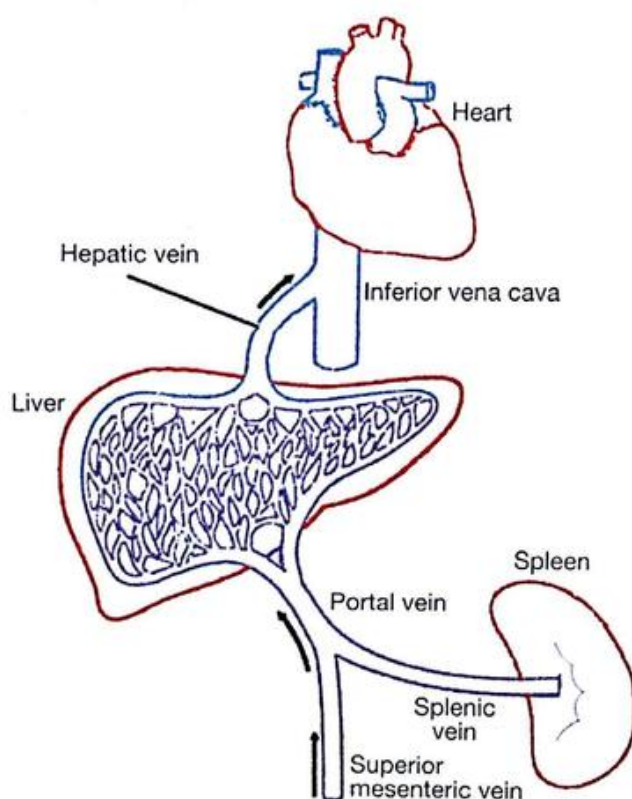
- Gastric erosion from any cause *e.g.* NSAID
- Mallory-Weiss syndrome
- Coagulopathy
- Severe thrombocytopenia from any cause

In this chapter, we will discuss portal hypertension.

PORTAL HYPERTENSION

Portal hypertension: Elevation of portal venous pressure $>10-12$ mm Hg.
(Normal pressure: ≈ 7 mm Hg)

Aetio-pathogenesis



Portal circulation

Aetiology

- Idiopathic
- **Pre-hepatic:** Portal vein thrombosis due to sepsis (umbilical, portal pyaemia), dehydration, umbilical vein catheterization, abdominal trauma including surgery
- **Hepatic:** Cirrhosis of liver, congenital hepatic fibrosis, veno-occlusive disease, schistosomiasis
- **Post-hepatic**
 - * Budd-Chiari syndrome
 - * Biliary tract disease: Extra-hepatic biliary atresia, choledochal cyst, cystic fibrosis

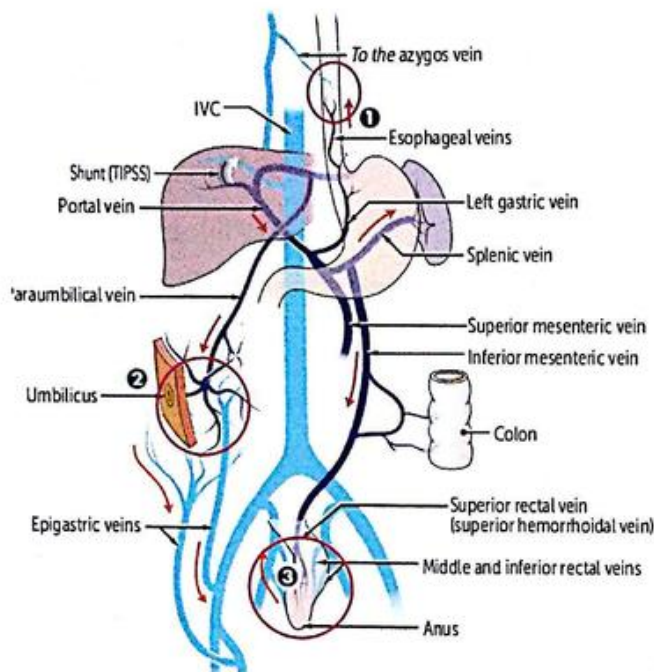
In portal hypertension, the net clinico-pathological consequences are -

- Increased resistance to portal blood flow
- High resistance in the tributaries of portal vein
- Development of collaterals, diverting blood from portal into systemic veins (**porto-systemic shunting**) *e.g.* oesophageal varices, haemorrhoids etc

Common sites of porto-systemic anastomosis

Regions & Effects	Portal vein	Systemic vein
1. Lower end of oesophagus with development of oesophageal varices	Oesophageal branch of left gastric vein	Hemiazygous vein
2. Around the umbilicus <i>e.g.</i> Caput medusae	Paraumbilical vein	Superior epigastric vein
3. Rectum <i>e.g.</i> Haemorrhoid	Superior rectal vein	Middle & inferior rectal vein

Blood flow in portal hypertension and porto-systemic shunts



Clinical Manifestations

- Recurrent bouts of blood vomiting
- Black tarry stool
- Per rectal bleeding from haemorrhoids
- Features of underlying cause of portal hypertension e.g. Stigmata of CLD/cirrhosis of liver (see previous chapter)
- Recurrent ascites
- Prominent vessels on abdominal wall around the umbilicus due to collateral blood flow (*Caput medusae*)



Caput medusae

- Splenomegaly
- Features of shock (if massive haemorrhage) e.g. cold clammy skin, increased perspiration, rapid thready pulse, hypotension, prolonged capillary refilling time etc.

Diagnosis

Based on C/F and relevant investigations.

Investigations

A. To establish diagnosis of portal hypertension

Non-invasive

- Barium swallow X-ray of oesophagus: To look for evidence of oesophageal varices

- Ultrasonogram of abdomen: To assess hepatic echotexture, presence of ascites, to assess portal venous pressure & exclusion of other pathology
- Doppler flow ultrasonography of hepatic & portal vein: To assess circulation through these vessels & also pressure

Invasive

- Upper GI Endoscopy: To detect & grade oesophageal varices



Oesophageal varices

Courtesy: Prof ASM Bazlul Karim

- Angiography: To detect any abnormality and direct measurement of portal pressure

B. To find-out aetiology of portal hypertension

- Liver function tests e.g. *S. albumin, S. bilirubin, SGPT, alkaline phosphatase, prothrombin time etc.*
- Viral markers e.g. *HBsAg, Anti-HCV*
- Serum ceruloplasmin: if low, then possibility of Wilson disease
- 24 hours urinary copper: if high, then possibility of Wilson disease

Treatment

A. Management of acute variceal bleeding

- Assess vital parameters e.g. pulse, BP, resp rate, temperature
- Resuscitate & stabilize the patient
 - * Give blood or crystalloid fluid for volume replacement
 - * Transfuse fresh frozen plasma (if PT >20 sec.) & platelet (if count < 50,000/cmm).
- Keep NG tube in situ to aspirate blood and to monitor extent of bleeding
- Give Inj. Vit K₁ 5-10 mg IV for 3 days

- Give Inj. Ranitidine (0.5-1 mg/kg/day) to prevent bleeding from gastric erosions
- Give parenteral antibiotics, if evidence of infection
- Consider Vasopressin, Terlipressin, Somatostatin or Octreotide (*e.g. Sandostatin 1 µg/kg/hour*) to reduce portal blood pressure by reducing portal blood flow

If bleeding is not controlled

- Endoscopic sclerotherapy (Na-marrhuate) or band ligation of varices

If bleeding still continuing

- **Sengstaken - Blakemore Balloon tamponade** can be placed to stop haemorrhage.
- Surgery *e.g. transjugular intrahepatic portosystemic stent shunt (TIPSS)*

B. Prevention of further bleeding

- Nonselective β -blockers *e.g. propranolol isosorbide mononitrate*
- Endoscopic ligation/sclerotherapy
- Surgery *e.g. TIPSS, liver transplantation*

References

1. Suchy FJ. Portal Hypertension and Varices. In: Kliegman RM, Stanton BF, Geme III JWS, Schor NF, Behrman RE. Editors. Nelson Textbook of Pediatrics, 20th Edition. New Delhi: Elsevier; 2016: 1972-1975
2. Sheila Sherlock S, Diseases of the liver and biliary system. 11th ed.: Blackwell Science; 2002.
3. Walker BR et al. Davidson's Principles & Practice of Medicine. 22nd ed.: Churchill Livingstone; 2014: p945

SELF ASSESSMENT

Short answer questions [SAQ]

1. What are the common causes of haematemesis ?
2. What is portal hypertension ?
3. Write down the important causes of portal hypertension.
4. What are the important clinico-pathological consequences of portal hypertension?
5. What are the sites of portosystemic anastomosis?
6. Write down the investigations of portal hypertension.
7. Outline the treatment of acute variceal bleeding.

Multiple choice questions [MCQ]

1. The common clinical presentations of portal hypertension are -
☐ a) haematemesis ☐ b) haematochezia ☐ c) splenomegaly
☐ d) fever ☐ e) jaundice
2. Common causes of haematemesis in children
☐ a) portal hypertension ☐ b) drugs-NASIDs ☐ c) coagulopathy
☐ d) malignancy ☐ e) peptic ulcer disease
3. Non invasive investigation to diagnose portal hypertension
☐ a) upper GIT endoscopy ☐ b) USG of abdomen ☐ c) liver function test
☐ d) barium swallow x ray of oesophagus ☐ e) angiography
4. Drugs used in portal hypertension
☐ a) Propranolol ☐ b) diuretics ☐ c) Adrenaline
☐ d) Vasopressin ☐ e) Somatostatin
5. Surgical options in portal hypertension
☐ a) splenectomy ☐ b) band & ligation ☐ c) TIPSS
☐ d) sclerotherapy ☐ e) liver transplantation

GENERALIZED LYMPHADENOPATHY

TUBERCULAR LYMPHADENOPATHY	174
LYMPHOMA	175
INFECTIOUS MONONUCLEOSIS	177

Generalized lymphadenopathy means enlargement of more than 2 non-contiguous lymph node groups. It is the clinical manifestation of many underlying diseases.



Generalized lymphadenopathy

The following conditions should be considered when a child presents with lymphadenopathy-

- * Tuberculosis
- * Lymphoma
- * Leukaemia
- * Infectious mononucleosis
- * Systemic onset juvenile idiopathic arthritis
- * Systemic lupus erythematosus (SLE)
- * Cat scratch disease

Among all causes, tuberculosis, lymphoma and infectious mononucleosis will be discussed in this section.

Lymph node (LN) examination: Points to note-

- * Site of lymph node enlargement
- * Number: Single or multiple
- * Size of the largest one
- * Local temperature: Normal or raised

- * Tenderness: Present or absent
- * Nature: Matted or discrete
- * Consistency: Soft, cystic, rubbery, firm or hard
- * Overlying skin colour: Normal or reddish
- * Discharging sinus: Present or not
- * Adjacent structures: Free or adherent
- * Pressure symptoms e.g. Respiratory distress, dysphagia, facial puffiness etc.: Present or not

TUBERCULAR LYMPHADENOPATHY

Organisms: *M. tuberculosis*, atypical micobacteriae

Lymph node enlargement (scrofula) is the most common manifestation of extra pulmonary tuberculosis.

Cervical glands are affected most frequently, followed by submandibular, supraclavicular, axillary and inguinal nodes.

Sometimes, more than one region are involved. Abdominal (mesenteric) lymph nodes are also involved e.g. *tabes mesenterica*.



Scrofula

Characteristics of the lymph nodes in TB

- * Firm, not hard
- * Usually painless and non-tender
- * Matted, though initially mobile
- * Often fixed to underlying or overlying tissue
- * When caseation and liquefaction occurs, nodes become fluctuant and may discharge through the skin with the formation of a collar-stud abscess and sinus formation

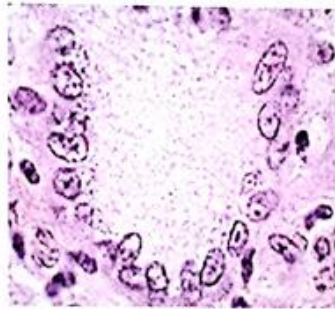
Systemic symptoms other than low grade fever are usually absent. However, sometimes, along with lymph node enlargement, growth failure, pallor, hepatosplenomegaly may be present.

Diagnosis

Based on C/F & relevant investigations.

Investigations

- Complete blood counts: Hb% (low). TC and DC of WBC will show lymphocytosis
- Tuberculin test: Usually positive
- Chest radiography: Mostly normal though paratracheal, hilar and other lymphadenopathy may be present. Hilar lymphadenopathy is characteristic
- Lymph node biopsy & histopathology: Central caseation surrounded by epithelioid and multinucleated giant cells



Lymph node biopsy showing giant cells and caseation necrosis

Source: Internet

Treatment

- Counsel the parents
- Anti-TB drugs (Isoniazid, Rifampicin, Pyrazinamide) for 6 months according to category 1
- Good nutritional support
- Follow up

LYMPHOMA

Lymphoma is the malignant proliferation of cells native to lymphoid tissue i.e. lymph nodes and extra-nodal sites like Waldeyer's ring, liver, spleen, thymus, Peyer's patches, vermiform appendix etc.

Lymphoid tissues anywhere in the body can be affected in lymphoma but cervical nodes are commonly affected and less frequently the mediastinal and sub-diaphragmatic nodes.

Lymphoma is always malignant; no benign category

Types

- Hodgkin disease (HD)
- Non-Hodgkin lymphoma (NHL)

Pathology

The net clinico-pathological consequences are-

- Depression of cellular immunity
- Increased susceptibility to infections

Clinical Manifestations

- Painless nodular swellings in neck and other areas of body is the commonest presentation



Cervical, submandibular and pre-auricular lymphadenopathy

- Constitutional symptoms:
 - * Intermittent fever
 - * Weight loss (>10%) during last 3 months
 - * Drenching night sweats
 - * Others like *fatigue, lethargy, anorexia, urticaria*
- Pressure symptoms:
 - * Respiratory distress (*pressure over trachea & principal bronchi by mediastinal lymph nodes*)
 - * Facial oedema, chemosis, plethora, venous engorgement (*pressure over superior vena cava i.e. superior vena caval syndrome*)
 - * Dysphagia (*pressure over oesophagus*)
 - * Hoarseness of voice (*pressure over recurrent laryngeal nerve*)
 - * Abdominal pain, discomfort & disturbances of bowel habits (*pressure over bowel*)
 - * Paraplegia and root pain (*pressure over spinal cord & nerve roots*)
 - * Cholestatic jaundice (*pressure over biliary channels at porta hepatis*)
 - * Symptoms due to extra-nodal involvement:

- Cough, dyspnoea (*lungs*)
- Ascites (*peritoneum*)
- Pleural effusion (*pleura*)
- Pericardial effusion (*pericardium*)
- Features of leukaemia (*bone marrow*)
- Pruritus (*skin*)
- Neurological manifestations (*cerebral involvement*)
- Pain and swelling of jaw, testes

Characteristics of lymph nodes (LN) in Lymphoma

- * Non-tender
- * Discrete
- * Firm to rubbery in consistency
- * Not fixed to underlying or overlying structures

Difference between NHL and HD

Parameters	NHL	HD
Lymph node involvement	At multiple peripheral sites	Localized to a single axial group
Waldeyer ring involvement	Common	Rare
Mesenteric nodes involvement	Common	Rare
Spread	Non contiguous	Orderly spread
Extra nodal involvement	Common	Uncommon

Diagnosis

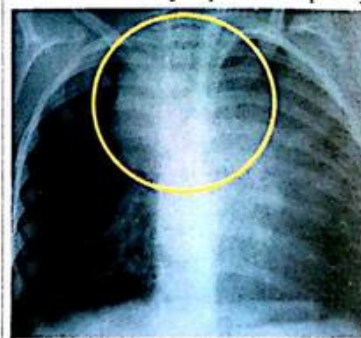
Based on C/F & relevant investigations.

Investigations

CBC, PBF, ESR	Hb: Low WBC: Counts variable. May have neutrophilia/eosinophilia (HD). In advance stage, there may be lympho and other cytopenias. Platelets: Normal/low PBF: Normocytic normochromic anaemia. ESR: Very high
Blood for LDH	Very high

X-Ray chest AP/
Lateral view

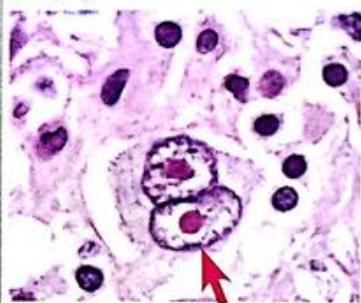
Mediastinal lymphadenopathy



(widenings) may be present.

Lymph node biopsy for
histopathology,
immuno-
phenotyping,
cytogenetics
molecular
studies

Reed-Sternberg giant cell is the hallmark of classical HD (pic below)



Source: Internet

Small round cell in case of NHL
Immunohistochemistry:
Confirmatory for types of NHL

CT scan of chest, abdomen, pelvis

To detect involvement of other lymph node groups as well as extra nodal sites

MRI of bones

To evaluate bone (vertebral) involvement

PET scan

For disease staging, treatment response and bone involvement

Bone marrow examination

To assess whether marrow infiltration occurs or not.

Bone scan

Indicated in bone pain or with high S alkaline phosphatase level

Liver, renal function tests

May be altered, if dissemination occurs to these organs

CSF & other body fluids
(cytospin analysis)

To identify malignant cells and to characterize cellular their morphology

Treatment

- Counseling parents about the disease, treatment and prognosis
- Mainly with chemotherapy and sometimes along with radiotherapy

Chemotherapy

Protocol based chemo-schedules are followed for different types and stages of lymphoma.

Hodgkin Disease

Treatment consists of chemotherapy and low dose radiotherapy. Standard chemotherapy regimen are either -

- 6 cycles of ABVD or
- 6 cycles of alternating COPP and ABVD

These regimen has a cure rate up to 90%.

ABVD	COPP
Doxorubicin (Adriamycin)	Cyclophosphamide
Bleomycin	Vincristine (Oncovin)
Vinblastine	Oral Procarbazine
Dacarbazine	Oral Prednisolone

Repeat each cycle every 28 days.

Non-Hodgkin Lymphoma

Usual duration of treatment with chemotherapy is about 2 years according to NHL BFM-90 (Berlin-Frankfurt-Munich) protocol (for T cell), LMB-96 (for B cell).

Commonly used drugs are -

- | | |
|--------------------|------------------|
| * Cyclophosphamide | * Vincristine |
| * Cytarabine | * Etoposide |
| * Methotrexate | * L-asparaginase |

INFECTIOUS MONONUCLEOSIS (GLANDULAR FEVER)

Organism: Epstein-Barr virus in 90% cases

Incubation period: 30-50 days

Transmission: Through saliva, sexual contact

Clinical Manifestations

- Fever, Sore throat
- Generalized lymphadenopathy (*Epitrochlear lymphadenopathy is suggestive*)
- Hepatosplenomegaly may be present
- Maculopapular rash usually appeared after intake of Amoxicillin

- **Petechiae at the junction of hard and soft palate** is characteristic

Complications

- **CNS:** Meningitis, encephalitis, cranial nerve palsy, GBS, ataxia, perceptual distortions of size, shapes (*Alice in wonderland syndrome*)
- **Respiratory:** Airway obstruction due to swelling of tonsil and oropharyngeal soft tissue, interstitial pneumonia
- **Haematological:** Haemorrhage due to thrombocytopaenia, auto immune haemolytic anaemia, aplastic anaemia
- **Others:** Splenic rupture, myocarditis

Diagnosis

Mainly clinical. Following investigations will be supportive.

Investigations	Results
Complete Blood Count	Lymphocytic leukocytosis
PBF	Normal with presence of atypical lymphocytes
<u>Heterophile antibody test</u>	Positive. Heterophile because it agglutinate antigen from other species
<u>Paul-Bunnell-Davidson test</u>	IgM antibody detected for sheep RBC agglutination. Positive after one week and persist for several months
Monospot test (rapid slide agglutination test)	Horse RBC agglutination test. Remain positive for 2 years

Treatment

Supportive only and includes

- **Bed rest:** Avoid contact sports for 6-8 weeks to decrease the risk of splenic rupture
- **Antipyretic:** Paracetamol
- **Antiviral:** Acyclovir
- **Steroid:** Prednisolone 1mg/kg for 7 days, then taper over another 7 days

Indications of steroid

- Airway obstruction
- Thrombocytopenia with haemorrhage
- Auto immune haemolytic anaemia

- Seizure
- Meningitis

Prognosis: Excellent.

References

1. Jessica Hochberg J et al.. Lymphoma. In: Kliegman RM, Stanton BF, Geme III JWS, Schor NF, Behrman RE. Editors. Nelson Textbook of Pediatrics, 20th Edition. New Delhi: Elsevier; 2016: 2445-2452
2. Maloney K et al. Neoplastic disease. Current diagnosis & Treatment in pediatrics. 18th ed. New York: McGraw-Hill; 2007. p 885-916.
3. Kurkure PA, et al. Pediatric Oncology: Hodgkin's disease & Non-Hodgkin's lymphoma. In: Parthasarathy A. editor. IAP Textbook of Pediatrics. 4th ed. New Delhi: JP; 2009. P 880-887.
4. Patte C, et al. The Societe Francaise d'Oncologie Pediatrique LMB89 protocol: highly effective multiagent chemotherapy tailored to the tumor burden and initial response 'in 561 unselected children with B-cell lymphomas and L3 leukemia. Blood. 2001; 97: 3370-3379.
5. Reiter A, et al. Intensive ALL-type therapy without local radiotherapy provides a 90% event-free survival for children with T-cell lymphoblastic lymphoma: a BFM group report. Blood. 2000; 95: 416-21.
6. Alan C. Aisenbere. Problems in Hodgkin's Disease Management. Blood, 1999, 93: p761-779.
7. Pizzo PA et al. Principles & Practice of Pediatric Oncology, 6th edition. 2011, p638-79

SELF ASSESSMENT

Short answer questions [SAQ]

1. What are the causes of generalized lymphadenopathy?
2. What symptoms may develop due to pressure by enlarged lymph nodes in lymphoma?
3. What are the characteristics of lymph nodes in TB lymphadenopathy?
4. What relevant investigations will you consider in a patient with lymphoma?

Multiple choice questions [MCQ]

1. The characteristics of lymph nodes in lymphoma are -

☐ a) rubbery consistency	☐ b) discrete	☐ c) matted
☐ d) necrosis of the lymph nodes	☐ e) fixed to underlying structures	
2. Generalized lymphadenopathy is found in -

☐ a) tuberculosis	☐ b) systemic onset JIA	☐ c) aplastic anaemia
☐ d) kala-azar	☐ e) acute lymphoblastic leukaemia.	
3. Patient with lymphoma may present with extra nodal symptoms like -

☐ a) pleural effusion	☐ b) pericardial effusion	☐ c) pruritus
☐ d) neurological manifestations	☐ e) swelling of jaw	
4. Characteristic clinico-haematological features of infectious mononucleosis are

☐ a) maculopapular rash	☐ b) epitrochlear lymphadenopathy
☐ c) petechiae at the junction of hard and soft palate	
☐ d) atypical lymphocyte in PBF	☐ e) blast cells in PBF
5. Drugs used to treat Hodgkin's Disease (HD) are

☐ a) Doxorubicin	☐ b) Vincristine	☐ c) Etoposide
☐ d) Methotrexate	☐ e) Dacarbazine	

CHAPTER 23

PALLOR OR ANAEMIA

IRON DEFICIENCY ANAEMIA (IDA)	179
HEREDITARY HAEMOLYTIC ANAEMIAS	181
• BETA (B) THALASSAEMIA MAJOR	182

Pallor (anaemia) is a common problem in children. It is defined as the decreased concentration of haemoglobin for specific age and sex of the child.

Normal Haemoglobin levels at different ages

Age	Haemoglobin (g/dl)
1 to 3 days	18.5
1 month	13.9
6 months	12.6
6 months to 2 years	12.0
2 to 6 years	12.5
6 to 12 years	13.5
12 to 18 years	14.5
Male/Female	14.0

Common causes of anaemia in children of Bangladesh are-

- * Iron deficiency anaemia
- * Hereditary haemolytic anaemias
e.g. thalassaemia syndrome, haemoglobinopathies
- * Helminthiasis
- * Malnutrition
- * Chronic kidney diseases
- * Chronic infection *e.g. malaria, kala-azar, tuberculosis*
- * Diseases of the bone marrow *e.g. leukaemia, aplastic anaemia*
- * Others *e.g. chronic liver disease, SLE, JIA*

In this chapter, iron deficiency anaemia and hereditary haemolytic anaemia will be discussed.

IRON DEFICIENCY ANAEMIA (IDA)

The most common cause of anaemia in children. It is associated with depressed motor and mental development of infants and children.

Iron Metabolism

Sources: Iron is widely present in animal and plant foods as-

- Heme iron: Present in meat, liver, fish and poultry. It is readily absorbed and absorption is not influenced by other dietary factors
- Non-heme iron: Present in beans, pulses, tubers, dried fruits and green vegetables like banana, arum (kochu) etc.

Daily requirement: 10 mg of elemental iron

Absorption: At duodenum and jejunum in ferrous form.

Stored form of iron: Ferritin, haemosiderin.

Factors influence iron absorption

Factors enhance absorption	* Vitamin C * Proteins
Factors inhibit absorption	* Phytates (found in unrefined cereals) * Tannins (found in tea & legumes) * Phosphates (found in eggs) & * Polyphenols (found in coffee and spinach)

Aetiology

- * Preterm, LBW babies
- * Babies born to mothers with unusual perinatal haemorrhage
- * Lactation failure: Iron in breast milk is 2-3 times more efficiently absorbed than that in cow's milk

- Inappropriate weaning
 - * Consumption of large amount of cow's milk (may give rise to chronic intestinal blood loss due to a heat labile protein present in whole cow's milk)
 - * Regular consumption of foods deficient in iron *e.g. rice gruel, suzi, barley etc.*
- Increased demand: During rapid growth of infants or adolescents
- Occult bleeding: From gut *as in peptic ulcer, Meckel's diverticulitis, polyp, haemangioma or inflammatory bowel disease or cows milk consumption*
- Worm infestation *e.g. hook worms in particular*
- Persistent or recurrent episodes of diarrhoea

Clinical Manifestations

- General symptoms of anaemia *e.g. fatigue, dizziness, less activities, irritability etc.*
- Pallor of palm and conjunctiva
- The cardinal features of iron deficiency are -

- Features related to atrophic changes in epithelium of -

- * Mouth, lips (cracking) and tongue (atrophy of papillae, smooth, pale and shiny tongue), angle of mouth (redness, soreness and cracking)



Severely pale conjunctiva



Cracked lips, angles of mouth, shiny tongue

- * Pharynx & oesophagus *e.g. dysphagia (Plummer-Vinson syndrome)*
- * Nails *e.g. flattening and thinning of nails, koilonychia*



Koilonychia

- Features related to change of behaviour *e.g. Pica - the compulsive ingestion of non-nutritive substances like clay, dirt, paint or others*
- Neurological & intellectual dysfunctions *e.g. reduced attention span, alertness and school performance*
- Reduced immunity and frequent infections

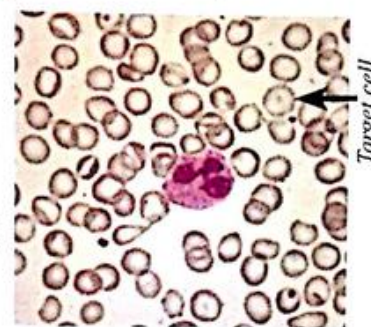
In addition, the affected child may have **breath-holding attacks** and profound anorexia

Diagnosis

Based on C/F & relevant investigations.

Investigations

- Complete blood counts: Hb% (reduced), TC and DC (normal), reticulocyte counts (low or normal), platelet counts usually normal but occasionally may be high (thrombocytosis)
- Peripheral blood film: Shows microcytic hypochromic RBC with anisocytosis, poikilocytosis and occasional target cells
- RBC indices: MCV, MCH are reduced but RDW (red cell distribution width) is high
- Serum iron profile: S. iron and ferritin are low and Total Iron Binding Capacity (TIBC) is high



Microcytic and Hypochromic red cells with few target cells
Courtesy: Dr Akhil Ranjan Biswas

- Other investigations: May be directed towards detecting aetiology e.g. stool R/M/E & for occult blood test (may be positive)

Differential diagnoses

- * β thalassaemia trait
- * α thalassaemia trait
- * Hemoglobin-H disease
- * Anaemia of chronic disease e.g. *JIA*
- * Lead poisoning
- * Sideroblastic anaemia

Treatment

The objectives are to-

- * Restore haemoglobin level to normal
- * Replenish the depleted iron stores and
- * Treat the underlying causes
- Counsel the parents about the disease
- Oral iron therapy: 3 mg of elemental iron/kg/day in 3 divided doses. It should be given about half an hour before meal to maximize absorption

The choices are Ferrous sulphate, Ferrous fumarate and Iron polymaltose complex.

Duration of treatment: 6 - 8 weeks after haemoglobin indices return to normal.

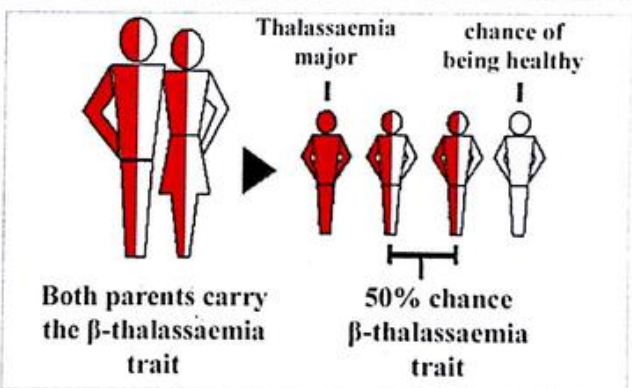
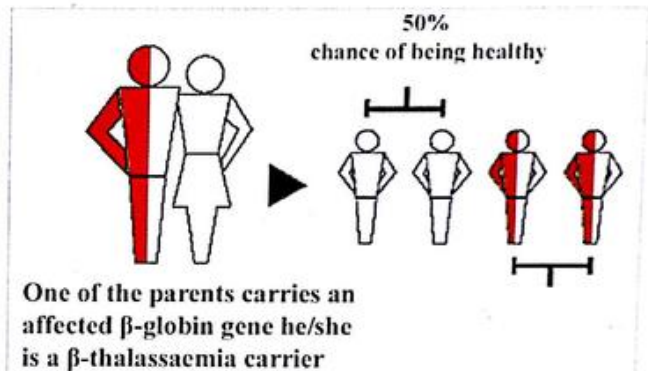
- Diet
 - * Supplementation of diets rich in iron
 - * Avoidance of foods deficient in iron
 - * Avoidance of foods those interfere with iron absorption e.g. *tea, coffee etc.*
- Treatment of underlying cause e.g. anthelmintics

HEREDITARY HAEMOLYTIC ANAEMIAS

These are a group of genetically determined disorders of RBC characterized by excessive haemolysis. The defects/deficiency is attributed to RBC either in -

- * Membrane e.g. *spherocytosis, elliptocytosis*
- * Enzymes e.g. *deficiency of G6PD, pyruvate kinase*
- * Haemoglobin e.g. *Thalassaemia syndromes, haemoglobinopathies*

Of these, Thalassaemia syndromes and haemoglobinopathies are the common haemolytic disorders where the defective genes are inherited from the parents.



Thalassaemia syndromes

These are inherited abnormalities in globin synthesis where there is a deficient production of either α or β chains. In thalassaemia syndromes, the globin chains are structurally normal.

Based on the deficiency of either α or β chains, thalassaemias are of 2 types

A. α thalassaemia (deficient production of α chain): It may be-

- * Homozygous e.g. *hydrops foetalis* ($\alpha 0$ or Hb Bart), or
- * Heterozygous e.g. *silent carrier* ($3\alpha+$), *α thalassaemia trait* ($2\alpha+$) or Hb H ($1\alpha+$).

B. β thalassaemia (deficient synthesis of β chains): It may be-

- * β Thalassaemia major: They are transfusion dependent
- * β Thalassaemia minor or trait: They carry the defective gene, completely asymptomatic and are identified incidentally
- * β Thalassaemia intermedia: Their clinical phenotype is more than thalassaemia minor but milder than thalassaemia major. Their clinical behaviour is widely variable. Some of them maintain Hb concentration of about 7-8 gram without transfusion but some may remain completely asymptomatic until adult life

Haemoglobinopathies

These are inherited disorder of haemoglobin where globin chains are structurally abnormal.

The most important of these are HbS, HbC, HbE and HbD Punjab and all are the results of amino acid substitutions in globin chains. They may be either heterozygous or homozygous and their clinical presentations are variable.

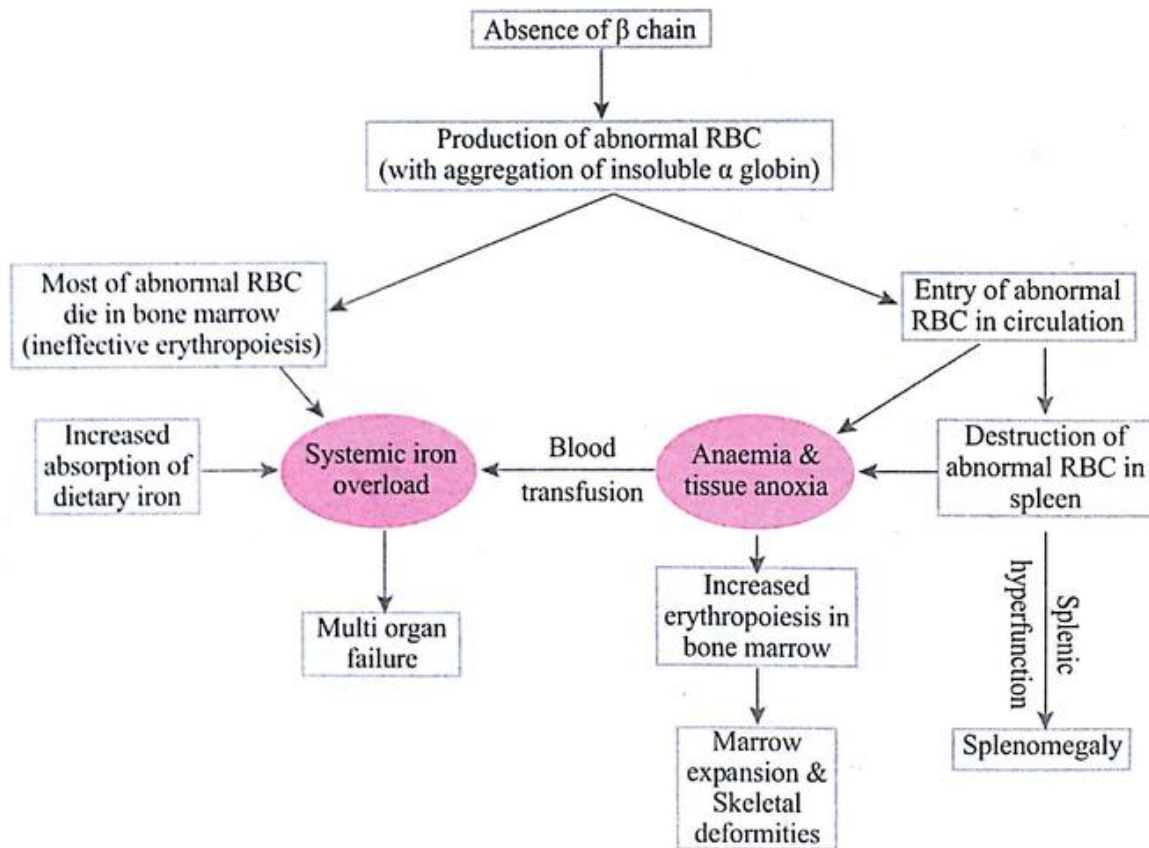
Of the different types, HbE is most prevalent in South East Asia and is important because of its combination with beta thalassaemia gene (HbE-beta thalassaemia) and children having this combination are usually transfusion dependent. 26 glutamate → 1st line

Prevalence

Overall prevalence of β thalassaemia trait and Hb-E trait in Bangladesh are 4.1% & 6.1 % respectively.

BETA (β) THALASSAEMIA MAJOR

Pathogenesis



Pathophysiology of β thalassaemia Major (Adopted from Robbin's & Cotran's pathology '2010)

In β thalassaemia due to absence or decreased β chain production, the unpaired α globin chains are accumulated as 'toxic inclusion bodies' in the developing erythroblasts and cause their destruction within the bone marrow (ineffective erythropoiesis). The remaining RBC escapes destruction in the marrow and come to the circulation. These defective RBC (carrying inclusion bodies) are ultimately destroyed in the spleen. This premature haemolysis causes 2 major clinico-pathological consequences-

- * Severe anaemia
- * Accumulation of excess iron in the circulation as well as in vital organs, causing their progressive dysfunction

To compensate severe anaemia, medullary as well as extramedullary erythropoiesis (*e.g. in liver*) occurs. The marrow spaces are expanded due to erythroid hyperplasia (medullary erythropoiesis). Expansion of marrow space causes thinning of bony cortex and may cause **pathological fractures** of long bones. Marrow expansion of flat bones of skull and face (*e.g. maxilla, zygoma*) results in -

- * Facial deformities
- * Dental mal-occlusions
- * Frontal and Parietal bossing

In addition, the untreated or partially treated children grow poorly (growth failure) and develop massive hepatosplenomegaly.

Clinical Manifestations

Affected child may be normal at birth but develop significant anaemia during their first year of life.

The common presentations are -

- Progressive pallor, weakness, lethargy and effort intolerance

- Failure to thrive and growth retardation
- Psychological depression
- Recurrent episodes of infections
- Problems in movement and abdominal discomfort because of massive splenohepatomegaly
- Sometimes patient may present with features of complications like -
 - * Respiratory distress due to heart failure from severe anaemia
 - * Bleeding from nose, gum etc. because of hypersplenism
 - * Pathological fracture due to thinning of bony cortex
- Sometimes they may present with complications related to deposition of excess iron to different tissues -

- * Diabetes mellitus
- * Chronic liver disease
- * Others *e.g. hypogonadism, delayed puberty, hypothyroidism, hypoparathyroidism etc.*

Physical Examination

- Moderate to severe pallor



Pale palm

- Mild jaundice



Jaundice

- Changes in facial profiles like frontal and parietal bossing, depressed nasal bridge, prominent zygoma, malaligned jaw and teeth (*Thalassaemic facies*)



Prominent zygoma, misaligned jaw and teeth

- Changes in complexion (greenish brown complexion due to the effect of combined pallor, haemosiderosis and jaundice)
- Growth failure (Stunting)

- Massive hepatosplenomegaly



Massive hepatosplenomegaly

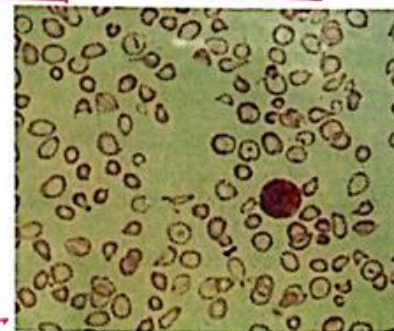
Diagnosis

Based on C/F & relevant investigations.

Investigations

A. Blood

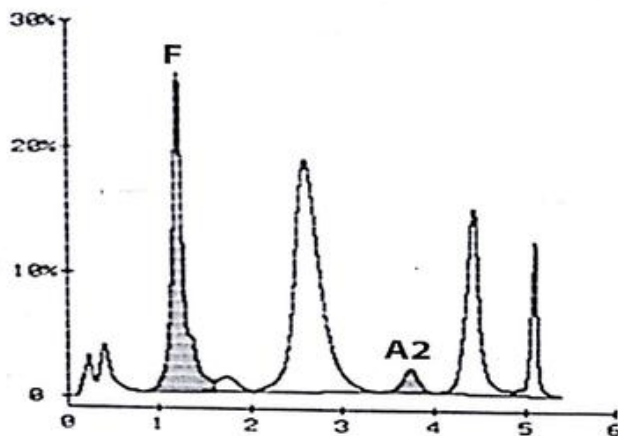
- Haemoglobin level: Always low depending on the severity of the disease
- TC & DC of WBC: Normal except in associated infection (leukocytosis) or hypersplenism (depleted)
- Platelet count: Usually normal except in hypersplenism (Thrombocytopenia)
- Reticulocyte count: Higher (due to compensatory erythropoiesis) than normal (normal range 0.2-2%)
- Peripheral blood film: Shows microcytic hypochromic picture with marked anisocytosis & poikilocytosis. Appearance of abnormal cells like target cells, tear drop, pencil shaped cells, nucleated cells, schistocytes, fragmented cells



Hypochromia with plenty of tear drop cells, schistocytes, target cells and few nucleated RBC.

Courtesy: Dr. Akhil Ranjan Biswas

- RBC indices: MCV, MCH, MCHC are low
- Serum iron profile: Serum iron and ferritin are high with low total iron binding capacity (TIBC)
- Haemoglobin electrophoresis: Shows markedly reduced or absent HbA and raised HbF and HbA2



Summary of Haematological changes in IDA & Thalassaemia

Haematological parameter	Iron deficiency anaemia	Thalassaemia
Haemoglobin	Reduced	Markedly reduced
Reticulocyte	Normal or low	Raised
Platelet	Thrombocytosis	Normal or low
S. iron	Reduced	Raised
Ferritin	Reduced	Raised
TIBC	Raised	Reduced
RDW	Raised	Normal
MCHC	Reduced	Reduced
MCV	Reduced	Reduced

B. Radio-imaging

- X-ray skull shows -
 - * Increased diploic space
 - * Hair on end appearance



Typical X-ray skull of thalassaemia Major

- X-ray of long bones shows -
 - * Lacy increased trabecular, mosaic patterns and
 - * Osteopenia



X-ray hands showing mosaic pattern

Complications

- Growth retardation
- Bony deformities: Deformed skull & facies
- Complications related to iron overload:
 - * Damage to heart (cardiomyopathy), liver (CLD) and endocrine system (hypothyroidism, diabetes mellitus)
- Recurrent infection due to low immunity and blood borne infections
- More prone to fracture as the bones are thin and brittle
- Spinal cord compression due to extramedullary haemopoiesis
- Enlarged spleen (splenomegaly) causing worsening of anaemia & mechanical discomfort
- Cardiac problems *e.g. congestive heart failure, arrhythmias*
- Complications of blood transfusion *e.g. allergic reaction, acute haemolytic reaction, TRALI (Transfusion Related Acute Lung Injury), TACO (Transfusion Associated Circulatory Overload), transmission of infectious agents*

Treatment

The affected children are transfusion dependent. In addition to regular blood transfusions, they require an integrated supports from Paediatrician, Haematologist, Psychologist and Transfusion specialists.

• Counseling parents -

- * Provide information for better understanding of the illness
- * Help the patient to accept the illness and to take care of him/herself
- * Facilitate a 'normal' lifestyle and encourage self-esteem
- * Genetic counseling

• The major options of treatment are-

- * Conventional method
- * Bone marrow transplantation
- * Pharmacological methods to increase gamma chain synthesis
- * Gene therapy

A. Conventional method: This includes -

I. Blood transfusion

To correct anaemia and to maintain appropriate haemoglobin level so as to -

- * Minimize expansion of bone marrow
- * Ensure normal growth and to increase physical activity



Childrens getting blood transfusion



Desferrioxamine infusion through pump

A transfusion programme is adopted to maintain-

- * Pre transfusion Hb: > 9-10.5 gm/dl
- * Post transfusion Hb: ~ 15 gm/dl & to maintain mean Hb: 12.5 gm/dl

However, in patients with cardiac disease, higher pre-transfusion haemoglobin levels (11-12 gm/dl) may be beneficial.

• The recommended blood products are-

- * Leukoreduced packed RBC with a minimum haemoglobin content of 40 gm/dl
- * Washed RBC
- * Frozen or cryopreserved RBC
- * Neocyte or young red cell

II. Iron chelation

To keep iron in a safe zone, so as to prevent its deposition in various organs. The iron chelators are -

- Desferrioxamine: (Inj. DFO, Desferol 500 mg)
- Deferiprone (Cap Kelfer 500 mg)
- Deferasirox (Tab. Asunra 100, 400 mg)

When to start iron chelation: Usually -

- * After 10-20 transfusions
- * Serum ferritin level >1000 ng/ml
- Combined therapy: DFO at the time of transfusion and Deferiprone in between transfusions is effective & may be given

III. Diet & Nutrition

- The child can eat & drink almost everything that a normal child can. But better to avoid red meat
- Foods e.g. tea, coffee decreases iron absorption, hence taking these just after meal is beneficial
- Vitamin C increases iron excretion by increasing the availability of chelable iron. Dose 2-3 mg/kg/day as supplements to be taken at the time of DFO infusion so that liberated iron is rapidly chelated and excreted through urine
- Vitamin E should be supplemented as antioxidant to reduce iron induced oxidative damage

Iron should not be given in the form of drug

IV. Splenectomy

- Indications
 - * When transfusion requirement is > 200 ml of packed cells/kg/year
 - * When spleen enlargement is accompanied by left upper quadrant pain, early satiety & fear of rupture
 - * Mechanical discomfort due to large spleen

• Precondition for splenectomy

- * Age more than 5 yrs (because of mature immune system)
- * Vaccination (4 weeks prior to surgery) against pneumococcus, *H. influenzae type b* and meningococcus

• Care after splenectomy

- * Oral Phenoxymethyl Penicillin (lifelong prophylaxis)
 - <2 years: 125 mg every 12 hours
 - >2 years: 250 mg every 12 hours
- * Prompt treatment of any infection

V. Treatment of complications if any e.g.

Replacement of insulin (diabetes) or thyroxin (hypothyroidism) etc.

VI. Follow up

Monthly	Complete Blood Count
Every 3 months	S. ferritin, RBS, SGPT, albumin, creatinine
Every 6 months	Echocardiography, ECG
Yearly	Hepatitis B, C & HIV screening, FT4, TSH, LH, Testosterone, Estradiol, GTT, Ophthalmology & audiological examination

B. Bone marrow or stem cell transplant from a HLA identical sibling donor

- * The probability of haematological cure is >90% when transplantation is done prior to the development of hepatomegaly or portal fibrosis

C. Pharmacological methods

This is done to increase γ chain production through methylation of γ genes (to produce more HbF) by drugs like Hydroxyurea, Sodium phenyl butyrate and 5-azacytidine. This helps to improve haemoglobin status of patients.

D. Gene therapy

One of the curative treatment of thalassaemia major but this modality is still not available.

Thalassaemia: How to prevent?

- **Carrier detection** among general population through blood CBC, PBF, MCV, MCHC & Haemoglobin electrophoresis
- **Pre-marital counseling** specially among carriers about the chance of getting thalassaemia among the offsprings
- **Antenatal detection**: When a carrier mother becomes pregnant, the status of the foetus whether having thalassaemia major, carrier or normal can be detected by chorionic villus sampling and DNA analysis during 8-11th weeks of pregnancy

References

1. Khan W A et al. Prevalence of beta thalassemia trait and Hb E trait in Bangladeshi school children and health burden of thalassemia in our population. Dhaka Shishu Hospital Journal 2005; 21(1): 1-7
2. Rund D, Rachmilewitz E. β thalassemia. The New England Journal of Medicine, 2005; 353 (11): 1135-46
3. Weatherall DJ. Genetic disorders of haemoglobin. In: Hofbrand AV, Lewis S, Tuddenham E, editors. Post Graduate Haematology. 4th ed. West Sussex, UK: Wiley-Blackwell; 1999
4. Oliveri NF, Brittenham GM. Iron chelation therapy and treatment of thalassaemia. Blood. 1997; 89: 739.
5. Choudhry VP, Naithani R. Current status of iron overload and chelation with deferasirox. Indian Journal of Pediatrics. 2007; 74: 59-64
6. Milner A D, Hull D. Blood In: Hospital Pediatrics. 3rd Edition, Oxford, UK: Churchill Livingstone; 1998 p 272-294
7. Mollah MAH et al. Seroprevalence of common transfusion transmitted infections among thalassemic children in Bangladesh. J Health Population Nutrition 2003; 21(1): 67-71
8. Shaligram D, Girimaji SC, Chaturvedi SK. Psychological problems and quality of life in children with thalassemia. Indian Journal of Pediatrics. 2007; 74: 27-30
9. Eleftheriou A. About thalassemia- a Thalassemia International Federation publication, 2005
10. Lanzkowsky P. In: Manual of Paediatric Haematology and Oncology. 5th ed., UK: Elsevier; 2011 p 55

SELF ASSESSMENT

Short answer questions [SAQ]

1. What are the cardinal features of iron deficiency in IDA?
2. Write down the treatment of iron deficiency anaemia with duration.
3. What are the radiological findings of beta thalassaemia major?
4. What do you mean by the hyper-transfusion regimen of blood transfusion in thalassaemia?

Multiple choice questions [MCQ]

1. Normal fractions of haemoglobin of a child include-
☐ a) HbA ☐ b) HbA2 ☐ c) HbF ☐ d) HbS ☐ e) Hb Gower
2. The blood picture of beta thalassaemia major are-
☐ a) microcytic hypochromic anaemia ☐ b) target cells ☐ c) nucleated RBC
☐ d) normal reticulocyte count ☐ e) high TIBC
3. The recommended iron chelators are-
☐ a) Desferrioxamine ☐ b) Deferiprone ☐ c) Deferasirox
☐ d) Hydroxyurea ☐ e) 5-azacytidine
4. The pathological consequences of thalassaemia major are-
☐ a) haemolysis ☐ b) organ dysfunction ☐ c) iron overload
☐ d) iron deposition to vital organs ☐ e) excessive medullary and extramedullary haemopoiesis
5. In iron deficiency anaemia serum iron profile shows-
☐ a) low serum iron ☐ b) low serum ferritin ☐ c) high % saturation of iron
☐ d) low total iron binding capacity ☐ e) low marrow sideroblast
6. Pharmacotherapy in thalassaemia causes increased production of -
☐ a) alpha chain ☐ b) beta chain ☐ c) gamma chain ☐ d) delta chain ☐ e) theta chain

7. The common clinico-haematological profile of iron deficiency anaemia include
 - ☐ a) clubbing ☐ b) Microcytic hypochromic anaemia
 - ☐ c) low serum total iron binding capacity ☐ d) high serum ferritin level
 - ☐ e) low serum iron level
8. Iron deficiency anemia in children
 - ☐ a) depressed motor & mental development ☐ b) may have breath holding attacks
 - ☐ c) iron absorption is affected by vit C ☐ d) macrocytosis found in blood film
 - ☐ e) 3-6 months treatment is required for improvement
9. Iron deficiency in childhood occur due to
 - ☐ a) exclusive use of goats milk ☐ b) heavy tea drinkers ☐ c) in most cases of celiac disease
 - ☐ d) in adolescent girls during puberty ☐ e) early weaning
10. Hypochromic microcytic anemia may be seen in
 - ☐ a) iron deficiency anemia ☐ b) beta thalassaemia ☐ c) hereditary spherocytosis
 - ☐ d) vit B12 deficiency ☐ e) glucose 6 phosphate deficiency
11. Drugs used to treat thalassaemia through γ chain production are
 - ☐ a) Hydroxyurea ☐ b) Sodium phenyl butyrate ☐ c) Vitamin C
 - ☐ d) Deferasirox ☐ e) Deferiprone
12. The haematological profile of thalassaemia includes
 - ☐ a) low S. iron ☐ b) high S. ferritin ☐ c) high TIBC
 - ☐ d) high RDW ☐ e) low MCV
13. Important follow-up investigations for a thalassemia patient include
 - ☐ a) S. ferritin, ☐ b) S. Testosterone ☐ c) S. albumin
 - ☐ d) S. Estradiol ☐ e) S. creatinine
14. Example of iron chelators include
 - ☐ a) Desferrioxamine ☐ b) Rituximab ☐ c) Deferiprone
 - ☐ d) Cycloserine ☐ e) Deferasirox
15. Complications of intramedullary erythropoiesis include
 - ☐ a) Facial deformities ☐ b) Dental mal-occlusions
 - ☐ c) Frontal bossing ☐ d) Pathological fractures ☐ e) Thinning of bony cortex

PALLOR, BLEEDING AND FEVER

LEUKAEMIA	190
APLASTIC ANAEMIA	194

Whenever children present with pallor, mucocutaneous bleeding and fever simultaneously i.e. features of involvement of RBC, platelets and WBC, one should think that the problem is possibly in the bone marrow. In such situation, the following common bone marrow diseases should be considered -

- * Leukaemia
- * Aplastic anaemia
- * Bone marrow infiltrating diseases

However, sometimes septicaemia/disseminated intravascular coagulation (DIC), hypersplenism also present with the above manifestations.

In this section acute leukaemia and aplastic anaemia will be highlighted.

LEUKAEMIA

Leukaemia is the commonest malignancy of childhood, constitutes about 40% of the total childhood cancers.

Other childhood malignancies are

- | | |
|------------------|--------------------------|
| • CNS tumor | • Retinoblastoma |
| • Neuroblastoma | • Sarcoma e.g. |
| • Hepatoblastoma | <i>rhabdomyosarcoma,</i> |
| • Lymphoma | <i>osteosarcoma</i> |
| • Wilm's tumor | |

Aetiology

- Unknown
- Genetic & chromosomal disorders
- Environmental factors e.g. radiation, viral infections, exposure to chemicals and cytotoxic drugs

Pathogenesis

Leukaemias are primary malignancy of bone marrow, where there is malignant proliferation of haemopoietic stem cells with diffuse replacement of normal marrow by neoplastic (blast) cells. As the blast cells occupy a major area of bone marrow, they suppress the function of normal haemopoietic stem cells.

As a result, there is decreased production of RBC, mature WBC and platelets and the consequences are -

* Paucity of RBC	* Anaemia
* Paucity of mature WBC	* Immune suppression and infection
* Paucity of platelets	* Bleeding

In most cases, the leukaemic cells gradually spill over into blood from bone marrow. Sometimes, they may infiltrate into the extramedullary sites like, lymph nodes, liver, spleen, bone, brain, eyes, testes and other tissues throughout the body.

Types: Leukaemia may be acute or chronic. The common types are -

- Acute lymphoblastic leukaemia (75-80%)
- Acute myeloblastic leukaemia (12-15%)
- Chronic myelogenous leukaemia (5%)
- Others (7-8%)

Clinical Manifestations

- Non specific -
 - * Profound loss of appetite, lethargy, irritability
 - * Pain in different parts of body.
- Specific -
 - * Fever: May be prolonged or intermittent. Fever results from either leukaemia induced liberation of cytokines or secondary infections due to leukopenia/immunosuppression

- * Progressive pallor
- * Bleeding from nose, gum and into skin. *e.g. petechiae, purpura, ecchymosis*
- Sometimes patients may have-
 - * Convulsion and other neurological manifestations *e.g. headache, vomiting, nerve palsy etc.* because of CNS/meningeal infiltration
 - * Problems of vision because of infiltration to retina
 - * Respiratory distress from mediastinal mass or from anaemic heart failure

Physical Examination

Findings at presentation may range from virtually normal to highly abnormal physical findings. The usual features are-

- Sick looking, irritable, febrile child



Pallor



Purpuric spots

- Signs related to bone marrow infiltration *e.g. raised body temperature (infection), pallor (depleting haemoglobin), petechiae, purpura, nose or gum bleeding due to platelet depletion*



Gum bleeding



Infection at nose

- Lymphadenopathy: Either localized or generalized



Lymphadenopathy

*Bony tenderness*

- Bony tenderness over sternum, legs
- Hepatomegaly and splenomegaly
- Infections anywhere in the body
- Sometimes testicular enlargement due to leukaemic cell infiltration
- In AML, bone pain and tenderness are more than ALL. In addition, there may be gingival hypertrophy, parotid swelling, proptosis and chloroma (solid collection of leukaemic cells occurring outside of the bone marrow)

*Gingival hypertrophy**Infiltration of leukaemic cells to eye**Chloroma**Leukaemia cutis in a 6 months old boy*

Differential Diagnoses

- Aplastic anaemia
- ITP
- Kala-azar

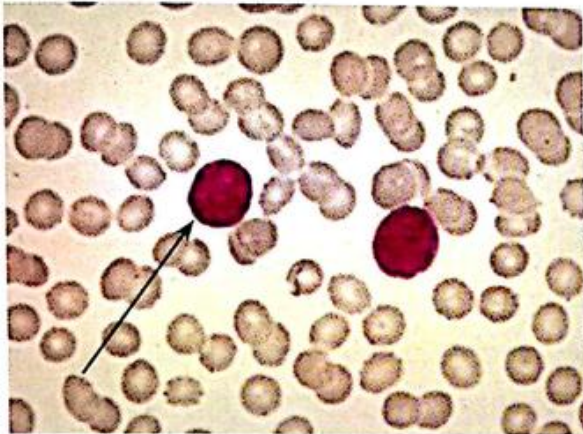
Diagnosis

Based on C/F & relevant investigations.

Investigations

- Complete blood counts with PBF
 - * Haemoglobin level: Reduced
 - * Total counts of WBC: Can be high, normal or low
 - * Differential counts of WBC: Depending on the type of leukaemia, cell lines may be changed. There may be presence of blast cells

- * Platelet counts: Usually low
- * Peripheral blood film: RBC normal
- * WBC series shows **blast cells** & platelets reduced

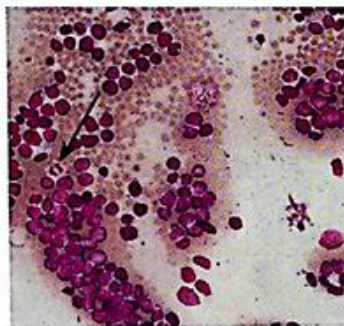


PBF showing lymphoblast

Courtesy: Dr. Akhil Ranjan Biswas

• Bone marrow study

- * Cellularity: Hypercellular
- * M:E ratio: Increased
- * Granulopoiesis: Increased
- * Erythropoiesis: Reduced
- * Megakaryopoiesis: Reduced
- * **Blast cells of >25% is diagnostic**



Bone marrow showing lymphoblast

Courtesy: Dr. Akhil Ranjan Biswas

• CSF examination

- * Blast cells may be found in CNS leukaemia

• Other investigations

- * X-Ray chest (to detect mediastinal lymphadenopathy)
- * S. uric acid and S. LDH (usually elevated)
- * S. electrolytes (may be altered)
- * S. calcium, phosphate (may be raised)
- * S. creatinine (may be raised in uric acid nephropathy)
- * Flow cytometry of marrow cells to characterize the types of leukaemia

Treatment

Counseling parents about the disease and its management and prognosis

A. Supportive

- Diet: Nutropenic diet (freshly prepared food)
- To treat & prevent infections by -
 - * Antibiotics: Broad spectrum covering gram positive and gram negative organism
 - * Antifungals (Nystatin drop) 2.5 ml over tongue 6 hourly
 - * Mouth wash (Oralene mouth wash mix with water and gargle 8 hourly)
 - * Hip bath (Acriflavine hip bath mix with water evacuation of bowel)
 - * Maintenance of total hygiene in living area
 - * Barrier nursing
- To correct anaemia: Blood transfusion
- To treat fever: Oral/IV paracetamol (not suppository)

Pre-chemo measures

To reduce leukaemic cell concentration	IV fluid 3 L/m ² /day for at least 24 hours
To reduce risk of uric acid nephropathy	Tab. Allopurinol 200-400 mg/m ² /day
To reduce metabolic acidosis	Inj. Sodi-bicarb 25 ml/500 ml IV fluid
For medical de-bulking of tumour cell load (in case of emergency)	Tab Prednisolone 60 mg/m ² /day

B. Specific

- Chemotherapy: Protocol based multi-staged poly-chemotherapy (risk directed therapy) is quite effective with good prognosis. The chemotherapeutic agents are used step by step, considering the patient's clinical, haematological, biochemical and bone marrow evaluation
- Bone marrow transplantation: The curative treatment of ALL for high risk group

Chemotherapeutic drugs at different stages of treatment

Induction of Remission	Intensification (Early and Late)	High dose IV Methotrexate	Maintenance
28 days	5 days each	4 days	2-3 yrs
Allopurinol (Oral, daily)	* MTX+Cyt+Het (IT, D1)	Methotrexate (IV, D1)	MTX+ Cyt+Het (IT) Vincristine
Vincristine (IV, weekly)	Vincristine (IV, D1)	Folinic acid (IV on D2-4)	<u>Methotrexate</u>
L-asparaginase (IV, alternate day, 9 doses)	Daunorubicin (IV, D1)		Dexamethasone
* MTX+Cyt+Het (IT, weekly, 4 doses)	Etoposide (IV, daily)		Cotrimoxazole
Daunorubicin (IV, D1, D2)	Cytarabine (IV, daily)		<u>Marcapurine</u>
Dexamethasone (Oral, daily)	Thioguanine (Oral, daily)		
	Dexamethasone (Oral, daily)		

*MTX+Cyt+Het (Methotrexate + Cytarabine + Hydrocortisone) - Triple IT

Maintenance

- Triple IT (Intrathecal): Every 3 months
- IV Vincristine: Monthly
- Oral Methotrexate: Weekly
- Oral Dexamethasone: Initial 5 days of each month
- Oral Cotrimoxazole: Every alternate day (to protect from *Pneumocystis jiroveci*)
- Oral 6 Marcapurine: Daily

Prognosis

Most children with ALL can now be expected to have long-term survival, with the survival rate >80% at 5 years from diagnosis.

Poor prognostic criteria (High risk)

- Age <1 year or >10 years at diagnosis
- Leukocyte count of >50,000/ μ L at diagnosis
- Slow response to initial therapy
- Associated chromosomal abnormalities, including hypodiploidy, the Philadelphia chromosome and translocations [t (1:19) or t (4:11)]

Good prognostic criteria (Average risk)

- Rapid response to chemotherapy
- Chromosomal alterations, including hyperdiploidy, trisomy of specific chromosomes e.g. trisomy 4, 10, 17

APLASTIC ANAEMIA

It is defined as the failure of the bone marrow to produce adequate number of circulating blood cells that give rise to peripheral pancytopenia.

Aetio-pathogenesis

- Idiopathic (>50% cases)
- Secondary:
 - * Viral infections e.g. *Hepatitis B, EBV, HIV, parvovirus*
 - * Exposure to radiation and chemicals e.g. *benzene, drugs and elements e.g. chloramphenicol phenylbutazone, gold*
- Congenital e.g. *Fanconi's anaemia*

Clinical Manifestations

The clinical features are related to Pancytopenia from bone marrow failure. The cardinal clinical features of bone marrow failure includes -



Aplastic child with severe anaemia & bleeding from multiple sites

Clinical features	Related to
Weakness, pallor and fatigue	Anaemia
Petechiae, purpura, ecchymoses and mucosal bleeding e.g. gum & nose bleeding, subconjunctival haemorrhage	Thrombocytopenia
Frequent severe infections, septicaemia or mouth and pharyngeal ulcerations	Leukopenia

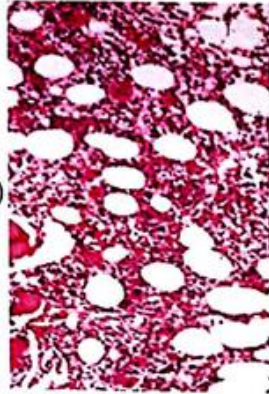
Diagnosis

Based on C/F & relevant investigations.

Investigations

• Complete blood counts with PBF

- * Usually pancytopenia (anaemia, leukopenia and thrombocytopenia)
- * Occasionally bicytopenia or monocytopenia



Normal bone marrow

• Bone marrow study

- * Cellularity: Hypocellular with empty spaces, increased fat space
- * M:E ratio: Increased (Increased lymphocyte or plasma cells)
- * Granulopoiesis: Reduced
- * Erythropoiesis: Reduced
- * Megakaryopoiesis: Reduced



Aplastic bone marrow

Source: Internet

• Tests to find out aetiology

- * Chromosomal study to see chromosomal breakage *e.g. Fanconi's anaemia*
- * Viral markers *e.g. HBsAg*

Treatment

Counsel parents about the disease.

A. Specific: Bone marrow transplantation

B. Other option: Immunotherapy -

- * Anti Thymocytic Globulin (ATGAM)
- * G-CSF (Granulocyte Colony Stimulating Factor)
- * Cap. Cyclosporine
- * Tab. Prednisolone

C. Supportive

- * Transfusion of blood /packed cell to keep Hb level above 7 g/dl and avoiding transfusions from family members is important because of possible sensitization against non-HLA tissue antigens of the donors.
- * Treatment of infection: Empirical broad based antibiotic therapy + antifungal therapy (*Aspergillus* species)
- * Diet: The diet for the patient with neutropenia or receiving immunosuppressive therapy should be tailored carefully to exclude raw meats, dairy products, fruits and vegetables that are likely to be colonized with bacteria, fungus, or molds.

References

1. Tubergen DG, Bleyer A, Ritchy AK. The Leukemias. In: Kliegman RM, Stanton BF, Geme III JWS, Schor NF, Behrman RE. Editors. Nelson Textbook of Pediatrics, 20th Edition. New Delhi: Elsevier; 2016: 2437-2444.
2. Maloney K et al. Neoplastic disease. In: Hay WW, Levin MJ, Sondheimer JM, Deterding RR, editors. Current diagnosis & Treatment in Pediatrics. 18th ed. New York: McGraw-Hill; 2007. p 885-916.
3. Leukemias. In: Manual of Pediatric Hematology and Oncology. Philip Lanzkowsky. 4th ed. London: Elsevier Academic Press; 2005, p 415-450.

4. Maloney K et al. Neoplastic disease. In: Hay WW, Levin MJ, Sondheimer JM, Detering RR, editors. Current diagnosis & Treatment in pediatrics. 18th ed. New York: McGraw-Hill; 2007. p 885-916.
5. Kurkure PA, Arora B, Bhagawat R. Pediatric Oncology: Hodgkin's disease & Non-Hodgkin's lymphoma. In: Parthasarathy A. editor. IAP Textbook of Pediatrics. 4th ed. Delhi: JB; 2009. P 880-887.

SELF ASSESSMENT

Short answer questions [SAQ]s

1. What are the common childhood cancers?
2. What are the different steps of treatment of acute leukaemia?
3. Name 5 chemotherapeutic agents used for treatment of acute lymphoblastic leukaemia?
4. What are the pre- chemo measures to be taken during treatment of a leukaemic child?
5. Outline the principles of treatment of aplastic anaemia.
6. Write down the clinical features of acute leukaemia.
7. How will you investigate acute leukaemia?
8. How will you investigate aplastic anaemia?
9. A 5 year old boy presented with fever and pallor for last 2 months along with hepatosplenomegaly.
 - a) Write three common differential diagnosis.
 - b) How will you investigate the boy?

Multiple choice questions [MCQ]

1. Blood picture of acute leukaemia includes-

☐ a) leukocytosis	☐ b) thrombocytopenia	☐ c) nucleated RBC
☐ d) target cells	☐ e) immature WBC (blast cells)	
2. Thrombocytopenia is found in -

☐ a) ITP	☐ b) haemophilia	☐ c) von Willebrand disease
☐ d) acute leukaemia	☐ e) Henoch-Schönlein purpura	
3. A child with aplastic anaemia may present with

☐ a) fever	☐ b) severe anaemia	☐ c) bleeding manifestation
☐ d) hepatosplenomegaly	☐ e) generalized lymphadenopathy	
4. Poor prognostic criteriae of ALL includes the associated

☐ a) chromosomal abnormality	☐ b) high leukocyte count	☐ c) thrombocytopaenia
☐ d) ALL in infants	☐ e) rapid response to therapy	
5. Immunotherapeutic agents for aplastic anemia include

☐ a) Anti Thymocytic Globulin	☐ b) Granulocyte Colony Stimulating Factor
☐ c) Tab. Cyclophosphamide	☐ d) Cap. Cyclosporine
	☐ e) Tab. Prednisolone
6. The drugs used for maintenance treatment of ALL include

☐ a) Etoposide	☐ b) Methotrexate	☐ c) Daunorubicin
☐ d) Cotrimoxazole	☐ e) Mercaptopurine	
3. Common childhood malignancies include

☐ a) Neuroblastoma	☐ b) Hepatoblastoma	☐ c) Adenocarcinoma
☐ d) Lymphoma	☐ e) Cholangiocarcinoma	

BRUISING AND BLEEDING

IDIOPATHIC THROMBOCYTOPENIC PURPURA	197
HAEMOPHILIA	200
VON WILLEBRAND DISEASE	203

When a child presents with bleeding, the following conditions should be taken into consideration-

- * Idiopathic thrombocytopenic purpura (ITP)
- * Leukaemia
- * Dengue haemorrhagic fever (DHF)
- * Aplastic anaemia
- * Haemophilia A, B
- * von Willebrand disease
- * Henoch Schönlein purpura

Rarely thrombasthenia e.g. Glanzmann disease and Bernard Soulier syndrome may also present with bleeding.

In this chapter, ITP, haemophilia and von Willebrand disease will be discussed.

IDIOPATHIC THROMBOCYTOPENIC PURPURA (ITP)

This is the most common bleeding disorder among children where platelets are coated by a circulating antibody, developed against platelet glycoprotein antigens and are destroyed in the spleen.

Clinical types

- Acute ITP
- Chronic ITP (persistent thrombocytopenia >12 months)

Nelson 20th ed. '2015

Aetio-pathogenesis

Unknown. However, in about 50-60% cases, this platelet destruction may follow an episode of viral upper respiratory tract infection about 2-3 weeks prior to the bleeding episodes. The viruses commonly involved are Epstein-Barr virus (EBV), Rubella, Varicella, Measles, Parvovirus B19 and Influenza. The viruses produce anti-platelet antibodies and these coat platelets and platelets are finally destroyed and removed by spleen

Clinical Manifestations

- It occurs mostly among children of 2-5 years
- Sudden onset of generalized skin bleeding in the form of petechiae and purpura, in a previously healthy child
- In addition, there may be bleeding from gum, conjunctiva and nose



Periorbital ecchymosis & gum bleeding

- Internal bleeding particularly haematuria, haematemesis, haemoptysis and intracranial bleeding are uncommon but can occur in severe thrombocytopenia and may be fatal

Physical Examination

- Evidence of bleeding in
 - * Skin e.g. petechiae, purpura or ecchymosis
 - * Mucosa e.g. nose, gum, oral cavity, conjunctiva



Multiple purpuric spots, do not blanch on pressure

However, patients neither have severe pallor, hepatosplenomegaly, lymphadenopathy nor bony tenderness

Differential Diagnoses

- Henoch Schönlein purpura
- Dengue haemorrhagic fever (DHF)
- Leukaemia
- Aplastic anaemia
- Meningococcal septicaemia

Skin rash of Henoch-Schönlein purpura

(Anaphylactoid purpura: Immune mediated vasculitis)

These rashes are characterized as palpable purpura that evolve from red to purple and



Skin rash of HSP

then to rusty brown before they eventually fade. These are non tender, do not blanch on pressure. Lesions usually involve buttock, lower extremities and the hands (waist down distribution).

Skin lesions of acute meningococcaemia

Lesions consist of tender pink macules, petechiae and purpura. These are most prominent on the extremities and may progress to form areas of frank necrosis.



Skin lesions of acute meningococcaemia

Skin lesions of Dengue fever

Transient macular rash in first 1-2 days, maculopapular, scarlet morbilliform, from day 3-5



Skin rash of DHF

Clinical severity of acute ITP

1. No/minimal symptoms
2. Mild: bruising and petechiae, occasional minor epistaxis, very little interference with daily living
3. Moderate: more severe skin and mucosal lesions, more troublesome epistaxis and menorrhagia
4. Severe: bleeding episodes—menorrhagia, epistaxis, melena—requiring transfusion or hospitalization, symptoms interfering seriously with the quality of life

Diagnosis

Based on C/F & relevant investigations.

Investigations

• Blood

- * Haemoglobin: Usually normal unless massive haemorrhage
- * TC and DC of WBC: Usually normal
- * Peripheral blood film: Normal. Sometimes larger platelets may be seen
- Coagulation profile (usually not done):
 - * Bleeding time (BT): Prolonged
 - * Prothrombin time (PT): Normal
 - * Activated partial thromboplastin time (aPTT): Normal
- Bone marrow study: Indicated when -

- * Severe pallor, hepatosplenomegaly, lymphadenopathy, bony tenderness
- * Cell lines other than platelets are affected
- * Before starting steroid

Findings

Cellularity	Normal
M:E ratio	Normal
Granulopoiesis	Normal
Erythropoiesis	Normal
Megakaryopoiesis	Increased

Differences between acute ITP, leukaemia and aplastic anaemia

A. Clinical

Parameters	Acute ITP	Acute leukaemia	Aplastic anaemia
Skin/gum/nose bleeding	Present	Present	Present
Fever	Usually absent	Usually present	Usually present
Appearance	Normal	Sick, irritable	Sick
Pallor	Insignificant	Severe	Severe
Lymphadenopathy	Absent	Present	Absent
Bony tenderness	Absent	Present	Absent
Liver size	Normal	Enlarged	Normal
Spleen size	Normal	Enlarged	Normal

B. Laboratory

Parameters	Acute ITP	Acute leukaemia	Aplastic anaemia
Haemoglobin	Normal or slightly reduced	Low	Low
WBC count	Normal	Usually very high	Low
Platelet counts	Low	Low	Low
Blood film	Normal	Blast cells	Bi/Pancytopenia but normal cell morphology
Bone marrow	Increased megakaryocytes	Blast cells >25%	Pancytopenia

Treatment

Acute ITP is a self limiting disease and > 80% of children require no therapy. However, when platelet count falls <20,000/cmm, treatment is required to induce a rapid rise of platelets to the safe level. Treatment is usually decided on

clinical severity as follows -

- * Patients with minimal, mild, and moderate symptoms: Usually require no therapy other than education and counseling of the family and patient.
- * Patients with severe symptoms: Intravenous immunoglobulin (IVIG) or a short course of corticosteroids should be used as first-line treatment.
 - IVIG: Dose (0.8-1.0 g/kg/day) for 1-2 days induces a rapid rise in platelet count (usually $>20 \times 10^9/L$) in 95% of patients within 48 hours. IVIG appears to induce a response by down regulating Fc-mediated phagocytosis of antibody-coated platelets.
 - Prednisone: Dose (1-4 mg/kg/day). Corticosteroid therapy is usually continued for short course (2-3 weeks) until a rise in platelet count to $>20 \times 10^9/L$ has been achieved.
 - Intravenous anti-D therapy for Rh-positive patients: Dose (50-75 $\mu g/kg$) causes a rise in platelet count to $>20 \times 10^9/L$ in 80-90% of patients within 48-72 hours.

Splenectomy in acute ITP: The role of splenectomy should be reserved for -

- * The older child (≥ 4 yrs) with severe ITP that has lasted >1 yr (chronic ITP) and
- * Whose symptoms are not easily controlled with therapy

Platelet transfusion is usually not indicated in ITP because the antiplatelet antibodies bind to the transfused platelets to destroy them. It may be given in life-threatening bleeding combining with IVIG or steroid.

Treatment of chronic ITP

- IVIG (1 g/kg/dose every 2-6 weeks)
- Corticosteroids (low dose for 6-9 months)
- IV anti D
- Monoclonal anti-B cell antibody e.g. Rituximab

- Two new effective agents stimulating thrombopoiesis e.g. *Romiplostin & Eltrombopag*
- Immunosuppressive drugs e.g. Azathioprine, Cyclosporin
- Splenectomy

Prognosis

90% of children with acute ITP will have a spontaneous remission within a few months. About 10% of patients may have a chronic course.

HAEMOPHILIA

Prevalence

Haemophilia A (Classical): 1 in 5,000 males

Haemophilia B (Christmas disease): 1 in 30,000 males.

These, along with von Willebrand disease account for $>90\%$ of hereditary coagulopathies.

Clinical Types

- **Haemophilia A:** Deficiency of factor VIII
- **Haemophilia B:** Deficiency of factor IX

Aetio-pathogenesis

Both types exhibit X-linked recessive characters where males suffer and females carry the disease. Family history of bleeding in relatives on maternal side is present in about 80% cases. In about 20% cases, family history is absent and this is perhaps due to new mutation of genes that regulate the synthesis of factor VIII and IX.

The genes for both factor VIII & IX are present on X chromosome. Due to mutation of the genes, the haemophiliacs have reduced synthesis of either VIII or IX. This adversely affects the intrinsic coagulation cascade with delay in clot formation and consequent prolonged bleeding. Neither factor VIII nor IX crosses placenta and thus bleeding may present since birth or even in utero.

Clinical Severity

Depending on the percentage of factor VIII or IX level/activity -

Type/ Severity	% of Factor VIII/IX	Patterns of Haemorrhage
Severe	<1%	Spontaneous haemorrhage; deep soft tissue haemorrhage & haemarthrosis
Moderate	1-<5%	Gross bleeding following mild to moderate trauma, seldom spontaneous haemorrhage, sometimes haemarthrosis
Mild	5-25%	Haemorrhage only following moderate to severe trauma or surgery

[1 unit of either factor VIII/IX in 1 ml of plasma is equivalent to 100% factor activity]

Clinical Manifestations

Bleeding is the main symptom. Depending on the extent of factor deficiency, bleeding may be either spontaneous or following trauma. It may occur at any age and anywhere in the body. Deep-seated bleeding induced by relatively minor trauma are characteristics of coagulopathy.

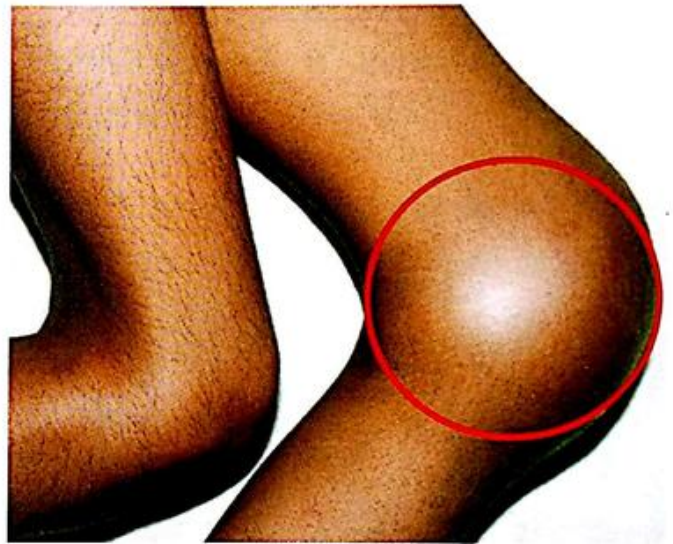
Neonatal, Infancy & childhood bleeding

There may be history of bleeding from umbilical cord, cephalhaematoma or intracranial haemorrhage in newborn. Easy bruising, formation of haematoma or haemarthrosis may occur at crawling, walking and following vaccination. Excessive bleeding following circumcision may be the first presentation of haemophilia. Prolonged bleeding may also occur at the time of teething.

Sites of Bleeding

Joints

Haemarthrosis is the hallmark of haemophilia. Haemarthrosis begins in toddler age and ankle joints are affected earliest. When child tries to maintain upright posture, the knee joints are second most common joint affected. As the age advances the common bleeding sites become knees and the elbows. Patients with haemophilia often develop a **target joint** where repetitive episodes of bleeding occur. Chronic arthropathy is the major long-term morbidity of haemophilia.



Haemarthrosis at left knee joint

Muscles

Mostly occurs in gastrocnemius, quadriceps and iliopsoas.

Oral cavity



Bleeding following tooth extraction

Prolonged bleeding from minor traumatic laceration in mouth or following tooth extraction may occur in many patients.

CNS bleeding

It is life threatening and patients present with altered consciousness, convulsions and other neurological manifestations.

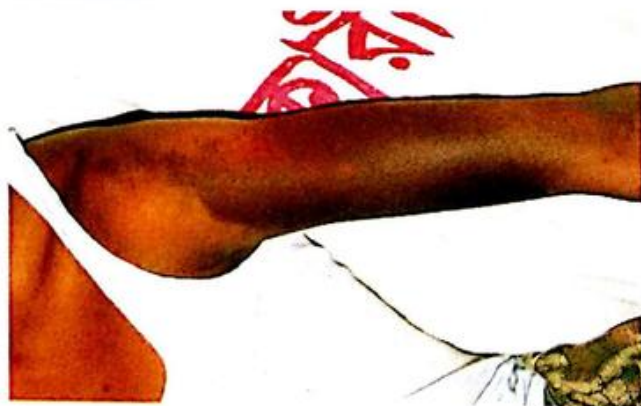
Other sites

- Gut (*haematemesis and melaena*)
- Nose (*epistaxis*)
- Urinary tract (*haematuria*)
- Upper airway (*severe respiratory distress, cyanosis*)



Bleeding in scrotum and haematoma formation following riding on bicycle rod

However, bleeding in skin (*petechiae*) is usually uncommon.



Extensive ecchymosis over the left arm & muscle bleeding

Complications

- Haemodynamic instability because of massive bleeding
- Severe pallor
- Pain and pressure effects over vital organs
- Permanent joint damage due to frequent bleeding inside the joint cavities

Other complications are transfusion transmitted infections

Diagnosis

Based on C/F & relevant investigations.

- Clinical evaluation with particular emphasis on -

- * Age of onset of bleeding
- * Site of bleeding
- * Target joints if any
- * Family history of similar disease

Investigations

Investigations	Results
<u>Complete Blood Count</u>	* Hb% may fall and is related to extent of haemorrhage * WBC, platelet counts are normal
PBF	Normal
Investigations	Results
• Bleeding time (BT)	Normal
• Prothrombin time (PT)	
Activated partial thromboplastin time (aPTT)	Prolonged
<u>Factor VIII</u>	Reduced in Haemophilia A
<u>Factor IX</u>	Reduced in Haemophilia B

Treatment

- Counsel parents about the natural history of the disease

A. Replacement therapy

With either Factor VIII (in Haemophilia A) or factor IX (in Haemophilia B) concentrate according to standard protocol

Dose calculation for haemophilia A & B

- Dose of F VIII (IU) = % desired (rise in F VIII) $\times$ Body weight (kg) $\times$ 0.5
- Dose of F IX (IU) = % desired (rise in plasma F IX) $\times$ Body weight (kg) $\times$ 1.4

Types of haemorrhage	Dosage of factor VIII
<u>Haemarthrosis</u>	50 U/kg on day 1, then 20 U/kg on days 2, 3, 5 until the joint function normalizes or back to baseline
<u>Intramuscular haematoma</u>	50 U/kg on Day 1 then 20 U/kg every other day until haematoma is well resolved
<u>Major surgery, life threatening bleeding</u> (e.g. CNS, GI bleeding etc)	Stat: 50-75 IU/kg Next 5-7 days: 25 IU/kg 8-12 hourly to maintain trough level >50 IU/dl Next 7 days: 50 IU/kg once daily to maintain trough > 25 IU/dl

- When factor VIII or IX are not available -
 - * Cryoprecipitate (does not contain factor IX)
 - * Fresh frozen plasma
 - * Whole blood may be given
- Life style modification: Avoiding contact sports e.g. football, hockey, basketball etc.

B. Supportive Treatment of haemarthrosis

- RICE (rest, ice, compression, elevation): The bleeding joints and muscles can be kept at rest by splinting or by casting, avoidance of weight bearing and use of crutches

- Analgesics: Paracetamol or Ibuprofen may be sufficient. Aspirin and narcotic analgesics should be avoided
- Ice therapy: It relieves pain and reduces the extent of bleeding by promoting vasoconstriction. It is applied for a period of 24-48 hours. Ice should not be applied directly to the skin but to be applied with wrapping in a thick towel
- Physiotherapy: It should be initiated as soon as active bleeding stops and pain is diminished. However, factor VIII concentrate may be required to prevent physiotherapy-induced haemorrhage

C. Other haemostatic measures

- Desmopressin acetate: Used in mild cases. It helps release of endogenously produced factor VIII. Desmopressin is not effective in factor IX deficient haemophilia
- Tranexamic acid or Aminocaproic acid: These antifibrinolytic agents are used locally in case of mouth and dental bleeding

VON WILLEBRAND DISEASE (vWD)

Inheritance: Mainly autosomal dominant but sometimes autosomal recessive.

Sex: Children of both sexes are equally affected, unlike that of haemophilia.

Pathophysiology

Normally, von Willebrand factor (vWF) -

Functions of vWF	* Supports, carries and <u>delivers factor VIII to the site of injury</u> * Helps <u>adhesion</u> between the platelets to form platelet plugs * Helps adhesion of platelets to the sub-endothelial connective tissue at the site of vascular injury
------------------	--

But, in its deficiency, these functions do not occur and as a result, haemorrhage occurs.

Clinical Manifestations

- Bleeding usually occurs from skin and mucous membrane
- Usual presentation is easy bruising, recurrent epistaxis, menorrhagia, postoperative bleeding (particularly after tonsillectomy or tooth extractions), bleeding from wounds and gum bleeding
- There may be family history of similar bleeding episodes
- Patients neither have pallor nor hepatosplenomegaly & their haemodynamic status are usually stable
- Affected children may be asymptomatic

Differential Diagnoses

- Haemophilia A and Haemophilia B
- Platelet disorders *e.g. ITP, Thrombasthenia*

Investigations

Investigations	Results
<u>CBC with PBF</u>	Usually normal
<u>Bleeding time (BT)</u>	Prolonged
Prothrombin time (PT)	Normal
Activated partial thromboplastin time (aPTT)	Prolonged
<u>von Willebrand factor assay</u>	Reduced

Coagulation profile of common bleeding disorders

Diseases	Bleeding time	Prothrombin time	aPTT
ITP	Prolonged	Normal	Normal
Haemophilia	Normal	Normal	Prolonged
vWD	Prolonged	Normal	Prolonged

Treatment

Counseling parents about the disease

- Mild case
 - * Desmopressin (DDAVP): It causes release of von Willebrand factor (vWF) from endothelial storage sites. It may be administered intravenously, intranasally or subcutaneously. Intranasal DDAVP (Stimate) 150 µg (1 puff) for children weighing <50 kg and 300 µg (2 puff) for those weighing >50 kg
- Severe Case
 - * Plasma or plasma-derived factor VIII (F VIII) concentrates containing (vWF)

References

1. Scott JP, Montgomery RR. Hereditary Clotting Factor Deficiencies. In: Kliegman RM, Stanton BF, Geme III JWS, Schor NF, Behrman RE. Editors. Nelson Textbook of Pediatrics, 20th Edition. New Delhi: Elsevier; 2016: 2384-2391.
2. Ambruso DR et al. Bleeding disorders. In: Current diagnosis and Treatment in Pediatrics. Hay WW, Levin MJ, Sondheimer JM, Deterding RR editors. 18th edition. New York: The McGraw-Hill companies; 2007.
3. Sachdeva A, Jain V, Yadav SP. Hemophilia. In: Advances in Pediatrics by Dutta AK & Sachdeva A. 1st ed. New Delhi: Jaypee Brothers Medical Publishers Ltd; 2007, pp 434-41.
4. Weatherall DJ. Genetic disorders of haemoglobin. In: Hoffbrand AV, Lewis S, Tuddenham E, editors. Post Graduate Haematology. 4th ed. West Sussex, UK : Wiley-Blackwell ; 1999, p 91-119.

5. Ancona KG et al. Randomized trial of high dose methylprednisolone versus IVIG for the treatment of acute ITP in children. *J Pediatr Hematol Oncol* 2002; 24: 504-544.
6. Beck CE et al. Corticosteroids versus IVIG for the treatment of acute ITP in children: a systematic review and meta-analysis of randomized control trials. *J Pediatr* 2005; 147: 521-27.
7. Tarantino MD et al. High dose anti-D immune globulins is as effective as IVIG in the treatment of newly diagnosed ITP in children. *Blood* 2003; 102:299-300.
8. Khan MR, Rahman ME. *Essence of Pediatrics*. 4th ed. Elsevier; 2011. Chapter 15, Hematology; p. 291-302.

SELF ASSESSMENT

Short answer questions [SAQ]

1. Classify haemophilia according to severity.
2. What findings do you expect to get in coagulation profile of a child with von Willebrand disease?
3. A girl has been hospitalized with bleeding from gum and generalized purpuric rash.
 - a) what are the clinical possibilities?
 - b) What are the investigations required for diagnosing the case?
 - c) Outline the management of a child with ITP.

Multiple choice questions [MCQ]

1. Bleeding time is prolonged in –

☐ a) haemophilia	☐ b) von Willebrand disease	☐ c) dengue haemorrhagic fever
☐ d) Henoch-Schönlein purpura	☐ e) fulminant hepatic failure	
2. The clinical features of acute ITP includes-

☐ a) petechiae	☐ b) mild pallor	☐ c) lymphadenopathy	☐ d) splenomegaly	☐ e) bony tenderness.
---------------------------------------	---	---	--	--
3. The recommended treatment options of acute ITP are-

☐ a) prednisolone	☐ b) cyclophosphamide	☐ c) IVIg
☐ d) anti-D immunoglobulin	☐ e) platelet transfusion	
4. The haematological profile of haemophilia A includes-

☐ a) thrombocytopenia	☐ b) prolonged bleeding time	☐ c) prolonged aPTT
☐ d) prolonged prothrombin time	☐ e) normal reticulocyte counts	
5. The haematological profile of von Willebrand disease include-

☐ a) thrombocytopenia	☐ b) reticulocytosis	☐ c) prolonged bleeding time
☐ d) normal prothrombin time	☐ e) normal aPTT	
6. DDAVP is recommended to treat-

☐ a) von Willebrand disease	☐ b) haemophilia	☐ c) ITP
☐ d) Henoch-Schonlein purpura	☐ e) thrombasthenia	
7. A 5-years old boy, clinically diagnosed as a case of haemophilia, has

☐ a) prolonged clotting time	☐ b) prolonged PT	
☐ c) normal bleeding time	☐ d) prolonged PTT	☐ e) reduced vWF activity
8. The coagulation factors consumed in DIC include

☐ a) Factor II	☐ b) Factor VII	☐ c) Factor VIII
☐ d) Factor V	☐ e) Factor IX	

CHAPTER 26

PUFFY FACE AND SCANTY URINE

ACUTE POST STREPTOCOCCAL	
GLOMERULONEPHRITIS	206
NEPHROTIC SYNDROME	208
ACUTE KIDNEY INJURY (AKI)	213
CHRONIC KIDNEY DISEASE	215

Puffiness of face and low urine output is the usual clinical presentation of renal diseases. Among children, the two most common conditions with these presentations are frequently seen include-

- * Acute glomerulonephritis (AGN)
- * Nephrotic syndrome (NS)

In nephrotic syndrome, in addition to puffy face, patients usually present with generalized oedema.

In this section, AGN, nephrotic syndrome, acute kidney injury (AKI) and chronic renal disease (CKD) will be discussed.

ACUTE POST STREPTOCOCCAL GLOMERULONEPHRITIS (APSGN OR AGN)

Acute post streptococcal glomerulonephritis (APSGN) is the most common cause of gross haematuria in children. In addition to haematuria, puffy face, scanty urine and hypertension are other common presentations.

Aetio-pathogenesis

AGN is an immune complex mediated disease that occurs following infection in the



Scabies, infected with streptococci

skin or in throat by certain nephritogenic strains (e.g. 49-skin, 12-throat) of group A beta haemolytic streptococci.

Following infection, antibody is produced against the streptococcal antigens. Antigen-antibody complexes are thus formed in blood, deposited in the glomeruli where they incite glomerular inflammation and activate the complement cascade.

The net results of these pathological process are-

- * Reduced renal blood flow with consequent low GFR and oliguria
- * Presence of RBC in urine
- * Accumulation of water, electrolytes, toxic waste materials and acids in the body, leading to acidosis, azotaemia and hyperkalaemia
- * Intravascular volume overload leading to hypertension
- * Sudden rise of systemic BP increases cardiac workload and ensues heart failure. High BP may also cause hypertensive encephalopathy

Clinical Manifestations

- Age of onset is between 5-12 years. Uncommon before 3 years
- History of skin or throat infections may be present 1-6 weeks prior to disease manifestations
- The manifestations are variable and are related to severity of renal involvement ranging from asymptomatic microscopic haematuria with normal renal function to acute kidney injury (AKI). The affected child usually presents with-

- Passage of scanty high coloured urine.
Sometimes patients may have anuria
- Puffiness of face
- Fever: Uncommon
- Non-specific symptoms
e.g. malaise, lethargy, headache or vomiting may be present
- Sometimes, patients may present with features of complications like -



Smoky urine

- * Sudden severe respiratory distress
(*acute left ventricular failure*)
- * Convulsion & unconsciousness
(*hypertensive encephalopathy*)
- * Complete cessation of urine
(*acute renal failure*)

Physical Examination

- Face: Puffy
looking *i.e. swelling of eyelids (periorbital) and face*
- Mild pallor
- Skin:
Evidence of infected scabies or scars of previous infected scabies
- Oedema: Present
- Blood Pressure: High
- Features of heart failure
 - * Severe respiratory distress, orthopnoea, feeding difficulties, tachypnoea
 - * Pulse: Tachycardia
 - * Jugular Venous Pressure (JVP): Raised
 - * Precordium: Hyperdynamic



Puffy face

- * Apex beat: Shifted
- * Gallop rhythm: Present
- * Lung bases: Crepitations on auscultation
- * Liver: Enlarged and tender

• Features of hypertensive encephalopathy

- Headache
- Vomiting
- Blurred vision
- Confusion
- Convulsion
- Unconsciousness
- Coma

• Features of renal failure

- Oliguria
- Anuria
- Vomiting

Other causes of haematuria

- * UTI
- * Renal tumour
- * IgA nephropathy
- * Renal TB
- * Renal calculi
- * Coagulopathy

Diagnosis

Based on C/F & relevant investigations.

Investigations

Investigations	Results
<u>Urine for R/M/E</u>	Urine will show <u>RBC, RBC cast</u> (coagulated protein) and mild proteinuria
Complete blood counts	Hb (mildly reduced), TC, DC (mild <u>polymorphonuclear leukocytosis</u>), PBF (normochromic anaemia) and ESR (high)
<u>Blood for ASO/anti DNase B</u>	Elevated
Blood for C3	Low
<u>S. electrolytes</u>	May show <u>hyperkalaemia, acidosis</u>
<u>S. creatinine</u>	May be elevated
Streptozyme test	A useful and simple diagnostic test that detects antibodies to streptolysin O, DNase B, hyaluronidase, streptokinase
<u>X-Ray chest</u>	May show <u>cardiomegaly</u> with prominent <u>pulmonary vasculature</u> in case of heart failure

Treatment

- Counseling parents about the nature of the disease, its complications, treatment and prognosis
 - Treatment, mainly supportive and includes -
 - * Bed rest
 - * Diet:
 - Protein restricted (0.5 gm/kg/day)
 - Salt restricted: No added salt in the diet
 - Potassium and potassium containing food and fruits restricted
 - * Fluid restricted: 400 ml/m² + previous day's output
 - * Diuretics: Frusemide (1-2 mg/kg/day)
 - * Antibiotics
 - Oral Phenoxymethyl Penicillin (50 mg/kg/day) in 4 divided doses for 10 days
- Penicillin does not alter the course of the disease but prevents spreading of remaining nephritogenic strain of streptococcus to the contacts.*
- Antihypertensives
 - * For rapid reduction of BP -
 - Nifedipine (0.3 - 0.5 mg/kg) sublingual
 - * For maintenance
 - Captopril (0.25-6 mg/kg/day) in 2-4 doses
 - Nifedipine (0.25-0.5 mg/kg/day) in 2-4 doses
 - Follow up: Daily to assess clinical response and to search for any complications

Prognosis

Usually good with complete recovery in more than 95% cases. Recurrences are extremely rare.

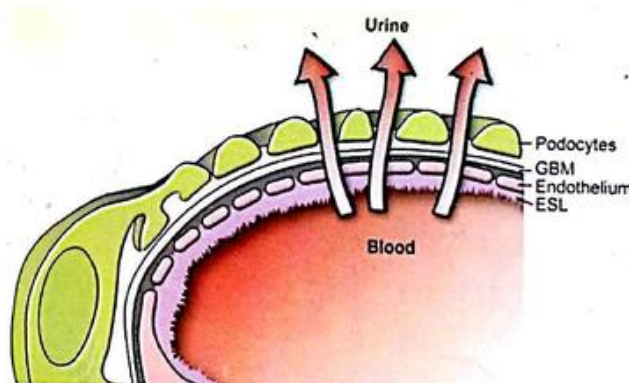
NEPHROTIC SYNDROME (NS)

NS is the commonest kidney problem in children. The incidence of new cases is 2 to 7 per 100,000 in children less than 16 years of age. The peak age of onset is 3 years. NS is 25 times more common in children than in adults.

4 Cardinal features	* Massive proteinuria (>1 gm/m²/day) * Hypoalbuminaemia (<2.5 gm/dl) * Generalized oedema and * Hyperlipidaemia (>200 mg/dl)
---------------------	---

To understand the disease it is essential to know the histological components of glomerular filtration barrier (GFB). It consists of -

- Fenestrated capillary endothelium
- Glomerular basement membrane
- Podocytes (with foot processes and intercalated slit diaphragm)



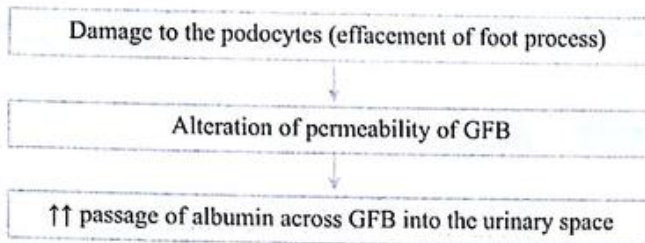
Glomerular filtration barrier

Aetiology

Idiopathic	Secondary
Types * <u>Minimal change</u> disease * Mesangial proliferation * Focal segmental glomerulosclerosis	* <u>Infection</u>: HBV, HCV, HIV, Malaria, Syphilis, Toxoplasma * <u>Drugs</u>: Penicillamine, Gold NSAIDs, Na Stibogluconate, * <u>System illnesses</u>: SLE, Henoch-Schönlein purpura * <u>Malignancy</u>: Leukaemia, lymphoma * <u>Allergic reaction</u>: Bee stings

Minimal change nephrotic syndrome (MCNS) is the commonest type in children and will be discussed in this section.

Pathogenesis



This massive albumin loss in urine (**Albuminuria**) gives rise to hypoalbuminaemia with fall of plasma colloid osmotic pressure. As a result, fluid shifts from plasma to interstitial space resulting in -

- * Development of oedema, ascites, pleural effusion and
- * Contraction of intravascular volume

The reduced intravascular volume compromises renal perfusion with consequent low GFR and oliguria. This activates renin-angiotensin-aldosterone system and promotes release of ADH, resulting in reabsorption of sodium from tubules and water from collecting ducts which further aggravates oedema. In addition, Hypoalbuminaemia induces lipoprotein synthesis in liver. This causes elevation of cholesterol and triglycerides in blood

Essential Characteristics of MCNS -

- * No appreciable glomerular pathology is noted in light microscopy but effacement of foot processes of podocytes in GBM seen under electron microscope
- * Prompt response to steroid but high tendency to relapse
- * Not associated with hypertension, haematuria and azotaemia

Clinical Manifestations

- Age: Common in between 2 to 8 years
- They may present for the first time (initial attack) or may have recurrent attacks (relapse) of -
 - * Facial puffiness, massive peri-orbital swelling
 - * Generalized oedema
 - * Scanty urination (colour usually normal)
- Sometimes, patient may additionally present with features of complications like -

- Cough & respiratory distress (*pneumonia, pleural effusion, huge ascites*)
- Abdominal pain (*gut ischaemia, peritonitis, renal vein thrombosis*)
- Pain, redness & tenderness of skin (*cellulitis*)
- Fever & dysuria (*UTI*)
- Haematuria (*NS other than MCD, UTI, renal vein thrombosis*)
- Diarrhoea (*impaired absorption of foods due to oedema of the bowel wall*)
- Neurodeficit like hemiplegia (*stroke from thrombo-embolism*)

Physical Examination

I. Signs secondary to hypoalbuminaemia

- Swelling of eye lids extending to chin and neck (double chin)



Periorbital swelling

- Huge ascites with or without parietal oedema



Huge ascites with transversely slit umbilicus

- Oedema and swelling of scrotum & penis with cracks & fissuring of skin with exudation



Peno-scrotal swelling

- Clinical features of pleural effusion and increased respiratory rate
- Oedema of ankles and back e.g. sacral area



Ankle and pedal oedema

- Oedematous chest wall with full intercostal spaces and
- Oedema of scalp

II. Signs related to diminished circulatory volume

- Pulse: Weak, low volume
- Peripheral part of the body: Cold
- BP: Low
- Capillary refill time: Prolonged (>3 seconds)

III. Signs related to complications

- Shiny abdominal wall, rigidity & tenderness and absent bowel sounds (*peritonitis*)
- Palpable kidney with haematuria (*renal vein thrombosis*)
- Alterations of consciousness, hemiplegia (*stroke*)

IV. Signs related to steroid toxicity

Cushingoid facies, buffalo hump, abdominal striae, hirsutism, hypertension, cataract, muscular weakness due to steroid induced proximal myopathy



Cushingoid face from prolonged steroid use

Diagnosis

Based on C/F & relevant investigations.

Investigations

- Urine
 - * Routine & microscopic examination
 - Shows albuminuria (done by Albustix)

or Heat coagulation test), granular and hyaline casts, pus cells.



Positive heat coagulation test

Albustix

- RBC and RBC cast usually absent in MCNS
- * 24 hours urinary total protein (UTP): Proteinuria exceeding > 3.5 gm/day
- * Spot urinary protein creatinine ratio: If > 2 , suggests significant proteinuria indicating NS

$$\frac{\text{Urine protein (mg)}}{\text{Urine creatinine (mg)}}$$

$$\frac{\text{Urine protein (mg)}}{\text{Urine creatinine (mg)}}$$

Blood: Biochemistry

- * Serum total protein: Reduced
- * Serum albumin: Reduced
- * Serum albumin globulin ratio: Altered
- * Serum cholesterol: Elevated
- * Serum C3 level: Normal in MCNS. Decreased in NS of other types
- * Serum urea/creatinine /BUN: Normal
- * Serum electrolytes: Normal
- CBC
 - * TC, DC of WBC: Usually normal
 - * Haematocrit and ESR: Increased
 - * Peripheral blood film: Normal
- Other investigations to assess aetiology, the extent of the disease, complication & to confirm the diagnosis

- * Blood for HBsAg, Anti HCV
- * Urine for C/S: When UTI is suspected
- * X-ray Chest: To look for pleural effusion
- * Ultrasonogram of chest /abdomen: to see pleural effusion, ascites and to assess the kidneys
- * Renal biopsy: To identify histological type

Indications for Renal Biopsy

At Onset

- * Age of onset < 1 year or > 12 years
- * Gross haematuria, persistent microscopic haematuria or low serum C3
- * Sustained hypertension
- * Renal failure not attributable to hypovolaemia
- * Suspected secondary causes of nephrotic syndrome

After Initial Treatment

- * Proteinuria persisting despite 4-weeks of daily corticosteroid therapy
- * Before starting treatment with Cyclosporin A or Tacrolimus

Treatment

Counseling parents about the nature of the disease, its treatment and prognosis.

A. Specific: Prednisolone

First attack

Prednisolone $60 \text{ mg/m}^2/\text{day}$ in a single morning dose for 6 weeks (followed by 40 mg/m^2 as single morning dose) on alternate day for another 6 weeks. The alternate day dose then slowly tapered and discontinued over the next 4-8 weeks.

Relapse cases

(When urine albumin is $3+$ or $4+$ or proteinuria $> 40 \text{ mg/m}^2/\text{hour}$ for 3 consecutive days in patient who had been in remission previously)

Prednisolone 60 mg/m²/day in a single morning dose till urine is free of albumin for 3 consecutive days, followed by 40 mg/m² as single morning dose on alternate day for another 4 weeks and gradually tapered over 4-8 weeks.

NB: Prednisolone should be started after confirming a negative PPD test and administering polyvalent pneumococcal vaccine.

B. Supportive

- Diet
 - * Normal family diet, adequate in protein (1.5-2 g/kg/day), ≤ 30% calorie from fat
 - * Salt restriction is not necessary; a 'no added salt' diet is usually sufficient
 - * Patient can take rice, vegetables, meat, fish, egg without yolk, dal, milk, sugar etc.
- Fluid
 - * Liberal fluid intake in mild oedema
 - * Severe oedema: Restricted to 400 ml/m² + previous day output
- Management of oedema
 - * Diuretics should be avoided in mild oedema
 - * In case of severe and persistent oedema
 - Oral Frusemide (1-2 mg/kg/day)
 - Oral Spironolactone (3 mg/kg/day)
 - * Hypovolaemic patients should receive normal saline bolus and/or albumin infusion prior to diuretic administration
- Antibiotics: Oral Penicillin 50 mg/kg/day till massive oedema persist (usually for 10-14 days). If patient is febrile or systemically unwell or showing evidence of infection, parenteral antibiotics like, Ampicillin with Aminoglycosides or Ceftriaxone may be started
- Support to scrotum if it is tense and susceptible to ulceration
- Other medication -
 - * Syp. Antacid or Syp. Ranitidine if upper GI discomfort
 - * Calcium supplementation if >3 months of steroid therapy

C. Follow up

- In hospital: Keeping records of vital signs e.g. pulse, BP, resp. rate, weight, oedema, abdominal girth, intake output, bed side urine for albumin, etc.
- After discharge: 2 weekly follow up to note -
 - * Response to drugs
 - * Toxicity of drug
 - * Any infection
 - * Renal functional status

Prognosis

Prognosis is usually good. But children <1 year or >10 years having haematuria or hypertension usually have guarded prognosis.

Differences between AGN and MCNS

Features	AGN	MCNS
Common age of onset	5-12 years	2-8 years
H/O sore throat or skin infection	More pertinent	May be present
Extent of swelling	Usually <u>confined</u> to facial puffiness	Generalized swelling
Ascites	Unlikely	Usually present
Colour of urine	High coloured	Normal
Hypertension	Present	Usually absent
Proteinuria	Mild	Massive
Urine R/M/E	RBC, RBC cast	RBC absent; <u>hyaline, granular cast present</u>
Serum albumin	Normal	Decreased
Serum cholesterol	Normal	Increased
Serum C3	Decreased	Normal
<u>Course of the disease</u>	Recurrence rare	Relapse & remission

ACUTE KIDNEY INJURY (AKI)

AKI is defined as any insult to kidney & is characterized by rapid decline in glomerular filtration rate (GFR).

This results in (i) accumulation of nitrogenous wastes and (ii) impairment of water, electrolytes and acid-base balances.

The net clinical and biochemical manifestations of AKI are -

- * Oliguria, anuria
- * Retention of nitrogenous waste products in the body as evident in elevation of blood urea, creatinine, blood urea nitrogen (BUN)
- * Dyselectrolyteemia *e.g. hyperkalaemia*
- * Acid-base imbalance *e.g. metabolic acidosis*
- * Fluid overload, hypertension

In children, acute kidney injuries are graded according to (i) extent of fall of GFR as measured by estimated creatinine clearance (eccl) and (ii) urine output as below -

Stages	Creatinine criteria	Urine output criteria
Risk	Increased creatinine (1.5 times normal) or GFR decreases >25%	UO ≤ 0.5 ml/kg/hr $\times 8$ hrs
Injury	Increased creatinine (2 times normal) or GFR decreases >50%	UO ≤ 0.5 ml/kg/hr $\times 16$ hrs
Failure	Increased creatinine (3 times normal) or GFR decreases >75% or GFR < 35 mL/min/ 1.73 m ²	UO ≤ 0.3 ml/kg/hr $\times 24$ hrs or anuria $\times 12$ hrs
Loss	Persistent failure for	> 4 weeks
Endstage	Persistent failure for	> 3 months

Schwartz formula to calculate -

estimated creatinine clearance (eccl)

$$= \frac{k \times \text{height (cm)}}{\text{S. creatinine (mg/dl)}} \quad k = 0.55 \text{ (for children)}$$

Aetiology of AKI

Pre renal

- Ischaemia
 - * Hypovolaemia *e.g. acute diarrhoea, vomiting, acute haemorrhage*
 - * Hypotension
 - * Sepsis
- Toxins *e.g. wasp sting, snake bite, plant toxin, pigment*

Renal

- Glomerulonephritis (GN)
 - * PSGN, SLE, HSP
- Vascular
 - * Haemolytic uraemic syndrome (HUS), renal vein thrombosis, renal arterial thrombosis
- Acute pyelonephritis
- Acute interstitial nephritis

Post renal

- Structural
 - * Post. urethral valve • PUJ obstruction
- Crystalluria
- Calculi
- Blood clot

Clinical Assessment

- History of anuria/oliguria
- History to find out the cause-
 - * Fluid loss *e.g. diarrhoea, severe vomiting*
 - * Pre existing kidney disease *e.g. AGN, Nephrotic syndrome*
 - * Ingestion of nephrotoxic drug *e.g. Paracetamol (di-ethyl glycol present in syrup)*

Physical Examination

- Evidence of fluid overload -
 - * Oedema
 - * Hypertension
 - * Heart failure (*Hepatomegaly, pulmonary oedema*)

- Status of hydration *e. g. evidence of dehydration, urine output, capillary refill time*
- Features of complications related to ARF *e.g. unconsciousness, arrhythmia, vomiting, convulsion etc.*
- Other parameters of physical examination-
 - * Pulse *e.g. rate, rhythm, volume*
 - * Blood Pressure, Pulse Pressure
 - * Body weight

Investigations

- Complete blood counts with PBF
- Blood biochemistry
 - * Serum electrolytes *e. g. hyperkalaemia, acidosis*
 - * Creatinine, urea, BUN (raised)
 - * Arterial blood gas analysis
- Urine R/M/E: RBC, pus cells, crystal, cast
- ECG: To note any change from dyselectrolytaemia
- To find out cause: ASO titre, C3, C4, ANA, Anti dsDNA
- Others
 - * Chest X-ray: To see pulmonary plethora & cardiac enlargement
 - * USG whole abdomen: To assess renal anatomy
- Renal biopsy

Treatment

For stage I and stage II of AKI, only supportive treatment and for stage III following treatment should be given -

A. General

- * Counseling about the nature, treatment options and prognosis of the disease
- * Urgent referral to a paediatric nephrologist/tertiary centre

B. Supportive

1. Discontinue nephrotoxic agents, if any

2. Fluid resuscitation

- * If the child is dehydrated give bolus normal saline 20 ml/kg over 30 min. *After volume resuscitation, hypovolaemic patients generally void within 2 hours*

3. Diuretic therapy

This should be considered only after establishing adequate circulating blood volume.

- * Give Inj. Frusemide 1–5 mg/kg/dose, intravenously, maximum of 200 mg.

If a response does not occur within an hour of maximum dose of Frusemide or if the urine output remains low (< 0.5 ml/kg/hour)

- Stop further administration of diuretics
- Restrict fluid to insensible losses (400 ml/m²/24 hours) plus previous day output
- Monitor fluid intake, urine and stool output, body weight, and serum chemistries daily

4. Peritoneal dialysis: Start as soon as possible

Indications of Peritoneal Dialysis (PD)

- * Volume overload with hypertension and/or pulmonary oedema refractory to diuretic therapy
- * Persistent hyperkalaemia
- * Severe metabolic acidosis unresponsive to medical management
- * Neurological symptoms
- * BUN >100-150 mg/dl
- * Calcium/phosphorus imbalance with hypocalcaemic tetany

5. Nutrition

- Calorie : High calorie diet rich in carbohydrate and fat to reduce protein catabolism
- Restrict protein intake
 - * 0 - 6 months: 1.8 g/kg/day
 - * 6 months - 3 years: 1.0 - 1.5 g/kg/day
 - * Children and adolescents: 1 g/kg/day
 - * Protein intake should be more if peritoneal or haemodialysis is going on
- Salt intake: A no added salt diet is adequate
- Avoid foods rich in potassium *e.g. citrus fruits, tomato paste, chocolates and potato crisps*

6. Management of associated Conditions

- Hyperkalaemia: *Management is discussed in chapter 37: p 308*
- Metabolic acidosis: Inj. Sodibicarb (1ml/kg)
- Hypocalcaemia: Inj. Calcium gluconate (1-2 ml/kg)
- Hyponatraemia: (Most commonly dilutional)
 - * Restrict fluid intake
 - * Symptomatic hyponatraemia *e.g. seizures, lethargy* and serum $\text{Na}^+ < 120 \text{ mEq/L}$ should be corrected as *mentioned in chapter 37: p 305*
- Hypertension
 - * Give Nifedipine (0.3-0.5 mg/kg PO) in asymptomatic cases
 - * In severe symptomatic hypertension *e.g. hypertensive encephalopathy*: Continuous infusions of Sodium Nitroprusside (0.5-10 $\mu\text{g/kg/min}$) or Labetalol (0.25-3.0 mg/kg/hour) infusion
- Seizures: Diazepam (0.5 mg/kg PR) most effective
- Anaemia
 - * Severe anaemia ($\text{Hb} < 7 \text{ g/dl}$) should be corrected with slow (4-6 hours) transfusion of packed red blood cells (10 ml/kg)

7. Treatment of any underlying cause

CHRONIC KIDNEY DISEASE (CKD)

CKD is defined as renal injury/proteinuria and/or $\text{GFR} < 60 \text{ ml/min/1.73 m}^2$ for more than 3 months

Aetiology

- * Idiopathic
- * Hypoplastic or dysplastic kidneys
- * Polycystic kidney disease
- * Glomerulonephritis
- * Posterior urethral valve (PUV)
- * Pelvi-ureteric junction (PUJ) obstruction
- * Bladder neck obstruction
- * Vesico-ureteric reflux

CKD: Major Clinicopathologic Events

- Damage/loss of nephrons & disruption of concentrating ability of nephron - polyuria, polydipsia
- Accumulation of nitrogenous waste products - vomiting, fatigue, poor concentration
- Fluid and electrolyte imbalance -
 - * Volume overload & Sodium retention (Excessive Renin production) - hypertension
 - * Hyperkalaemia
- Reduced production of erythropoietin - anaemia
- Decreased active form of vitamin D - renal osteodystrophy, hypocalcaemia, hyperphosphataemia
- Growth retardation & FTT due to renal osteodystrophy & anaemia
- Platelet dysfunction and other coagulation abnormalities leading to bleeding especially in GIT
- Seizures resulting from untreated hypertension or hypocalcaemia
- Congestive cardiac failure, pulmonary oedema and pulmonary hypertension

Investigations

Parameters	Results
CBC, PBF	Normocytic normochromic anaemia
Blood urea nitrogen (BUN)	Raised
Serum creatinine	
Serum electrolytes	Hyperkalaemia, hyponatraemia
Serum Ca^{++} , PO_4^{---} , Alkaline phosphatase, Parathyroid hormone	Hypocalcaemia, hypophosphatemia, raised ALP & PTH
Fasting Lipid profile	Hyperlipidaemia
Iron profile	Iron deficiency
Urine R/M/E	Proteinuria
USG KUB	Bilateral shrunken echogenic kidneys/ hydronephrosis
DTPA/DMSA scan	Renal scarring/ impaired renal excretion
MCU/VCUG	To evaluate PUV (posterior urethral valve)
IVU	To evaluate VUR, urinary tract & status of kidneys
Creatinine clearance to assess GFR	Reduced
MCU - Micturating Cystourethrogram VCUG - Voiding Cystourethrogram IVU - Intravenous Urography DTPA - Diethylene Triamine Penta Acetic acid DMSA - Dimercaptosuccinic Acid scan	



Posterior urethral valve in a 7-year-old male child. An oblique VCUG image shows a dilated posterior urethra (arrow) with an abrupt transition to a normal-calibre anterior urethra. Note the bladder neck hypertrophy, the irregular trabeculated bladder wall, and the left-sided grade III vesicoureteric reflux (curved arrow)

Management

A. General

- Counseling about the nature, treatment options and prognosis of the disease & give support to the parents
- Referral to a paediatric nephrologist /tertiary centre

B. Nutrition

- Protein intake: Restrict to around 1 g/kg/day, with 60-70% protein from high biologic value origin (animal source) to promote muscle anabolism and to reduce muscle wasting
- Calcium supplementation
 - * Age 1-10 years: 500-600 mg/day
 - * Age 11-18 years: 800-1000 mg/day
- Salt restriction: No added salt in diet

- Rich sources of potassium such as *e.g. citrus fruits, tomato paste, chocolates and potato chips should be avoided*

C. Specific: Renal transplantation.

D. Other Supportive Treatment

- Hypertension
 - * Salt restriction and Frusemide (1-4 mg/kg/day). If BP is not controlled
 - * ACE inhibitor (Captopril 0.25 - 6 mg/kg/day in 2-4 divided doses PO)
- Renal osteodystrophy
 - * Vitamin D3 (Calcitriol - 1, 25 dihydroxy cholecalciferol) supplementation -
 - 0.01 - 0.05 µg/kg/day PO (<3 years of age)
 - 0.25 - 0.75 µg/day (>3 years of age)
 - * Calcium carbonate (1 gram gives 400 mg of elemental Ca) for facilitating phosphate excretion
- Hyperkalaemia: *As mentioned in chapter 37*
- Metabolic acidosis: Inj Sodibicarb (1-2 mEq/kg ($\frac{1}{2}$ of NaHCO_3 should be given immediately and the remaining $\frac{1}{2}$ as an

infusion over 12-24 hours period)

- Anaemia: Treatment includes
 - * Human recombinant erythropoietin (50-150 U/kg/dose three times a week subcutaneously)
 - * Iron supplementation (2-6 mg/kg/day)
 - * Blood transfusion (10 ml/kg) of packed cell, when Hb < 6gm/dl
- Immunizations: Should receive all routine immunizations along with -
 - * MMR
 - * Influenza vaccine annually
 - * Pneumococcal conjugate vaccine
 - * Meningococcal vaccine
- UTI, ARI and other infection: Treat with non-nephrotoxic antibiotics

End Stage Renal Disease

When GFR < 10 ml/min/1.73 m² and progression of disease can no longer be managed by medical means then treatment options include -

- Peritoneal dialysis, or
- Haemodialysis (preferable) or
- Renal transplantation (living related donor/cadaveric donor)

References

1. Lum GM. Kidney & Urinary tract. In: Hay WW, Levin MJ, Sondheimer JM, Deterding RR, editors. Current diagnosis & Treatment in pediatrics. 18th ed. New York: McGraw-Hill; 2007. P 684-707.
2. Pan CG, Anver ED. Acute Poststreptococcal Glomerulonephritis. In: Kliegman RM, Stanton BF, Geme III JWS, Schor NF, Behrman RE. Editors. Nelson Textbook of Pediatrics, 20th Edition. New Delhi: Elsevier; 2016: 2498-2500.
3. Pais P, Anver ED. Nephrotic Syndrome. In: Kliegman RM, Stanton BF, Geme III JWS, Schor NF, Behrman RE. Editors. Nelson Textbook of Pediatrics, 20th Edition. New Delhi: Elsevier; 2016: 2521-2527.
4. Abeyagunawardena AS. Treatment of steroid sensitive nephrotic syndrome. Indian Journal of Pediatrics, 2005; 72: 763-69.
5. Bagga A et al. Revised guidelines for management of steroid-sensitive nephrotic syndrome. Indian Journal of Nephrology. 2008; 18(1): 31-39.
6. Nephrotic syndrome. In: Srivastava RN, Arvind Bagga. Pediatric nephrology. 4th ed. New Delhi: Jaypee brothers; 2005. p 161-200.
7. Dilys A. et al. Chronic Kidney Disease in Children. Pediatrics in Review. 2008;29: 335.

8. Bellomo R, Ronco C, Kellum JA, Mehta RL, Palevsky P. Acute renal failure - definition, outcome measures, animal models, fluid therapy and information technology needs: the Second International Consensus Conference of the Acute Dialysis Quality Initiative (ADQI) Group. Crit Care. Aug 2004;8(4):R204-12.
9. Liborio AB et al. AKI in neonates from urine output to new bio markers, Biomed Research Int 2014; Article ID 601568.

SELF ASSESSMENT

Short answer questions [SAQ]

1. Write down the essential features of minimal change nephrotic syndrome.
2. What investigations will you do and what are the expected findings in a case of nephrotic syndrome?
3. How will you treat a child with 1st attack of minimal change nephrotic syndrome?
4. A 6 years old boy presents with puffy face and smoky urine for 5 days. His BP is 130/100 mm Hg.
 - a) What is the probable diagnosis?
 - b) What complications can develop if the child remains untreated?
 - c) What investigations will you plan and what findings are expected?
 - d) How will you treat the child?

Multiple choice questions [MCQ]

1. The characteristic features of MCNS are-
☐ a) heavy proteinuria ☐ b) haematuria ☐ c) azotemia ☐ d) hypertension ☐ e) hyperlipidaemia
2. Blood biochemistry of MCNS includes-
☐ a) low C3 level ☐ b) high BUN ☐ c) hyperkalaemia
☐ d) hypoalbuminaemia ☐ e) hypercholesterolaemia
3. Complications that may occur in untreated AGN are-
☐ a) heart failure ☐ b) encephalopathy ☐ c) renal failure
☐ d) thrombo-embolism ☐ e) gut ischaemia
4. A 6 years old boy presents with generalized swelling, scanty urine and abdominal discomfort. He had similar problem 1 year back and improved with prednisolone. His BP is 120/70 mmHg. Bed side urine shows albumin +++. Choose the commonest pathological type of this problem is-
☐ a) MCNS ☐ b) FSGS ☐ c) membranous GN
☐ d) membranoproliferative GN ☐ e) mesangiocapillary GN
5. The proposed diagnostic criteriae of acute renal failure are-
☐ a) S creatinine > 3 times normal ☐ b) urine output < 0.3 ml/kg/day ☐ c) anuria > 12 hours
☐ d) generalized oedema ☐ e) haematuria
6. The diagnostic criteria of nephritic syndrome include
☐ a) generalized edema ☐ b) hypertension ☐ c) hypercholesterolaemia
☐ d) haematuria ☐ e) hypoalbuminaemia
7. Indications for Renal Biopsy are
☐ a) Age of onset <6 months ☐ b) Gross haematuria ☐ c) low serum C4
☐ d) Sustained hypertension ☐ e) Suspected secondary causes of nephrotic syndrome
8. Causes of haematuria include -
☐ a) AGN ☐ b) UTI ☐ c) CKD ☐ d) Renal TB ☐ e) CLD
9. Features of hypertensive encephalopathy
☐ a) Headache ☐ b) Vomiting ☐ c) Slurred speech
☐ d) Convulsion ☐ e) Unconsciousness

DYSURIA

URINARY TRACT INFECTION

219

Dysuria usually represents urinary tract infection (UTI), which is a common cause of morbidity in children. Many UTI cases have an underlying urinary tract anomaly *e.g. vesico-ureteric reflux (VUR), obstruction etc.* that, if remains untreated may predispose to renal damage. In this chapter we will highlight UTI.

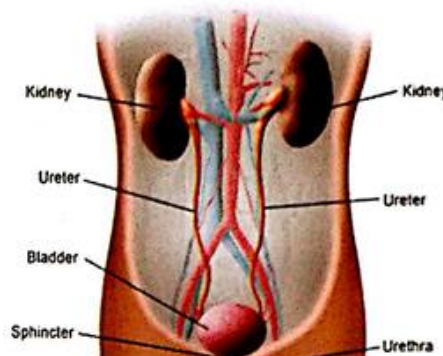
URINARY TRACT INFECTION

Aetio-pathogenesis

Virtually all UTI are ascending infections where bacteria from faecal flora colonize the perineum and subsequently enter into bladder via urethra (*cystitis*) and finally find their way to the kidneys (*pyelonephritis*).

Risk factors

- * Female gender
- * Uncircumcised males
- * Vesico ureteric reflux (VUR)
- * Voiding dysfunction
- * Obstructive uropathy
- * Urethral instrumentation
- * Wiping of perineum in females from back to front
- * Constipation
- * Pinworm infestation
- * Neuropathic bladder
- * Tight clothing
- * Bubble bath



Microorganisms

Most common	<i>E. Coli (90%)</i>
Less common	<i>Klebsiella, Proteus, Pseudomonas, Staph. epidermidis, Strept. faecalis</i>

Types & Clinical features of UTI

Pyelonephritis (Infection of renal parenchyma)	High fever, chills and rigor, abdominal or flank pain, nausea, persistent vomiting, dehydration, renal angle tenderness Presentations among neonates are nonspecific. They usually presents with features of sepsis <i>e.g. vomiting, lethargy, hypo or hyperthermia, poor feeding, irritability, failing to thrive</i> and sometimes <i>prolonged neonatal jaundice</i>
Cystitis (Infection of urinary bladder)	Dysuria, urgency, frequency, incontinence, suprapubic pain and malodorous urine. Fever usually absent

BP should be measured in every case of UTI.

Asymptomatic Bacteriuria

When patients have positive urine culture but no symptoms of UTI.

Diagnosis

Based on C/F & relevant investigations.

Investigations

- Urine R/M/E: Show many pus cells (>5 pus cells/HPF). Sample should be sent to laboratory within 30 minutes of collection
- Urine for C/S: Will identify the organisms and their antibiotic sensitivity pattern

Diagnostic significance of colony count in urine		
Method of Collection	Colony count	Probability of infection %
Clean voided	1 specimen $>10^5$	80
	3 specimen $>10^5$	95
Catheterization	$>10^5$	95
	$10^4 - 10^5$	Infection likely
	$<10^3$	Infection unlikely
Suprapubic puncture	Gram negative bacilli-any number	99
	Gram positive cocci- $>$ few thousand	

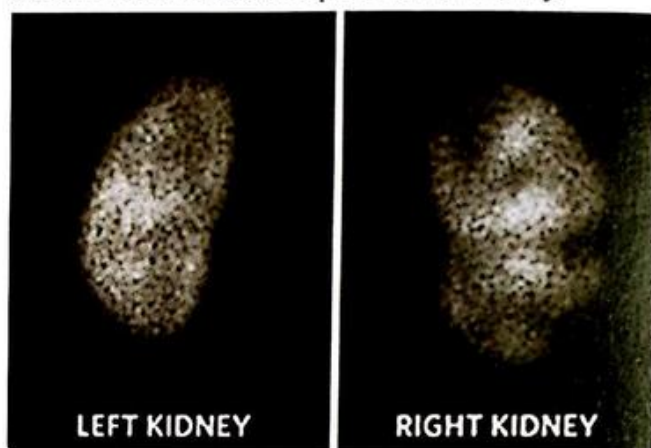
- Blood for CBC: Neutrophilic leukocytosis
- Imaging study: Renal ultrasound, voiding/micturating cystourethrogram (MCU), DTPA and DMSA scan should be done to find out the cause as well as extent of renal damage

DTPA renogram

DTPA renogram is a graphical representation of arrival, uptake & elimination of DTPA (Diethylene Triamino Pentaacetic Acid) by the kidney. It has 3 phases - arterial phase, glomerular phase & excretory phase and provide information about functional status of both kidneys.

DMSA scan

DMSA denotes Dimercaptosuccinic acid, used to assess the renal morphology, presence of any scar, certain renal masses & position of kidney.



DMSA scan showing UTI-related scarring of the right kidney.

Source: Internet

Treatment

- Counseling parents about the disease
- Antibiotics

Types	Antibiotics, Route, Dose	Duration of treatment
Acute Pyelonephritis	Ceftriaxone, IV, 100 mg/kg/day or Cefotaxime, IV, 150 mg/kg/day or Gentamicin, IV, 5 mg/kg/day	10-14 days
Acute Cystitis	Cotrimoxazol or Amoxicillin or Co-Amoxiclav or Cefadroxil or Ciprofloxacin	5-7 days

- Supportive treatment: More liquid intake, avoiding the risk factors

Recurrent UTI

Children with > 1 attacks of UTI, irrespective of age. They should be evaluated with ultrasound, DMSA scan and micturating cysto-urethrogram.

Risk factors

- * Vesico-ureteric reflux (VUR)
- * Urinary tract abnormalities
- * Diseases e.g. diabetes mellitus, neurogenic bladder, immune deficiency disorder etc.

Treatment

- Counseling the parents about the complications and outcome of recurrent UTI
- Correction of constipation, if any
- Training for proper voiding of urine
- Washing of perineum in females from front to back after defaecation
- Identification & elimination of the underlying cause of recurrent UTI
- Antibiotic prophylaxis: Indications-
 - * First febrile UTI
 - * UTI with bowel, bladder dysfunction
 - * Grade III or IV reflux

Drugs used for Prophylaxis

- Cotrimoxazole: 1-2 mg of Trimethoprim/kg/day, or
- Nitrofurantoin: 1-2 mg/kg/day or
- Cephalexin: 10 mg/kg/day, or
- Cefadroxil: 3-5 mg/kg/day

Duration of Prophylaxis

Varies according to the underlying cause of persistent infection and prophylaxis may be discontinued if the cause has been removed and the repeated urine C/S shows no growth. Sometimes it may be discontinued after 5-6 years of age, even if low grade reflux persists.

References

1. Menon S. Urinary tract infection: an update. In: Dutta AK, Sachadeva A editors, *Advances in Pediatrics*. 1st Ed. Delhi: Jaypee Brothers Medical Publishers ; 2007. p 1058-65.
1. Elder JS. Urinary tract infection. In: Kliegman RM, Stanton BF, Geme III JWS, Schor NF, Behrman RE. Editors. *Nelson Textbook of Pediatrics*, 20th Edition. New Delhi: Elsevier; 2016: 2556-2562.
2. Prajapati BS et al. Advances in the management of urinary tract infections. *Indian Journal of Pediatrics* 2008; 75: 809-14.

SELF ASSESSMENT

Short answer questions [SAQ]

1. What are the microorganisms responsible for UTI?
2. Write down the treatment of acute pyelonephritis.
3. A 4 year old girl has complaints of dysuria , increases frequency of micturition and fever.
 - a) what is your probable diagnosis?
 - b) How to investigate the child?
 - 3) Write down her management.

Multiple choice questions [MCQ]

1. The known risk factors of UTI are-

___a) Vesicoureteric reflux	___b) obstructive uropathy	___c) neuropathic bladder
___d) constipation	___e) pin worm infestation.	
2. The recommended drugs for prophylaxis of recurrent UTI are-

___a) Nitrofurantoin	___b) Trimethoprim	___c) Cephalexin	___d) Ampicillin	___e) Erythromycin
----------------------	--------------------	------------------	------------------	--------------------

SUDDEN PARALYSIS OF LIMBS

POLIOMYELITIS	222
GUILLAIN-BARRÉ SYNDROME	224
TRANSVERSE MYELITIS	226

Whenever a child presents with sudden onset of paralysis, one should think of the following possible problems involving -

- * Spinal cord: Poliomyelitis, transverse myelitis (TM), spinal cord tumor
- * Peripheral nerves: Guillain-Barré ' syndrome (GBS) diphtheria, porphyria
- * Neuromuscular junction: Tick, botulism
- * Brain: Stroke

In this chapter, diseases, those give rise to acute flaccid paralysis *e.g. poliomyelitis, GBS, TM* will be highlighted.

POLIOMYELITIS

Aetio-pathogenesis

Organism: *Polio virus* type 1, 2, 3.

All the 3 types can cause paralysis but **type 1** is associated with most of the major epidemics and shows the greatest propensity to cause paralytic form of the disease.

- Transmission: Faecal-oral route
- Incubation period: 1-3 weeks
- The areas of spinal cord and brain affected by polio virus are-

Spinal cord	Anterior horn cells
Medulla	Motor cranial nerve nuclei
Cerebellum	Nuclei in the roof and vermis
Pons	Substantia nigra, and occasionally the red nucleus

Clinical Manifestations

Presentations are variable.

A. Asymptomatic: About 90-95% of patients.

B. Symptomatic: About 5-10% cases and they present as one of the following 3 ways-

i) Abortive polio: Like any viral infection. No paralysis. Recovery is complete

ii) Nonparalytic

aseptic meningitis:

Characterized by fever, headache and neck stiffness without paralysis

iii) Paralytic

poliomyelitis

According to the site of lesions, paralytic poliomyelitis are of 3 types

- * Spinal
- * Bulbar
- * Polio encephalitis



A child with paralyzed right lower limb from polio

Cardinal features of 3 types of Paralytic Poliomyelitis

Parameters	Spinal poliomyelitis	Bulbar poliomyelitis	Polio encephalitis
	Anterior horn cells of spinal cord	Motor cranial nerve nuclei at Medulla	
Presentation	* Initially severe muscle pain, paraesthesia, hyperaesthesia, fasciculations * Within 1–2 days, asymmetric flaccid paralysis or paresis occurs * Lower limbs affected more than the upper limbs * Proximal muscles more affected than distal muscle * Absent or diminished deep tendon reflexes * Affected muscles are floppy	* Nasal intonation of voice * Absence of effective coughing * Nasal regurgitation of saliva and fluids during swallowing * Deviation of the palate, uvula or tongue * Involvement of vital centers in the medulla, which manifest as - * Irregularities in rate, depth and rhythm of respiration * Blood pressure changes (especially increased blood pressure and cardiac arrhythmias) * Rapid changes in body temperature * Paralysis of 1 or both vocal cords, causing hoarseness, aphonia and ultimately asphyxia	* Higher center of brain involved * Cranial nerve involvement * Irritability/drowsiness * Seizure * Coma

Diagnosis

- Clinical
- Isolation of virus from stool is confirmatory

After receiving the patient, it has to be notified to AFP surveillance office and stool sample should be sent. (2 samples of 8-10 gm stool each to be collected 24 hours apart within 14 days of onset of AFP & to be sent in cold box at 4-8°C to National Lab for Polio & Measles at IPH building, Mohakhali, Dhaka)

Treatment

Polio is a non curable disease and the treatment is mainly supportive and rehabilitative. The aim of interventions are to -

- Strengthen all the affected muscles
- Prevent contractures and deformities
- Make the patient as self sufficient as possible
- Provide emotional and psychological support

Treatment in the acute stage of muscle paralysis (7-10 days)

- Give NG tube feeding if unable to feed orally
- Apply moist hot packs to the affected muscles along with analgesics to treat pain
- Support the spine, hip, knee, foot and other joints to prevent contracture, sores and deformities. e.g.
 - * Rest on a firm mattress with back supported on a lumbar board. Use early spinal bracing if the back is weak
 - * Support the feet by rigid boards at 90° angle
 - * Apply passive range of movement for the joints
 - * Position hip and knees as straight as possible and arms in abduction with mild support
 - * Change posture 2 hourly
 - * Avoid forceful exercise as this may increase paralysis
 - * Avoid massaging
 - * Do endotracheal intubation and artificial ventilation if respiratory failure
 - * Treat pulmonary atelectasis and other infections with antibiotics

Treatment in the recovery or convalescent stage (upto 2 years)

- Encourage sitting up if the paralysis is not severe
- Start exercises as soon as possible to prevent contractures and regain strength
- Start passive exercise first, and then begin active assisted to active resisted exercises
- Gradually introduce sitting balance training & standing balance training in parallel bars, gait training etc.
- Crutches, leg brace (calipers) and other devices may help the child to move better and prevent contractures or deformities
- Whenever possible make exercises fun
- Introduce active games, swimming and other activities to keep limb moving

Prevention

Immunization with polio vaccine according to EPI & NID programme.

Prognosis

- Paralyzed muscles generally recover power to a variable degree over time. If not recover by 6 months than it will be permanent
- Mortality is about 5-10%, mostly due to respiratory failure

GUILLAIN-BARRÉ SYNDROME (GBS) ACUTE POST-INFECTIOUS DEMYELINATING POLYNEUROPATHY

GBS is a *postinfectious polyneuropathy* involving mainly motor but sometimes sensory and autonomic nerves.

Aetiology

The pathogenic triggers are -

- * *Campylobacter jejuni* (most common)
- * *Mycoplasma pneumoniae*
- * Viruses e.g. Epstein-Barr virus, Cytomegalovirus, Enteroviruses, Hepatitis A and B, Varicella

Pathogenesis

The syndrome usually develops 1-4 weeks after a gastrointestinal (*Campylobacter jejuni*) or respiratory tract (*Mycoplasma pneumoniae*) infection. The major pathological event is an immune mediated demyelinating neuropathy

where myelin sheath is damaged.

Degeneration of the axon also occurs.

This damage of myelin sheath of peripheral nerves blocks/interferes with conduction of nerve impulse.



Types

- * Acute inflammatory demyelinating polyneuropathy (AIDP)
- * Acute motor axonal neuropathy (AMAN)
- * Acute motor sensory axonal neuropathy (AMSAN)
- * Miller-Fisher syndrome (MFS)
- * GBS with severe bulbar and facial paralysis
- * Congenital GBS

Clinical Manifestations

- Pain & tenderness in muscles at the onset
- Abrupt onset of -
 - * Symmetrical weakness usually in the lower extremities
 - * Progressive ascending paralysis gradually involving the trunk and upper limbs
 - * *Distal muscles more affected than proximal muscles*
- Affected muscles show signs of lower motor neuron paralysis e.g.

- * Profound muscle weakness
- * Loss of movement
- * Reduced tone and strength
- * Loss of deep tendon reflexes
- * Absence of planter reflexes

- Respiratory failure due to paralysis of diaphragm & other muscles of respiration and presents as -

- | | |
|--|---|
| * Dyspnoea | * Progressive elevation of the respiratory rate |
| * Prominence of accessory muscles of respiration | * Tachycardia |
| * Cyanosis | * Agitation, confusion, coma |

- Bulbar palsy (bilateral impairment of function of the IX, X, XI & XII cranial nerves) presents as -

- * Dysarthria
- * Dysphagia (often with choking episodes and nasal regurgitation of fluids)
- * Dysphonia (nasal intonation of voice)
- * Poor cough and susceptibility to aspiration pneumonia

- Autonomic manifestations are-

- * Fluctuation of BP and heart rate
- * Fluctuation of body temperature

Bladder dysfunction: Usually absent but may occur on about 20% cases, sometimes there may be pain at the back (radiculopathy)

- Complications of immobility: Aspiration pneumonia, bed sore etc.

Investigations

- CSF study: characteristic **Albumino-Cytological** dissociation evident after 7 days of onset of symptoms
 - * Cytology : Usually normal (<10 cells/cmm)
 - * Biochemistry: Increased protein (may be

as high as 400-500 mg/dl). Increased CSF protein is thought to reflect the wide spread inflammation of the nerve roots

- * Glucose: Normal

- Stool culture: *C. jejuni may be found*
- Motor nerve conduction velocity: Reduced
- Electromyogram (EMG): Shows evidence of acute denervation of muscle
- Sural nerve biopsy: Shows segmental demyelination, focal inflammation and Wallerian degeneration - which is diagnostic. *But virtually never required for diagnosis*

Treatment

A. Specific

- Intravenous immunoglobulin (IVIG): 400 mg/kg/day for 5 consecutive days (total dose 2 g/kg)
- Plasmapheresis (*Here whole blood from patient is separated into plasma and blood cells; the plasma is replaced with saline/albumin or specially prepared donor plasma, reconstituted with blood cells and retransfused into the patient*): Helps speedy recovery. It is more beneficial when started within seven days of the disease onset
- Combination of IVIG and interferon
- Corticosteroids: No role

B. Supportive

- Counsel parents about the disease, prognosis and provide psychological support
- Bed rest (pneumatic bed is preferable) and frequent change of posture to avoid bed sores
- Feeding: NG tube feeding if unable to take orally
- Maintain personal hygiene *e.g. bathing, hand washing etc.*
- Care of bowel: By ensuring regular bowel movement by a high fiber diet, adequate and timely fluid intake, medications to regulate bowel evacuations *e.g. Lactulose, enema if necessary*
- Care of the bladder: By catheterization with regular check up

- Avoidance of aspiration pneumonia by clearing the throat off secretions by oropharyngeal suction, chest physiotherapy
- Assisted ventilation if respiratory failure (*arterial PO₂ falls below 70 mmHg*)
- Management of pain with non-steroidal anti-inflammatory drugs (NSAIDs) *e.g. Ibuprofen*
- Physiotherapy
 - * Should be started before recovery begins by moving patients' limbs manually to help keep the muscles flexible and strong

Follow up

- Improvement usually occurs in 2-3 weeks but may need 1 to 2 months
- Sometimes complete recovery may occur in 1-2 years

Prognosis

- More than 90% of children recover fully, while a small minority has mild weakness
- Predictors of poor outcome
 - * Cranial nerve involvement
 - * Required intubation
 - * Maximum disability at the time of initial presentation
- Mortality is low (1-2%) and generally results from respiratory failure, cardiac arrhythmia, BP instability

TRANSVERSE MYELITIS (TM)

The term transverse means across the width, myelitis refers to inflammation of the spinal cord. So transverse myelitis means inflammation across the width of one level or segment of spinal cord.

Pathogenesis

Inflammation causes -

- Damage or destruction of nerve cells in the inflamed segment
- Interruption of connection between brain & spinal cord with spinal nerves below the level of lesion

The net neurological profile in TM are -

At the level of lesion	Signs of LMN lesion
Below the level of lesion	Signs of UMN lesion
Above the level of lesion	Normal nerve function

LMN: Lower motor neuron, UMN: Upper motor neuron

Clinical Manifestations

- Non-specific symptoms -
 - * Initially paraesthesias ascending from the feet, or
 - * Back pain at the level of myelitis (usually at thoracic level)
- Sensory loss: Loss of sensation with a definite upper level. Pain, temperature, and light touch sensation are affected, but joint position and vibration sense may be preserved
- Motor dysfunction: Characterized by flaccid paralysis in the initial phase (2-3 days) of "spinal shock" (lower motor neuron signs). Thereafter, flaccidity gradually changes to spastic paraparesis with exaggerated deep tendon reflexes (upper motor neuron signs)
- Autonomic dysfunction
 - * Fluctuation of blood pressure
 - * Sweating
 - * Urinary retention with dribbling
 - * No spontaneous bowel movement

Investigations

- MRI of spine: Mild fusiform swelling of cord over several segment, most frequently in the thoracic region
- CSF study

- * Cytology: Moderate pleocytosis (50-100 lymphocytes/mm³).
- * Biochemistry: Elevated protein (≈ 100 mg/dl)



Fusiform swelling of spinal cord in TM

Source: Internet

Treatment

A. Supportive

- Counsel parents about the disease, its prognosis and provide psychological support
- Bed rest (pneumatic bed is preferable) and change of posture 2 hourly to avoid bed sores
- Maintain personal hygiene *e.g. bathing, hand washing etc.*
- Ensure chest physiotherapy to prevent hypostatic pneumonia
- Care of urinary bladder: By catheterization
- Care of bowel: Ensuring regular bowel movement by -
 - * High fiber diet
 - * Adequate and timely fluid intake
 - * Medications to regulate bowel evacuations *e.g. Lactulose*
 - * Enema if necessary
- Physiotherapy

* Should be started when pain subsides. It is done by passive movement of patients' limbs

- Anti-spasticity drugs *e.g. oral/intrathecal Baclofen, Tizanidine and Benzodiazepines, therapeutic Botulinum toxin injections and serial casting*

B. Specific

- Steroid: Pulse IV Methylprednisolone for 5 days
- Plasmapheresis: Indicated in patients who don't show much improvement with intravenous steroids

Prognosis

- Recovery may occur over a period of weeks or months
- One third completely recovers, one third live with residual symptoms and the remaining show no improvement at all

Differences among the causes of Acute Flaccid Paralysis (AFP)

Parameters	Poliomyelitis	GBS	TM
Paralysis	<u>Asymmetric paralysis</u> , proximal muscles are more affected than distal muscles	<u>Symmetrical ascending paralysis</u> , distal muscles are more affected than proximal muscles	Initially LMN, subsequently UMN paralysis
Site of lesion	<u>Anterior horn cells of spinal cord</u> and motor cranial nerve nuclei at medulla	Peripheral nerves	Inflammation across the width of one level or segment of spinal cord
Sensory loss	Absent	May be but rare	Occurs with a definite upper level
Cranial nerve involvement	May be present most commonly IX & X	May be present VII, IX, X, XI, XII are more affected	Usually absent
Respiratory insufficiency	Present in both Bulbar & Bulbo-spinal polio	Present & life threatening	Usually absent
Autonomic involvement	Absent	May be present <i>e.g. fluctuant BP, body temperature, excessive sweating</i>	May be present
Bladder dysfunction	Absent	Usually absent	Usually present
CSF changes	Cytology: Pleocytosis, mostly lymphocyte Biochemistry: Protein normal	Cytology: Usually normal (<10/cmm) Biochemistry: Protein (Albumino - Cytological dissociation)	Cytology: Moderate pleocytosis Biochemistry: Mild elevation of protein

References

1. Sarnat HB. Guillain-Barre' syndrome. In: Kliegman RM, Stanton BF, Geme III JWS, Schor NF, Behrman RE. Editors. Nelson Textbook of Pediatrics, 20th Edition. New Delhi: Elsevier; 2016: 3010-3012.
2. Rekate HL. Transverse myelitis. In: Kliegman RM, Stanton BF, Geme III JWS, Schor NF, Behrman RE. Editors. Nelson Textbook of Pediatrics, 20th Edition. New Delhi: Elsevier; 2016: 2958-2959.
3. Hughes RAC, Swan AV, van Doorn PA. Intravenous immunoglobulin for Guillain-Barre' syndrome. Cochrane Database of Systematic Reviews 2010, Issue 6. Art. No.: CD002063.
4. S Agrawal, D Peake, WP Whitehouse. Management of children with Guillain-Barre' Syndrome. Arch Dis Child Educ Pract Ed. 2007;92: ep161–ep168.
5. Monique M Ryan, Guillain-Barre' syndrome in childhood, J. Paediatr. Child Health. 2005; 41: 237–241
6. Peake D, Whitehouse WP, Philip S, The management of Guillain-Barre syndrome, Current Paediatrics. 2004;14:252–257.
7. J Kalita, UK Misra. Is methyl prednisolone useful in acute transverse myelitis? Spinal Cord 2001; 39: 471 – 76.
8. Transverse myelitis fact sheet: National Institute of Neurological Disorders and Stroke, National Institute of Health Publication No. 01-4841 [Internet]. 2010 [updated 2011 July 1; cited 2011 Dec 5]. Available from: http://www.ninds.nih.gov/disorders/transversemyelitis/detail_transversemyelitis.htm.
9. Guillain-Barre' Syndrome Fact Sheet, National Institute of Neurological Disorders and Stroke, National Institute of Health Publication No. 05-2902, [Internet]. 2010 [updated 2011 August 19; cited 2011 Dec 5]. Available from: http://www.ninds.nih.gov/disorders/transversemyelitis/detail_transversemyelitis.htm.
10. Transverse Myelitis Centre, Johns Hopkins Medicine. [Internet]. Available from: http://www.hopkinsmedicine.org/neurology_neurosurgery/specialty_areas/transverse_myelitis/about-tm/.
11. Polio Treatment [Internet]. Available from: <http://www.physiotherapy-treatment.com/polio-treatment.html>.

SELF ASSESSMENT

Short answer questions [SAQ]

1. What are the causes of sudden paralysis in children?
2. What are the common clinical features in GBS?
3. How will you treat a case of GBS?
4. What are the net neurological dysfunction in TM?

Multiple choice questions [MCQ]

1. Characteristic features of acute poliomyelitis are -
☐ a) symmetrical, ascending paralysis ☐ b) loss of sensation
☐ c) loss of bladder function ☐ d) high chance of respiratory insufficiency
☐ e) more cells and normal proteins in CSF
2. The following features are characteristics of GBS -
☐ a) sensory loss ☐ b) paralysis of distal than proximal muscles
☐ c) ascending type of paralysis ☐ d) bladder dysfunction
☐ e) more protein and normal cells in CSF
3. Autonomic dysfunction found in transverse myelitis include
☐ a) fluctuation of blood pressure ☐ b) Sweating ☐ c) deviation of the angle of the mouth
☐ d) urinary retention with dribbling ☐ e) no spontaneous bowel movement
4. Features of Bulbar palsy in GBS presents as -
☐ a) Dysarthria ☐ b) Dysphagia ☐ c) Dysphonia
☐ d) Poor cough ☐ e) Excessive sweating
5. Signs of lower motor neuron paralysis include
☐ a) Profound muscle weakness ☐ b) Loss of movement ☐ c) Reduced tone and strength
☐ d) Exaggerated deep tendon reflexes ☐ e) Absence of planter reflexes

CONVULSION

FEBRILE CONVULSION/SEIZURE	229
PYOGENIC MENINGITIS	231
TUBERCULAR MENINGITIS	235
VIRAL ENCEPHALITIS	236
EPILEPSY	238
STATUS EPILEPTICUS	240
INTRACRANIAL SPACE OCCUPYING LESIONS	242

Convulsion represents many underlying serious neurological illnesses. A seizure (convulsion) is a sudden, transient brain dysfunction manifested by involuntary motor, sensory, autonomic or psychic phenomena alone or in any combination, often accompanied by loss/alteration of consciousness. It may occur either with fever or without fever.



Convulsing child with fixed stare and rigidity

The conditions given in the box should be taken into consideration whenever a child presents with convulsion-

Convulsions with fever	Convulsions without fever
* Febrile convulsion * Acute meningitis-bacterial or viral * Cerebral malaria * Viral encephalitis * Tubercular meningitis (TBM) * Brain abscess	* Epilepsy * Encephalopathy <i>e.g. hypertensive, hepatic or uraemic, hypoxic, ischaemic</i> * Trauma <i>e.g. head injury</i> * Acute stroke syndrome * Intracranial space occupying lesions * Metabolic abnormalities <i>e.g. hypoglycaemia, hypo or hypernatraemia, hypocalcaemia, hypomagnesaemia, pyridoxine deficiency/dependency</i>

In this section, the common causes of convulsion in children will be discussed briefly.

FEBRILE CONVULSION/SEIZURE (FS)

Febrile seizure are seizures that occur between the age of 6 months and 60 months with a temperature of 38°C (100.4°F) or higher, that are not due to (i) CNS infection or (ii) any metabolic imbalance and that occur (iii) in the absence of a history of prior afebrile seizure.

Types

Types	Duration	Pattern of seizure	Recurrence
Simple	< 15 minutes	GTCS	No recurrence within 24 hours
Complex (Atypical)	≥ 15 minutes	Focal seizures (usually)	Recurrence within 24 hours
Febrile status epilepticus	> 30 minutes	Focal or generalized	
Febrile seizure plus	Recurrence within 24 hours		

GTCS: Generalized tonic clonic seizure

Characteristics of Simple FS

- * Convulsion/seizure occurs among children between 6 months to 6 years with a peak age of around 14-18 months
- * Seizures are mostly generalized, usually once in 24 hours, last from few seconds to few minutes but not exceeding 15 minutes; occur early in the illness causing fever.
- * Absence of signs of meningitis e.g. bulging fontanelle, stiff neck, stupor and irritability
- * No residual neurodeficit
- * May have family history of febrile convulsion

Clinical Evaluation

History

- Age of the child
- Types & duration of seizure
- Family history of seizure disorder or febrile seizure
- Nature of fever
- Developmental of status of the child

Physical Examination

- To evaluate patient's neurologic status e.g. level of consciousness
- To check airway, breathing and circulation
- To check anterior fontanelle
- To check signs of meningeal irritation e.g. neck stiffness, positive Kernig's sign & Brudzinski's sign
- Others e.g. size of head, status of cranial nerves etc.
- To find out the cause of fever e.g. otitis media, pneumonia, UTI, tonsillitis, pharyngitis or a viral exanthem

Diagnosis

Based on C/F & relevant investigations.

Investigations

While managing the case, the most important decision is to rule out meningitis by CSF study.

Other investigations are planned to find out the cause of fever and also convulsion. These investigations are -

- Random blood sugar (RBS)
- Serum Calcium
- Serum electrolytes
- Blood for CBC, PBF, C/S
- Throat swab for C/S
- X-ray chest
- Urine R/M/E, C/S etc.
- EEG: Not required in simple febrile seizure
- Neuro-imaging: No role

Indications of CSF study in febrile seizure

- * Any doubt of meningitis/encephalitis
- * First attack is at < 12 months of age
- * Associated with complex seizure or altered sensorium
- * If recovery is slow or undue prolongation of post-ictal sleep

Treatment

Counseling parents about the natural history of the disease, treatment and prognosis.

- Maintain airway, breathing and circulation (see status epilepticus p 241)
- Termination of seizure by either -
 - * Inj. Diazepam (0.5 mg/kg) per rectal (PR) or 0.2-0.3 mg/kg slow IV or
 - * Inj. Midazolam (0.2 mg/kg) smeared on buccal mucosa or instilled intranasally
- Reduction of body temperature by
 - * Paracetamol (15 mg/kg/dose) every 6 hours, orally or per rectally
 - * Tepid sponging
- Treatment of associated infection by appropriate antibiotics

Prevention of recurrence of convulsion during subsequent episodes -

Generally, prophylaxis (continuous or intermittent) is not recommended for children with one or more simple febrile seizures. But intermittent prophylaxis can only be given when parents are very anxious concerning their child's seizure.

Intermittent prophylaxis: with either of the following, along with Paracetamol and tepid sponging.

- Oral Diazepam: 0.5 - 1mg/kg/day (max. 10 mg) in 3 divided doses for 48-72 hours, OR
- Oral Clobazam: 1mg /kg/day (maximum 20 mg) as single/bd doses, for 48-72 hours

Duration: Till 5 years of age.

Prognosis

- It is a benign condition leaving behind no death or neuro-disability
- Can recur: 30% after 1st seizure, 50% after 2nd seizure
- Chance of epilepsy: 2 - 7%

PYOGENIC MENINGITIS

It is the inflammation of leptomeninges *e.g.* pia & arachnoid mater by invasion of pyogenic bacteriae.

Aetio-pathogenesis

Organisms

Neonatal period	<i>E. coli</i> , <i>Gr. B Streptococci</i> , <i>L. monocytogenes</i>
Beyond neonatal period	<i>H. influenzae</i> , <i>Strept. pneumoniae</i> , <i>N. meningitidis</i>

Although the term meningitis means infection of meninges, the inflammatory process is not only confined to meninges but also extends to underlying cerebrum causing superficial cerebritis. Occasionally, it also involves other deeper structures of brain. Inflammation may

result in vasculitis, vascular thrombosis, cerebral oedema, cerebral infarction raised intracranial pressure and impaired CSF flow.

Clinical Manifestations

Older children: Classically present with -

- * High fever
- * Vomiting
- * Headache
- * Recurrent convulsions
- * Alteration in consciousness

Neonates: Presentations are non-specific -

- * Reluctant to feed
- * High-pitched cry
- * Vacant look
- * Hypo/hyperthermia
- * Jitteriness
- * Convulsions
- * Respiratory distress
- * Features of sepsis
- * Bulged fontanelle

Physical Examination

- Altered sensorium/consciousness, stupor
- Bulging of anterior fontanelle (*neonates and infants*)



Bulged anterior fontanelle

- Signs of meningeal irritation *e.g.* neck rigidity, Kernig's sign (may not be present in children <18 months), Brudzinski's sign

Source: Internet



Neck rigidity



Kernig's sign



Brudzinski's sign

Source: Internet



Left 7th cranial nerve palsy

In meningococcal infection, children may additionally have typical skin rash in different parts of body and sometimes features of shock e.g. Low volume pulse, low BP, CRT > 3 sec.



Complications

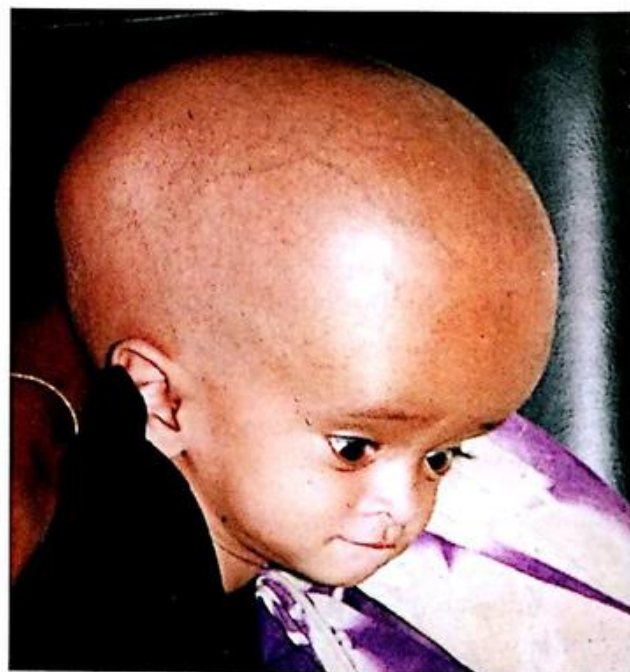
- Signs of upper motor neuron lesion or cranial nerve palsy may be present when it is complicated

Immediate

- * Hydrocephalus
- * Subdural effusion
- * Subdural empyema
- * Ventriculitis
- * Cerebral abscess
- * Cerebral infarction e.g. acute stroke
- * Cranial nerve palsy

Long-term

- * Cerebral palsy
- * Deafness
- * Intellectual disability
- * Epilepsy
- * Visual impairment
- * Learning and language disability



Hydrocephalus



Microcephaly and lateral squint (left 3rd cranial nerve palsy)

Diagnosis

Based on C/F & relevant investigations.

Investigations

- Blood
 - * CBC shows polymorphonuclear leukocytosis
 - * Culture & sensitivity may reveal the organism in 80% of cases
- CSF study: To confirm the diagnosis

Precautions before doing an Lumber Puncture (LP) -

- * Fundus examination to rule out papilloedema
- * No infection at the site of LP
- * Bleeding diathesis excluded

Physical appearance

- Pressure: Usually elevated
- Colour: Hazy, cloudy or purulent

(Normal CSF: crystal clear)



Clear vs Purulent CSF

Cytological

Neutrophilic leukocytosis usually 300-2000 cells per cmm (normal: 0-5 lymphocytes/cmm). CSF must be examined within half an hour of LP to obtain correct result.

Biochemical

- Glucose: Decreased, usually <40 mg/dl (normal CSF glucose: 40-80 mg/dl) or less than 2/3 rd of blood glucose. Corresponding blood sugar estimation is recommended half an hour before LP for this purpose
- Protein: Increased, usually 100-500 mg/dl (normal: 15-45 mg/dl) 15-50
- Chloride: Decreased, 102 -120 mmol/liter (normal: 120-130 mmol/L)

Microbiological

Gram staining & AFB: May show the organisms.

- Gram+ve cocci: *Staphylococci*, *Streptococci*, *Pneumococci*
- Gram -ve diplococci: *Meningococci*
- Gram -ve coccobacilli: *H. influenzae*
- Gram-ve bacilli: *E. coli*, *Proteus*, *Pseudomonas*

Bacterial antigens: May be detected by latex agglutination or by PCR.

Culture: To grow the causative organism.

Other investigations

- * Blood glucose
- * Serum calcium
- * S. electrolytes e.g. hyponatraemia & hypochloreaemia in SIADH
- * Gram staining and culture from meningococcal skin rash

Treatment

- Counsel parents about the natural history of the disease, treatment and prognosis

A. Supportive

- * Maintain airway, breathing and circulation (details given in status epilepticus, p-241)

- * Give Inj. Diazepam 0.5 mg/kg per rectal (PR) or 0.2-0.3 mg/kg slow IV for convulsion
- * Start IV fluid : 2/3rd of daily maintenance with
 - * 10% dextrose in 0.225% NaCl (Baby saline) or
 - * 5% dextrose in 0.45 % NaCl (Junior saline)
- * Add maintenance dose of K 1-2 mmol/kg/day (not to exceed 20-40 meq/L) till patient is NPO
- * Give O₂ by nasal cannula (2L/min) or face mask (3-5 L/min) if indicated
- * Control temperature with Paracetamol (15 mg/kg/dose) 6 hourly and tepid sponging
- * Give NG tube feeding when patient is stable *e.g. no convulsion*
- * Monitor vital signs *e.g. heart rate, respiration urine output, BP or Capillary refill time* - 4-6 hourly during the first 24-28 hours of treatment

B. Specific: Parenteral Antibiotics

Organisms	Empiric Antibiotic of choice	Dose & Interval	2nd line	Duration
Unknown	Ceftriaxone or Cefotaxime or Ampicillin or Penicillin G + Chloramphenicol	100 mg/kg/day - 12 hourly 200-300 mg/kg/day - 8 hourly 400 mg/kg/day - 6 hourly 4,00,000 U/kg/day - 4-6 hourly 100 mg/kg/day - 6 hourly		10 days
Meningococcus	Penicillin G	4,00,000 U/kg/day - 4-6 hourly		7 days
Pneumococcus	Ceftriaxone + Vancomycin	100 mg/kg/day - 12 hourly 60 mg/kg/day - 6 hourly	Meropenem (40 mg/kg/dose - 8 hourly) ± Amikacin (15-20 mg/kg/day - 12 hourly)	10-14 days
H. influenzae	Ceftriaxone or Cefotaxime	100 mg/kg/day - 12 hourly 200-300 mg/kg/day - 8 hourly	Cefepime (150 mg/kg/day - 8 hourly)	10-14 days
Gram -ve except Pseudomonas	Ceftriaxone/ Cefotaxime + Amikacin	As above	Cefepime or Meropenem (40 mg/kg/dose - 8 hourly)	21 days
Pseudomonas	Ceftazidime	150 mg/kg/day 8 hourly	Meropenem ± Amikacin	14-21 days

C. Adjunctive therapy

Dexamethasone

- To block release of cytokines and toxic intermediaries from the brain cells thus to reduce inflammation
- To reduce complications such as deafness and adhesion between meninges
- To stabilize altered vascular permeability, so as to reduce cerebral oedema

Dose

- * 0.15 mg/kg/dose 6 hourly (total 8 doses)
- * It should be started 15 minutes before the 1st dose of antibiotics

D. Treatment of complications: If any.**E. Follow up**

To detect any neuro-deficit.

Prophylaxis for Contacts of meningococci

- Rifampicin (10 mg/kg/dose) orally every 12 hours for 48 hours, or
- Ciprofloxacin (500 mg) orally as a single dose for persons > 18 years

Prevention

By vaccination with -

- Meningococcal conjugate vaccine: 2 doses are recommended anytime after 2 years of age
- Haemophilus influenzae type B vaccine: Given in EPI with penta from 1½ months of age
- Pneumococcal conjugate vaccine: 3 doses from 1½ months of age (given in EPI schedule)

TUBERCULAR MENINGITIS (TBM)

(Also discussed in chapter 7 along with TB)

The most dangerous form of tubercular infection.

Aetio-pathogenesis

TB bacilli reach CNS by haematogenous route from a primary TB foci anywhere in the body. Initially, small tuberculous lesion (*Rich's foci*) develop in the CNS (*meninges, subpial or subependymal surface of ventricle or of spinal cord*) which may remain dormant, there for

years. Later on, rupture of these foci into the subarachnoid space or into the ventricular system results in meningitis.

Clinical Manifestations

Onset of the disease is gradual and symptoms progress over several weeks and present through 3 stages:

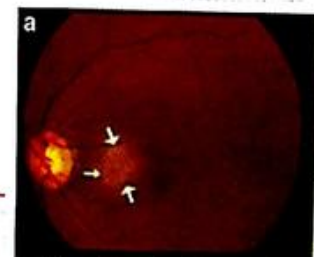
Stage I Stage of invasion/ Prodromal stage	• Non-specific symptoms <i>e.g. low grade fever, headache, malaise, irritability, behavioural change, drowsiness</i> • Focal neurological signs are absent
Stage II Stage of meningitis	• Neurological features <i>e.g. lethargy, convulsions, vomiting</i> • Signs of meningeal irritation <i>e.g. neck rigidity, Kernig's or Brudzinski's signs, hypertonia</i> • Cranial nerve palsies and • Focal neurological signs present
Stage III Stage of coma/ Terminal stage	• Marked by coma, hemiplegia or paraplegia • Decerebrate/decorticate posturing • Deterioration of vital signs and • Eventually death

Diagnosis

Based on C/F & relevant investigations.

Clinical Evaluation

- Typical clinical features as mentioned in the chart above
- Evidence of TB infection elsewhere in the body *e.g. lungs*
- H/O contact with an adult infectious TB patient
- Absence of prior BCG vaccination
- Examination of fundus: Choroid tubercle is highly specific for TBM



Choroid tubercle in TBM

Source: Internet

Investigations

- CSF study: Features given in the table below

CSF findings of common types of meningitis

CSF	Pyogenic	Tubercular	Viral
Pressure	Elevated	Elevated	May be elevated
Colour	Hazy, cloudy or purulent	Straw	Usually clear
Cells	Neutrophilic leukocytosis 300-2000/ cmm	10-500 lymphocytes	10-100, rarely >1000 mixed cells initially; becoming lympho- cytic by 36 hours
Glucose	< 40 mg/dl or <50% of blood glucose	< 40 mg/dl	45-75 mg/ dl
Protein	100-500 mg/dl	100-3,000 mg/dl	50-200 mg/dl
Gram stain/ AFB	May show the organism	May show the bacilli	
Bacterial antigen	May be detected by latex agglutination or PCR		
Culture	May grow the organism		

- Mantoux test: Non reactive in about 50% of cases
- Complete blood counts: Hb% (may be reduced), CBC (lymphocytosis) & ESR (high)
- X-ray chest: Appears normal in 20-50% cases. CXR may have miliary mottling
- MRI of brain: The pathognomonic feature is abnormal meningeal enhancement in basal cistern

Other investigations

- CSF for adenosine de aminase (ADA)
- CSF for Gene X-pert test

Treatment

- Counseling parents about the disease.
- Anti TB drugs (4 drugs): 2 (HRZ)S and 10 (HR) for total 12 months
- Prednisolone (2 mg/kg/day) for initial 4 weeks and gradual tapering by another 2 weeks

Prognosis

Correlates mostly with the clinical stage of illness & when treatment is initiated. It is good in 1st stage but most patients in 3rd stage die and who survive have permanent disabilities like blindness, deafness, intellectual disability, motor disabilities etc.

VIRAL ENCEPHALITIS

It is the inflammation of brain parenchyma. Patients however, have some degree of meningeal inflammation as well.

Aetiology

Organism: Enteroviruses, Herpes Simplex Virus, Epstein-Barr Virus, Nipah and Japanese B encephalitis.

Clinical Manifestations

The onset of the disease is usually abrupt. After a flu like prodrome, there is a rapid deterioration of CNS function and more than 80% of patients laps into coma. The patients commonly have fever, drowsiness, worsening headache, vomiting, confusion and behavioral change. Convulsions and lethargy also develops rapidly. Physical and neurological signs are variable.

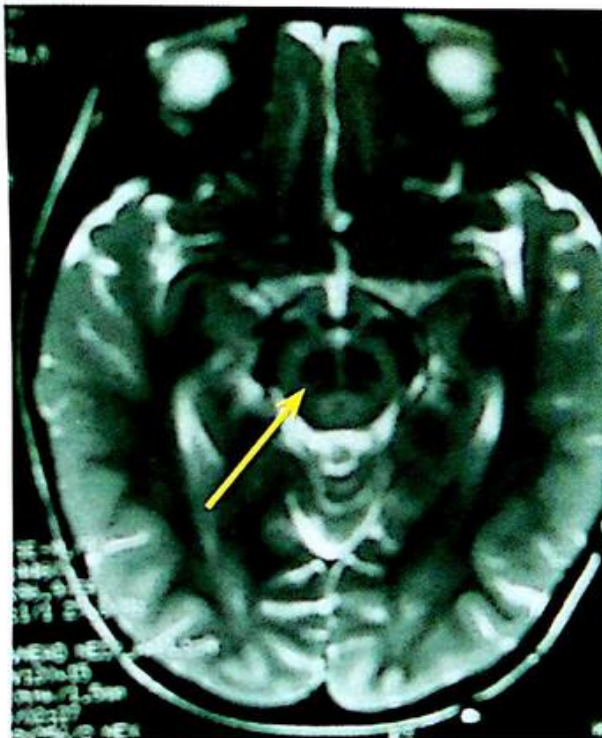
Diagnosis

Based on C/F & relevant investigations.

Investigations

- CSF study
 - * Routine examination

- Modest lymphocytic pleocytosis
- Mild rise of protein
- Glucose level normal
- * PCR for viruses in CSF
- * Antibodies against viruses in CSF
- MRI of brain
 - * Focal change
 - Temporal lobe pathology is seen in Herpes Simplex encephalitis
 - Bilateral thalamic haemorrhage seen as *Eyes of Panda* in Japanese B encephalitis



Panda sign

Courtesy: Dr Narayan Saha

Treatment

Many cases of encephalitis are mild and recover spontaneously. Parents should be counseled about the disease, its natural history and prognosis.

A. Supportive

- Maintenance of airway, breathing and circulation (details given in page 227)
- Control of convulsion : Give Inj. Diazepam 0.5 mg/kg per rectal or 0.2-0.3 mg/kg slow IV for convulsion (if not controlled, treat as per algorithm in status epilepticus)

- Administration of IV fluid : 2/3rd of daily maintenance with -
 - * 10% dextrose in 0.225% NaCl or
 - * 5% dextrose in 0.45% NaCl
 - * Add maintenance dose of K^+ @ 1-2 mmol/kg/day (not to exceed 20-40 meq/L) till patient is NPO
- Give O_2 by nasal cannula (2 L/min) or face mask (3-5 L/min)
- Control temperature with Paracetamol (15 mg/kg/dose 6 hourly) and tepid sponging
- Give NG tube feeding when patient is stable
- Ensure adequate nursing, especially taking care of -

- * Eyes: Apply eye drops & ointment to prevent exposure keratitis. Close the eyes with cotton pad if necessary
- * Mouth: Clear mouth from secretion, apply antifungal drop if required
- * Skin: Change posture 2 hourly. Gentle massage over pressure points to prevent bed sores
- * Bladder: Catheterization if necessary.
- * Bowel: Ensure regular bowel movement. give enema if necessary

- Give appropriate Antibiotic to prevent secondary infection/aspiration pneumonia and UTI

B. Specific

- Inj. Acyclovir, if *Herpes simplex* encephalitis.
 - * For older children: (10 mg/kg/dose) 8 hourly for 14 days
 - * For Neonates: (20 mg/kg/dose) 8 hourly for 21 days

Precautions for contacts and health workers

Close contacts and medical personnel should maintain **standard safety protocols** like hand washing, using gloves and masks while attending the patients.

CEREBRAL MALARIA

(Discussed in the chapter 17)

EPILEPSY/SEIZURES

The commonest neurological disorder affecting 50 million people globally, of which ~ 40 millions are in the developing countries. Over 60% has its onset in childhood.

Definition

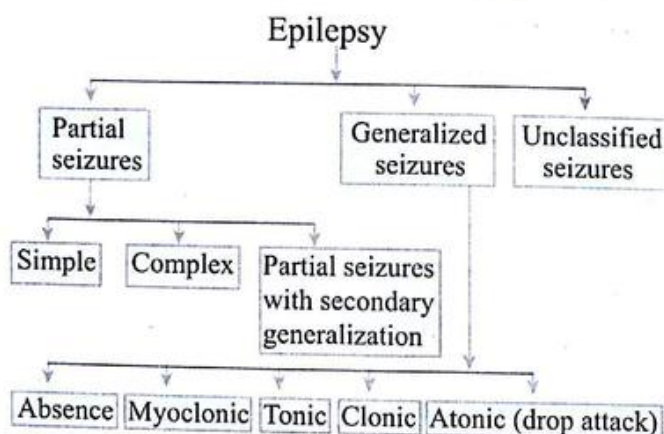
Epilepsy is a paroxysm of central nervous system characterized by altered consciousness with or without convulsion due to abnormal excessive synchronous neuronal discharge. Two unprovoked seizures >24 hours apart suggest the presence of epilepsy.

Aetio-pathogenesis

- * Idiopathic
- * Intrauterine infection *e.g. TORCH, HIV*
- * Abnormal brain development
- * Hypoxic ischaemic encephalopathy
- * CNS infections. *e.g. meningitis*
- * Brain injury & brain tumor
- * Neurometabolic & neurodegenerative diseases
- * Chromosomal disorders *e.g. Fragile X, Trisomies*

Epilepsy: classification

(International League Against Epilepsy, 1981)



A. Partial seizures: Only one cerebral hemisphere is involved and convulsion is noted on one side of the body

Types & characteristics

Types	Characteristics
Simple partial seizure	Seizure involves one side of the body and the <u>patient remains conscious after the seizure</u>
Complex partial seizure	Seizure involves one side of the body but the <u>patient become unconscious</u>
Partial seizures with secondary generalization	Seizure starts on one side of the body & then spreads throughout the whole body

B. Generalized seizures: Here both cerebral hemispheres are involved and seizures are evident on both sides of the body

Types & characteristics

Types	Characteristics
Absence	Sudden interruption of ongoing activities, <u>blank stare, upward rolling of the eyes</u>
Myoclonic	<u>Sudden brief, shock-like muscle contractions</u> , which may be generalized or confined to the face and trunk or one/more extremities or to group of muscles even individual muscle
Tonic	<u>Rigid, violent muscular contraction</u> , fixing the limb in some strained position. There is usually deviation of the eyes and of the head towards one side
Clonic	Repetitive clonic jerks
Atonic (drop attack)	<u>Brief loss in muscle tone lasting for <15 seconds</u> resulting in fall

C. Unclassified seizures *e.g. neonatal seizure, infantile spasm*

Diagnosis

Based on C/F & relevant investigations.

Clinical evaluation

- * Provocation or trigger factors *e.g.*, sleep deprivation, flicking of light, missing or withdrawal of anticonvulsant drugs etc.
- * Warning phase or Aura *e.g.* epigastric pain, abnormal behaviour, feeling of fear/ unwellness, numbness/tingling in the fingers or bright lights in one visual field etc.
- * Febrile or afebrile
- * No. of seizure: Single or recurrent
- * Gap between two seizure events
- * Motor expression *e.g.* atonic, tonic, clonic, myoclonic, athetoid etc.
- * Sensory expression *e.g.* pain, paresthesia
- * Distribution of seizures *e.g.* focal or generalized Responsiveness of the patient *e.g.* alteration in consciousness
- * Duration of seizure attacks
- * Associated features *e.g.* tongue biting, loss of sphincter control etc.
- * Recovery phase *e.g.* post ictal stage (headache, confusion, amnesia, sleep), prompt recovery etc.
- * Milestones of development

Investigations

- Electroencephalogram (EEG) is sometimes diagnostic. A normal EEG does not exclude epilepsy
- Neuro-imaging: It is indicated in all suspected epilepsies where the cause is not obvious after clinical evaluation. MRI of brain is more sensitive than CT scan and is strongly recommended in partial epilepsy

Treatment

Principles of treatment

- Confirm diagnosis and qualify seizure type
- Counseling parents about the nature of the disease, precipitating factors, treatment, importance of regular medications & prognosis
- Selection of suitable anti-epileptic drug (AED): Commonly used AED are

Carbamazepines, Sodium valproate, Phenytoin, Phenobarbitone, Clonazepam etc. depending on the seizure types

Seizure types	Anti-epileptic drug of choice
Partial	CBZ, PHT
GTCS	SVA, CBZ, PHT, PB
Absence	SVA, ESM, CZP, CLB
Myoclonic	SVA, CZP, CLB
Tonic	SVA
Atonic	SVA
Mixed	SVA

CBZ = Carbamazepine, PHT = Phenytoin, SVA = Sodium Valproate, ESM = Ethosuximide PB = Phenobarbitone, CZP = Clonazepam, CLB = Clobazam

Life style modification

Patients should -

- * be away from bright & flashing lights *e.g.* TV, Video games, fire place
- * avoid driving, swimming, climbing tree, etc.

Duration of Treatment & Drug Withdrawal

- If the patient remains seizure free for at least 2 years, the AED may be withdrawn gradually over the next 6-12 weeks. Longer withdrawal for BDZ (6 months / more)

Monitoring of treatment

- Control of seizure (seizure diary)
- Any side effects of drugs

Prognosis

- 70% go into full control of seizure
- 5-10 % of responders may have relapse & remain uncontrolled
- 30 % are "Difficult to treat/control "from outset

Sometimes, true seizures may be confused with pseudo or psychogenic seizures.

The Characteristics of True & Pseudoseizures

Characteristics	Pseudoseizures	Epilepsy: True seizures
Precipitating factors & situations	Often emotional factors. Attacks generally occur in presence of others	No association with presence of others
Movement pattern during the attacks	Variable; no specific pattern	Similar pattern in different episodes
H/O self injury	No	May have <i>e.g. tongue biting</i>
Occurrence in sleep	No	May occur
H/O bowel or bladder incontinence	No	Often present
Recall of details	Generally can	Can not
Consciousness	Preserved; may appear unresponsive but response to painful stimuli	Loss. Unresponsive to pain
Movements	Bizarre, nonsynchronous or may lie motionless or stiffness of limbs for long time	Typical generalized tonic clonic movements
State of child after the ictal phase	No confusion no neurodeficit	Post ictal confusion or Todd's paralysis may occur
Reflexes	No pathological reflexes	Hyperactive deep tendon reflexes and Babinski reflex after seizure
Demonstration on request	Often possible	Not possible
Stop on command	Can often stop	Cannot stop
Secondary gain	Generally present	None

STATUS EPILEPTICUS (SE)

SE is defined as continuous seizure activity or recurrent seizure activity without regaining of consciousness lasting for > 30 minutes. Some authors advocated 5 minutes (rather than 30 minutes) as the time limit.

This is a medical emergency and the major concern is irreversible brain injury.

Precipitating factors

- Underlying neurologic disorders *e.g. CNS infection, tumour or a metabolic abnormality like (hypoglycaemia, hypo or hypernatraemia, hypocalcaemia, hypomagnesaemia)*

- Sudden withdrawal of AED from an epileptic child. It can also happen if the anti convulsants are taken irregularly
- Flushed light *e.g. video game, TV, computer etc.*
- Others *e.g. sleep deprivation, intercurrent infection etc.*

Management

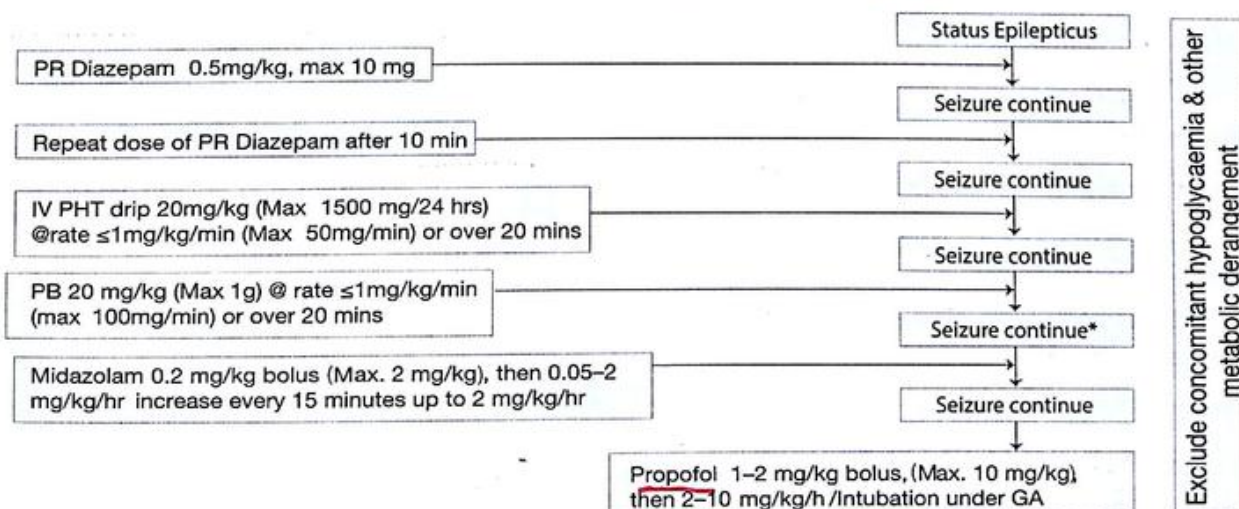
4 Sequential Steps

- * Maintenance of airway, breathing and circulation (ABC)
- * Control of convulsion
- * Search for the cause of status epilepticus
- * Prevention of further convulsion

A. Management of Airway, Breathing and Circulation

	A-Airway	B-Breathing	C-Circulation
ASSESSMENT	- Assess airway by looking at * Nose * Oral cavity * Throat * Pharynx - for any secretion or vomitus that could obstruct the airway.	- Assess breathing by looking * Respiratory rate (<i>Tachypnoea/apnoea</i>) * Flaring of alae nasi * Cyanosis * Chest movement, expansibility and recession * O₂ saturations (SpO₂ <90%)	- Assess circulatory status by looking * Pulse <i>e.g. volume, rate, rhythm</i> * Blood pressure * Pulse pressure * Capillary refill time (> 3 seconds)
ACTION	- Maintain airway by * <u>Clearing the airway</u> of secretions, vomitus by suction with <u>sucker</u> or by <u>finger-sweep</u> maneuver. * <u>Opening up the airway</u> by head tilt-chin lift maneuver (<i>to keep head and neck slightly extended</i>) * <u>Putting airway tube</u> * <u>Endotracheal intubation</u>, may be necessary to maintain the airway	If the patient have dyspnoea or cyanosis * <u>Give O₂ through</u> * Face mask (5L/min) or * Nasal catheter (1-2 L/min) If features of impending respiratory failure * <u>Bag & Mask ventilation</u> or * <u>Endotracheal intubation &</u> * <u>Mechanical ventilation</u>	- Secure an IV line and start IV crystalloid fluid (<u>Baby saline, Junior saline, Normal saline</u>) If patient is in shock <i>e.g. low systolic blood pressure and capillary refill time >3 seconds</i> * <u>Give IV Normal saline bolus</u> (20 ml/kg) rapidly * <u>Reassess</u> and if no improvement repeat the bolus * If shock still persists, give - * <u>Inj. Dopamine (10-20 µg/kg/min)</u> and or * <u>Inj. Dobutamine (10-20 µg/kg/min)</u>

B. Control of Convulsion using the following algorithm



* Give IV glucose, Sodibicarb, antioedema measures (e.g. corticosteroid & mannitol)

* PR- Per rectal; PHT- Phenytoin; PB- Phenobarbitone

Monitoring

- * Clinical e.g. heart rate, blood pressure, capillary refilling time (CRT), SpO_2 , respiratory rate & pattern
- * Laboratory e.g. CBC, glucose, calcium, magnesium, ABG, anti-epileptic drugs level and their appropriate correction
- * Continuous EEG monitoring

C. Search for the cause of SE

- CSF study
- Sepsis screening
- Neuroimaging
- Metabolic screening

D. Prevention of further convulsion

Counseling parents about regular intake of appropriate maintenance anti-epileptic drugs

INTRACRANIAL SPACE OCCUPYING LESIONS (ICSOL)

ICSOL are the 2nd most frequent malignancy among children and adolescents.

Aetiology

- * Unknown mostly
- * Radiation
- * Hereditary syndromes

Pathology

Tumor can occur anywhere inside the cranial cavity e.g. cerebrum, brain stem, cerebellum, etc. Grossly, these are classified as either supratentorial and infratentorial and the clinical presentation are related to the following consequences -

- * Raised intra-cranial pressure (ICP)
- * Focal brain dysfunction
- * Impairment of CSF circulation

Clinical Manifestations

- *Cardinal symptoms of raised ICP*
 - * Headache
 - * Nausea, vomiting
 - * Visual problem
 - * Papilloedema
- *Cranial nerve palsy*
- *Others are non-specific e.g.*
 - * Change in personality, mentation and speech
 - * Disorder of equilibrium, gait and coordination



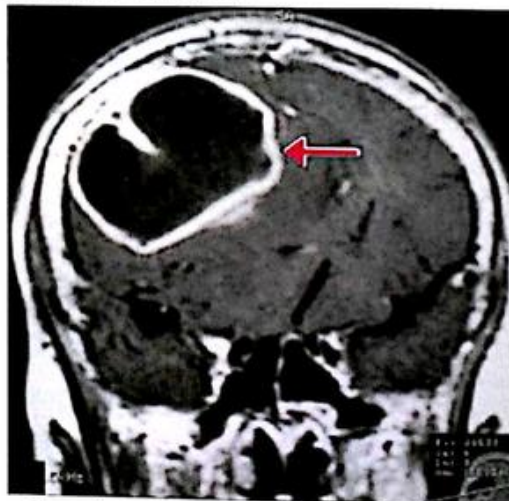
Right 7th cranial nerve palsy

Diagnosis

Based on C/F and relevant investigations.

Investigations

- CT scan/MRI of brain



Coronal section of contrast-enhanced MRI scan showing the lesion

Treatment

According to site and stage of disease. The options are either surgery and/or radiotherapy.

References

1. Waruiru C, Appleton R. Febrile seizure; an update. *Arch Dis Child* 2004; 89: 751-56.
2. Srinivasan J, Wallace KA, Scheffer IE. Febrile seizure. *Australian Family Physician* 2005; 34(12): 1021-25.
3. Mikati MA. Seizures in childhood. In: Kliegman RM, Stanton BF, Geme III JWS, Schor NF Behrman RE. Editors. *Nelson Textbook of Pediatrics*, 20th Edition. New Delhi: Elsevier; 2016: 2823-2856
4. Singhi P. Seizures and epilepsy in children: a practical guide. 1st ed. Publisher Noble Vision; 2008.
5. Aneja S, Aggarwal A. Acute bacterial meningitis: Issues and controversies. In: Dutta AK, Sachadeva A editors, *Advances in Pediatrics*. 1st Ed. Delhi: Jaypee Brothers Medical Publishers ; 2007.p 611-21.
6. Prasad AN, Status Epilepticus in pediatric practice: neonate to adolescent. *Adv Neurol*. 2006; 97:229-43.
7. Moe PG, Benke TA et al. Neurologic and Muscular disorders. *Current Diagnosis and Treatment in Pediatrics*. 18th ed. New York: The McGraw-Hill Companies; 2007.
8. Indian Academy of Pediatrics (IAP) guidelines on diagnosis and management of childhood epilepsy 2006.
9. National Guideline for Tuberculosis in Children of Bangladesh. DGHS, Bangladesh, 1st edition; March 2012.
10. World Health Organization. Pocket book of Hospital Care for Children, Guidelines for the Management of Common Illnesses with Limited Resources; 2010.
11. Lowenstein DH, et al. It's time to revise the definition of SE. *Epilepsia*. 1999; 40:120-122.
12. Swaiman KF. *Pediatric Neurology, Principles & Practice*. 4th ed. USA: Mosby Elsevier; 2006, p. 1098.
13. Kälviäinen R. Status epilepticus treatment guidelines. *Epilepsia*. 2007; 48 Suppl 8:99-102.
14. *Practical Pediatric Neurology*, Prof. Veena Kalra, 2nd edition , Arya publication, Delhi.
15. *Current Treatment Options in Neurology* 2009, 11:262-272.
16. John H Menkes, Harvey B Sarnat, Bernard L Maria. *Child Neurology*. 7th ed. USA: Lippincott Williams & Wilkins; 2006
17. *Current Neurology and Neuroscience Reports* 2009, 9:137-144.

SELF ASSESSMENT

Short answer questions [SAQ]

1. Write down the treatment of 1 year old boy with pyogenic meningitis.
2. How will you manage seizure of a child with status epilepticus?
3. Write down the characteristic feature of febrile convulsion.
4. What are the causes of convulsion without fever? How will you prevent recurrence of febrile convulsion?
5. Write down the clinical feature of pyogenic meningitis.
6. Write down the comparative CSF findings of pyogenic meningitis with TBM.
8. Write down the difference between pseudoseizure & seizure.
9. A 8 months old child admitted with fever for 3 days and several episodes of convulsions for last 1 day. On examination the child was found drowsy and had bulged anterior fontanelle.
 - i) What is the probable diagnosis?
 - ii) Write the relevant investigations with expected findings.
 - iii) Outline the management.
10. How will you differentiate febrile convulsion from meningitis clinically?

Multiple choice questions [MCQ]

1. The characteristic features of normal CSF include
☐ a) colour: straw ☐ b) pressure: 100-300mmH₂O ☐ c) protein: 20-45mg/dl
☐ d) glucose: 40-80mg/dl ☐ e) cell count: 7-10/cumm
2. The conditions present with fever and convulsions are -
☐ a) meningitis ☐ b) cerebral malaria ☐ c) acute stroke syndrome
☐ d) hepatic encephalopathy ☐ e) encephalitis
3. The classic CSF findings of pyogenic meningitis are-
☐ a) hazy appearance ☐ b) neutrophilic leukocytosis ☐ c) normal protein
☐ d) low chloride level ☐ e) low glucose level
4. The precipitating factors of status epilepticus are -
☐ a) hypoglycaemia ☐ b) hypocalcaemia ☐ c) intercurrent infection
☐ d) sleep deprivation ☐ e) sudden withdrawal of antiepileptic drugs
5. Following are the features of typical febrile seizure -
☐ a) seizure persisting >15 minutes ☐ b) occur >once in 24 hours
☐ c) epilepsy is a common sequelae ☐ d) CSF protein is elevated
☐ e) associated with intracranial infection
6. Features of stage 3 TBM are -
☐ a) nonspecific ☐ b) neck rigidity ☐ c) cranial nerve palsy
☐ d) decerebrate rigidity ☐ e) behavioural change
7. CSF finding of TBM are -
☐ a) colour - clear ☐ b) protein -35 mg/dl ☐ c) cells - mostly lymphocytes
☐ d) glucose - 35 mg/dl ☐ e) pressure - elevated
8. The common organisms for childhood (>2 months) meningitis are -
☐ a) *Listeria monocytogen* ☐ b) *H. influenzae* ☐ c) *Pneumococcus*
☐ d) *E. coli* ☐ e) *Meningococcus*
9. Cardinal symptoms of raised ICP
☐ a) Headache ☐ b) Nausea ☐ c) Convulsion
☐ d) Visual problem ☐ e) Cranial nerve palsy
10. Circulatory status can be assessed by at looking
☐ a) O₂ saturation ☐ b) Blood pressure ☐ c) Pulse pressure
☐ d) Cardiac murmur ☐ e) Capillary refill time
11. Drug of choice for absence seizure include
☐ a) Sodium Valproate ☐ b) Ethosuximide ☐ c) Phenobarbitone
☐ d) Clonazepam ☐ e) Clobazam
12. Common metabolic abnormalities that can cause seizure include
☐ a) hypoglycaemia ☐ b) hypernatraemia ☐ c) hypocalcaemia
☐ d) hypochloremia ☐ e) hypomagnesaemia

DEVELOPMENTAL DELAY

DEVELOPMENTAL DELAY	245
CONGENITAL HYPOTHYROIDISM	246
DOWN SYNDROME	248

DEVELOPMENTAL DELAY

Developmental delay refers to late or absent acquisition of expected developmental milestones for any reason.

Types of Developmental Delay

Isolated	Delay restricted to a particular domain <i>e.g. speech and language, motor etc.</i>
Global	Significant delay in ≥ 2 domains

Intellectual disability (ID)

Intellectual disability (once called mental retardation) is a clinical situation, characterized by significant limitation in both (a) Intellectual functioning (refers to general mental capacity such as learning, reasoning, problem solving etc.) & (b) Adaptive behavior (such as conceptional, social and practical skills) which affect many everyday's social and practical skills.

Intellectual disability originates before 18 years of age and its severity is categorized by measuring IQ status of the child.

[Normal Reference value: IQ 85-114: average intelligence; IQ 70-84: borderline intelligence; IQ 55-69: mild ID; IQ 40-54: moderate ID; IQ 25-39: severe ID and IQ < 25: profound ID]

Learning disability (LD)

It is a neurological disorder that affects the brain's communication channels e.g. its ability to receive, process, store and response to information. People who have LD generally have average or above-average IQ. The specific learning disabilities are dyslexia (problems in reading), dyscalculia (problem in mathematics), dysgraphia (problems in writing) etc.

When to suspect Developmental Delay?

If a child has not achieved -

Parameter	by
Social smile	3 months
Neck control	5 months
Sits without support	12 months
Stands without support	18 months
Walks well	20 months
2-3 words sentence	36 months
Tells self name	48 months
Toilet control	60 months

When a child is brought with history of delay in achieving age appropriate developmental milestone, one should consider the following diseases as the cause of developmental delay -

- * Idiopathic
- * TORCHS infection
- * Chromosomal abnormalities *e.g. Down syndrome, Klinefelter's syndrome, Fragile X syndrome*
- * Genetic disorders *e.g. Hurler syndrome, phenylketonuria*
- * Endocrine disorders *e.g. congenital hypothyroidism*
- * Perinatal asphyxia (*hypoxic ischaemic encephalopathy*)
- * CNS infections *e.g. meningitis, encephalitis*
- * Protein energy malnutrition

In this chapter, Congenital Hypothyroidism, Down syndrome will be discussed.

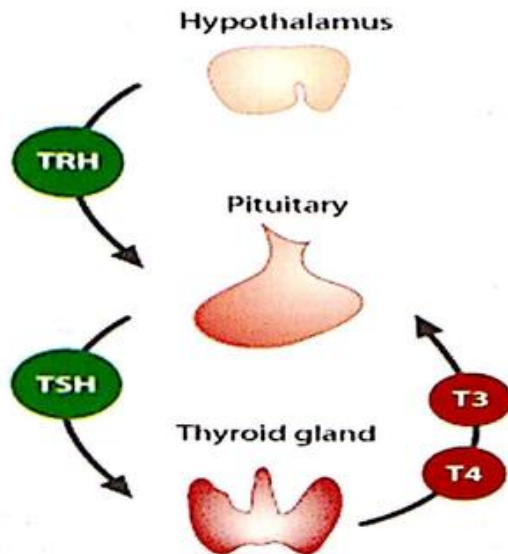
HYPOTHYROIDISM

It is a clinical condition arising from deficient production or deficient receptor activity of thyroid hormones.

Aetiology and Classifications

A. Based on the site of pathology

- Primary: Pathology is in thyroid gland with deficient production of thyroxine but rise of S. TSH
- Secondary: Pathology is in pituitary gland with deficient production of both TSH as well as thyroxine



- Tertiary: Pathology is in hypothalamus with deficient production of TRH, TSH & T4

B. Based on the time of onset of illness

Congenital	Acquired
* Aplasia, hypoplasia or ectopy of thyroid gland * Inborn errors of thyroid hormone biosynthesis * Insensitivity of the tissue receptors to thyroid hormone	* Autoimmune thyroiditis * Endemic iodine deficiency * Exposure to goitrogen * Irradiation or surgery to thyroid gland

CONGENITAL HYPOTHYROIDISM

Clinical Manifestations

One should suspect congenital hypothyroidism if a newborn presents with -

- Delayed passage of meconium (>24 hours after birth)



Prolonged jaundice & protruded tongue

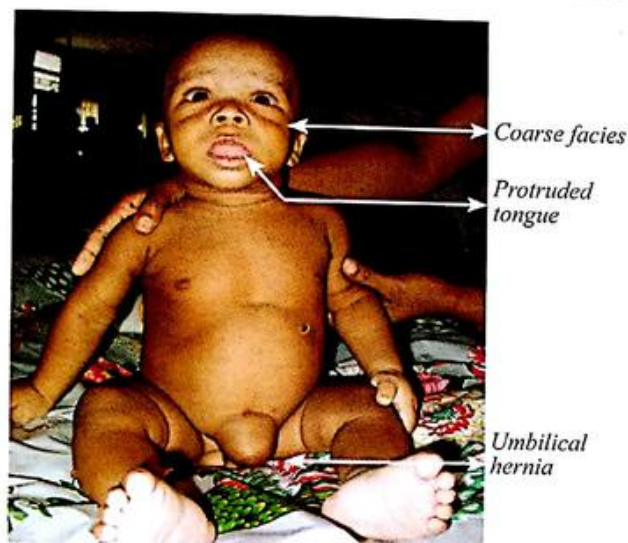
- Prolonged jaundice (jaundice persists beyond 2 weeks of age)

- Refractory constipation
- Little cry, somnolence, excessive sleepy
- Feeding difficulties
- Coarse facies *e. g. protruded tongue, puffy eye lids, wrinkled forehead, depressed nasal bridge*

Physical Examination

Head	* Normal head size with widely open anterior and posterior fontanells * Hair dry & scanty
Face	* Coarse with wrinkled forehead and low hairline * Large tongue protruding from the mouth * Depression of nasal bridge * Delayed dentition * Swollen eyelids with narrow palpebral fissures
Neck	* Appears short because of the presence of myxoedematous pads of fat above the clavicles
Skin	* Feels dry, thick, cold and mottled (<i>cutis marmorata</i>)
Abdomen	* Distended and umbilical hernia
Hands & fingers	* Broad and stumpy
Muscles	* Muscles are usually hypotonic * Ankle jerk shows slow relaxation
CVS	* Pulse slow * Cardiomegaly, murmur * Pericardial effusion

Growth and development	* Markedly stunted * Maintain infantile body proportion * Milestones of developments are delayed * Sexual maturation is delayed or may not take place at all
Intelligence	* Mentally retarded. About 20% have sensory neural hearing loss



Typical profiles of a child with congenital hypothyroidism

• Anthropometry

- * Length or height (*stunted*)
- * Ratio of upper to lower body segments reveals infantile body proportion (disproportionate short stature)

Normal body proportion at different ages

- At birth: 1.7:1
- At 6 years: 1.4:1
- At 11 years: 1:1



Short stature compared to a normal child of same age and sex

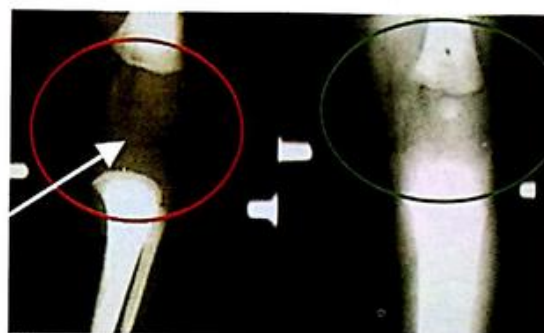
Courtesy: Dr Laila Yeasmin

Diagnosis

Based on characteristic symptoms, classical physical findings & relevant investigations.

Investigations

- Serum FT4, TSH: Low FT4 and high TSH (Primary hypothyroidism). If both TSH and FT4 are low, then problem is in pituitary gland
- Thyroid Scan: Iodine-123 (I-123) or Sodium pertechnetate 99 m (Tc99 m) uptake and scan: To detect an ectopic gland, thyroid hypoplasia or thyroid aplasia
- Thyroid ultrasonography: To assess the anatomy of thyroid whether enlarged or absent glands
- Skeletal survey:
 - * Absent distal femoral and proximal tibial epiphyses which is supposed to present at 36 weeks of gestation
 - * Epiphyseal dysgenesis for older children



Absent

Normal



Dysgenetic femoral epiphysis

These radiological findings give clues to the diagnosis where thyroid hormone assay is not readily available.

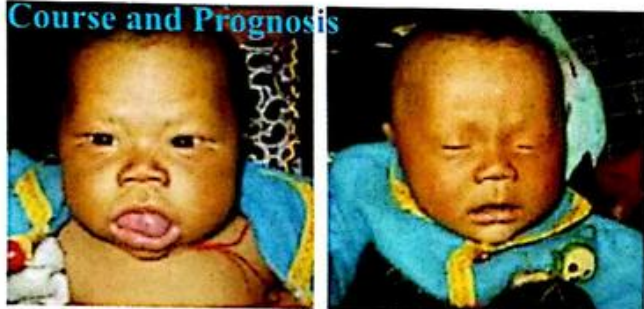
Treatment

- Counseling parents about the consequences of untreated cases and the importance of regular continuation of treatment with Thyroxine
- Drugs: Sodium L thyroxine. This is specific for hypothyroidism and should be started as soon as possible after birth or at diagnosis

Dose and Duration

Age group	Dose	Duration
Neonate	10 – 15 microgram/kg/day	Life long
Beyond neonatal period	4 microgram/kg/day	

Course and Prognosis



Profile before and 2 weeks after treatment

It depends on the age at which the treatment is started. Early therapy within first week of life gives a greater chance for normal linear growth and intellectual achievement. But delay to start therapy even by 2 months may cause significant intellectual disability.

Follow up

A. Biochemical: Check FT4 and TSH levels in the following schedule-

Age of baby	Frequency
0-6 months	Every 6 weeks
6 months-3 years	Every 3 months
> 3 years	6 monthly
6-8 weeks after any dosage change	

B. Clinical assessment including height, development and hearing

- Expected response in weeks -
 - * Regular bowel movement
 - * Reductions in weight and puffiness
 - * Increases in the pulse rate
- Expected response in months
 - * Reduction in hoarseness of voice
 - * Correction of anaemia
 - * Changes in skin and hair

How to identify congenital hypothyroidism at the earliest?

Neonatal screening

It is aimed to detect cases of congenital hypothyroidism immediately after birth so as to start treatment early to prevent irreversible damage of the brain of the affected children.

Method	Filter paper spot technique by heel prick
Timing	After 3 - 5 days of birth *
Results	FT4: <7 microgram/dl TSH: > 40 mU/ml Borderline TSH level (20-40 mU/ml): should be repeated
* To avoid false positive result due to physiological surge of TSH causing increased T4 upto 48 hours	

DOWN SYNDROME

Commonest chromosomal anomaly. The overall incidence is about 1 in 700 live births and incidence increases with advancing maternal age.

Aetio-pathogenesis

The exact cause is not known. The disease is characterized by the presence of an **extra copy of genetic material on chromosome no. 21** either whole or in part and occur in 3 ways-

- * Chromosomal non-disjunction (occurs in 95% of cases)
- * Robertsonian translocation (occur in 4% of cases)
- * Mosaicism (occurs in 1% of cases)

Clinical Manifestations

Regions	Features
Head & face	Brachycephaly, microcephaly, flat nasal bridge
Eyes	Upward slanting of palpebral fissure, epicanthic fold, Brush field spot, congenital cataract
Ears	Low set ears, chronic otitis media (glue ears)
Oral cavity & Teeth	Macroglossia, dental abnormalities like malposition and enamel hypoplasia etc.
Hands & feet	Broad and short hands, clinodactyle (short, incurved little fingers), single palmar crease (simian crease) increased gaps between 1st and 2nd toes and planter crease between them in the sole
Neuro-psychologic	Intellectual disability (IQ ranges from 20-75, average 50), delay in milestones of development, affinity for music
Muscle	Generalized hypotonia
Endocrine	Hypothyroidism
Sexual development	Delay in development of secondary sexual characteristics. Adult males are infertile but females are fertile



Brachycephaly



Upward slanting of palpebral fissure



Simian crease



Crease between 2nd and great toe

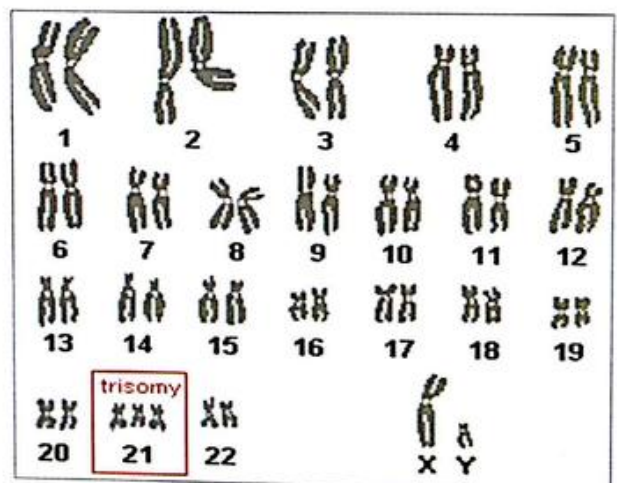
Associated illnesses

- Congenital heart diseases *e.g.* VSD, AV canal defect
- GIT anomalies *e.g.* Hirschsprung disease, duodenal atresia, increased chance of coeliac disease
- Frequent infections *e.g.* recurrent respiratory tract infections
- Malignancy *e.g.* increased chance of leukaemia (10-20 times more chances)
- Musculoskeletal *e.g.* atlanto-occipital subluxation, dislocation of hip

Diagnosis

Usually made on the basis of -

- Typical clinical features
- Karyotyping: Confirmatory



Karyotyping showing trisomy 21

Management

- Counseling parents about the problem
- Early & regular stimulation of the child *e.g.* exposure to games, music etc.
- Treatment of any associated illness *e.g.* cardiac problems, infections, thyroid replacement etc.
- Special education and occupational training to overcome mental subnormality

Prognosis

Around 20% patients die within 1st year, 45% survive up to 60 years of age and many of them suffer from Alzheimer's disease at 40-50 years of age.

References

1. Scott M. Myers and Chris Plauché Johnson, Management of Children with Autism Spectrum Disorders. *Pediatrics*. 2007;120:1162.
2. Lectures of Indrani Basu, Autism Society West Bengal.
3. Brasic JR, Pataki C. Autism Treatment & Management, [Internet]. 2011[updated 2012 May 4; cited 2012 May 18]. Available from: <http://emedicine.medscape.com/article/912781-treatment>.
4. Kalra V. *Practical Paediatric Neurology*, 2nd ed. New Delhi: Arya Publications; 2008, p. 227-230.
5. Autism, [Internet]. 2011[updated 2010 May 27; cited 2011 Dec 18]. Available from: <http://www.mayoclinic.com/health/autism/DS00348>.
6. Clinical Practice Guideline: Treatment of the School-Aged Child with Attention-Deficit/Hyperactivity Disorder. *Pediatrics* 2001 October;108 (4): 1033-1044.
7. American Psychiatric Association. *Diagnostic and Statistical Manual of Mental Disorders*, Fourth Edition, Text Revision. Washington, DC: APA Press; 2000:41-9.
8. Huang SA, LaFranchi S. Congenital Hypothyroidism. In: Kliegman RM, Stanton BF, Geme III JWS, Schor NF, Behrman RE. Editors. *Nelson Textbook of Pediatrics*, 20th Edition. New Delhi: Elsevier; 2016:2684-2685.
9. Molla MR. *The Concise Textbook of Pediatrics* 2nd edition, Dhaka: Child Friendly Publications, 2007.
10. Elias ER, Tsai CH et al. Genetic and dysmorphology. In: Hay WW, Levin MJ, Sondheimer JM, Deterding RR, editors. *Current Diagnosis and Treatment in Pediatrics*. 18th ed. New York: The McGraw-Hill Companies; 2007. P. 1031-32.
11. Hutchinson JH, Cockburn F. *Practical Pediatric Problems*. 6th ed. Singapore: PG Asian Economy Edition; 1989.
12. The status epilepticus working party, the treatment of convulsive status epilepticus in children, *Arch Dis Child*, 2000; 83: 415-19

SELF ASSESSMENT

Short answer questions [SAQ]

1. Write down the clinical manifestation of Cong. Hypothyroidism.
2. Name the investigations of Cong. hypothyroidism.
3. Write down the typical clinical features of Down syndrome.
4. Write short note on : Mental Retardation.

Multiple choice questions [MCQ]

- Features of Down syndrome are-

☐ a) brachycephaly	☐ b) hypotonia	☐ c) Brush field spots in eyes
☐ d) downward slanting of palpebral fissures	☐ e) incurving of little fingers	
- Features of congenital hypothyroidism are -

☐ a) irritability	☐ b) constipation	☐ c) prolonged physiological jaundice
☐ d) coarse wrinkled forehead	☐ e) appearance of lower femoral epiphyses at birth	
- Cardinal biochemical & radiological features of primary hypothyroidism are-

☐ a) delayed bone age	☐ b) epiphyseal dysgenesis	☐ c) low TSH
☐ d) low FT4	☐ e) low T3 level	
- A 10 month old boy is admitted because he can not sit yet. On examination, you noted that he is hypotonic, his eyes are slanted upwards and have epicanthic folds -
Choose the most common mechanism from the chart given below is associated with the child's problem

☐ a) translocation	☐ b) non-dysjunction	☐ c) mosaicism
☐ d) single gene mutation	☐ e) deletion	
- A 4 weeks old baby is brought to you because of persistent yellow face and sclera and constipation. The following investigations are relevant to reach a diagnosis of the baby's problem

☐ a) X-ray knee joint	☐ b) X-ray wrist joint	☐ c) Serum TSH estimation
☐ d) karyotyping	☐ e) Serum growth hormone estimation	
- A 3 week old baby is admitted with persistent jaundice. The following clinical features are relevant for congenital hypothyroidism -

☐ a) brachicephaly	☐ b) noisy respiration	☐ c) excessive sleepiness
☐ d) Simian crease	☐ e) constipation	
- The following features are characteristics of congenital hypothyroidism of 5 years old boy

☐ a) short stature	☐ b) 5 carpal bones	☐ c) Brush field spots
☐ d) epiphyseal dysgenesis	☐ e) upper segment to lower segment of body ratio of 1.7: 1	

ABNORMAL BEHAVIOUR

COMMON PSYCHIATRIC DISORDERS	253
AUTISM	254
ATTENTION DEFICIT HYPERACTIVITY DISORDER	255

Whenever a child is brought with abnormal behaviour or any deviation from age appropriate behaviour *e.g. restlessness, lack of interaction, poor communication etc.* then one should consider the possibilities of psychiatric problems. Among children, the following are the common psychiatric disorders.

1. Habit disorders
 - a. Head banging
 - b. Body rocking
 - c. Thumb sucking
 - d. Nail biting
 - e. Hair pulling (Trichotillomania)

- f. Teeth grinding (Bruxism)
- g. Temper tantrums
- h. Tics
- i. Masturbation & sex interest
- j. Breath-holding attacks

- 2 Eating disorders *e.g. rumination, pica, bulimia, anorexia nervosa*
- 3 Elimination disorders *e.g. encopresis, enuresis*
- 4 Sleep disorders *e.g. dyssomnia, parasomnia*
- 5 Psychosomatic disorders *e.g. dissociate or conversion disorder, school phobia*
- 6 Pervasive developmental disorder *e.g. autism spectrum disorder (ASD)*
- 7 Learning disorder *e.g. attention deficit hyperactivity disorder (ADHD), dysfluency, intellectual disability*

In this chapter, we will discuss autism and

attention deficit hyperactive disorder. The cardinal features of some of the psychiatric problems are also highlighted in a table.

Cardinal features of common Psychiatric disorders in children

Disorders	Clinical features
Pica	Persistent eating of non nutritive substances <i>e.g. plaster, charcoal, clay, ashes, paint, earth etc.</i>
Thumb sucking	Normal among infants and toddlers but if continued then it is considered as habit disorder. Thumb sucking provide a pleasurable sensation. This habit may interfere with dental alignment, may increase the incidence of helminthiasis. A bitter solution may be applied on the thumb to control thumb sucking & anthelmintics may be given
Head banging	Banging of head against the bed or wall when the child is under stress
Body rocking	Body rocking against bed during stress
Nail biting	Nail biting is an expression of anxiety, but if it is not associated with other symptoms, it should not be a matter of concern
Teeth grinding / Bruxism	May be associated with anxiety. Persistent bruxism can manifest as dental occlusion defect, muscular or temporomandibular joint pain
Hair pulling / Trichotillomania	Release of tension after hair pulling. Irregular areas of hair loss commonly seen over, occipital and parietal area of scalp and eyebrows or eyelashes

Temper tantrums	Is an expression of anger and frustration. In this condition child lying or throwing himself down, kicking, screaming, throwing things or hitting
Tics	Sudden, rapid, recurrent, nonrhythmic, stereotype motor movement or vocalization <i>e.g. eye blinking, neck jerking, shoulder shrugging, cough, throat clearing</i> . Can be controlled voluntarily. Absent during sleep or physical activity and exacerbated during emotional stress
Breath-holding spells	Following a trauma or an emotional stress, the child cries briefly & holds the breath in expiration. This events may be cyanotic or acyanotic. The spell may resolve or the child may develop convulsion or become unconscious. No specific treatment is necessary or effective. Parents should be reassured
School phobia	School phobia is caused by unwarranted fear or inappropriate anxiety about leaving home or in particular, the child's mother. The phobia is often accompanied by a vague abdominal pain or headache alleviated by school absence
Enuresis/Bed-wetting	Voiding of urine into clothes or bed twice or more in a week for at least three consecutive months after 5 years of age
Encopresis	Encopresis is usually defined as voluntary or involuntary passage of feces into inappropriate places at least once a month for 3 consecutive months, in the absence of any physical pathology after 4 years of age. Encopresis is 4-5 times more common in boys than in girls and tends to decrease with age

AUTISM

Autism is a disorder of neural development, characterized by -

- Impaired social interaction & communication, and
- Restricted and repetitive behavior

Aetiology

- Mostly unknown
- Genetic
- Other risk factors include -
 - * Prenatal rubella or cytomegalovirus infection of mother
 - * Advanced age in either parent
 - * Gestational diabetes
 - * Use of psychiatric drugs by the mother during pregnancy

Clinical Characteristics

Social interaction	* Fails to respond to his or her name * Resists cuddling and holding * Unaware of others' feelings * Seems to prefer playing alone - lives in his/her "own world"
Behaviour	* Starts talking later than age 2 * Loses previously acquired ability to say words or sentences * Doesn't make eye contact upon requests * May use a singsong voice or robot-like speech while talking * Can't initiate a conversation or keep one going * May repeat words or phrases
	* Performs repetitive movements, such as rocking, spinning or hand-flapping * Develops specific routines or rituals * Disturbed at the slightest change in routines or rituals * Moves constantly * May be fascinated by parts of an object, such as the spinning wheels of a toy car * May be unusually sensitive to light, sound and touch and yet oblivious to pain

Diagnosis: Mainly clinical.

Screening tools

1. Modified Checklist for Autism in Toddlers (MCHAT)
2. Communication and Symbolic Behavioral Scale (CSBS)

Diagnostic Tool

1. Autism Diagnosis Observation Schedule (ADOS)
2. Autism Diagnostic Interview Revised (ADI-R)

Management

Current interventions include

- Psychoeducational and behavioral interventions e.g.
 - * Teach-treatment and education of autistic and related handicapped children
 - * Applied behavioral analysis communication
 - * Alternative communication
 - * Social skill technique
 - * Parental involvement
- Psychopharmacological *e.g. antidepressants, selective serotonin reuptake inhibitors, beta blockers, mood stabilizers etc.*
- Others *e.g. megavitamin therapy, gluten and casein free diet, sensory and auditory integration etc.*

ATTENTION-DEFICIT HYPERACTIVITY DISORDER (ADHD)

ADHD is one of the most common neuro behavioural disorders of childhood characterized by an age inappropriate hyperactivity, impulsiveness and inattention.

Clinical Characteristics

Inattentiveness	• Difficult to hold and soothe as an infant • Careless mistakes at school • Easily distracted • Unable to finish tasks • Does not follow instructions
Hyperactivity	• Don't remain still in the classroom • Cannot sustain attention for either play or work • Excessive running /climbing • Talks excessively
Poor impulse control	• Blur out answer before questions have been completed • Risky acts without considering consequences

Diagnosis: Mainly clinical.

Screening tools

1. Conner's Rating Scales
2. ADHD Rating Scale
3. Vanderbilt ADHD Rating Scale
4. Child Behavioral Checklist

Management

- Behavioural therapy: parents are taught how to –
 - * Reinforce positive behaviour by praise or by using daily contingency charts
 - * Extinguish negative behaviours by active ignoring
- Pharmacotherapy includes
 - * Methylphenidate (5-20 mg bd)
 - * Atomoxetine (0.5 mg/kg/day OD)

References

1. Scott M. et al. Management of Children with Autism Spectrum Disorders. *Pediatrics*. 2007;120:1162.
2. Lectures of Indrani Basu, Autism Society West Bengal.
3. Brasic JR, Pataki C. Autism Treatment & Management, [Internet]. 2011 [updated 2012 May 4; cited 2012 May 18]. Available from: <http://emedicine.medscape.com/article/912781-treatment>.
4. Autism, [Internet]. 2011 [updated 2010 May 27; cited 2011 Dec 18]. Available from: <http://www.mayoclinic.com/health/autism/DS00348>.
5. Clinical Practice Guideline: Treatment of the School-Aged Child with Attention-Deficit/Hyperactivity Disorder. *Pediatrics* 2001 October;108 (4): 1033-1044.
6. American Psychiatric Association. Diagnostic and Statistical Manual of Mental Disorders, 4th ed, Text Revision. Washington, DC: APA Press; 2000:41-9.
7. Molla MR. The Concise Textbook of Pediatrics 2nd ed, Dhaka: Child Friendly Publications, 2007.
8. Khan MR, Rahman ME. Essence of Pediatrics. 4th ed. Elsevier; 2011, Nutritional Problems; p. 72-84.
9. Kahan S. et al. Autism Spectrum Disorder In A Page Pediatrics, 2nd ed. 2008; 346-47.
10. Parthasarathy A. et al. IAP Textbook of Pediatrics. 5th ed. New Delhi: Jaypee Brothers; 2013. P 394-95.

SELF ASSESSMENT

Short answer questions [SAQ]

1. What are the common psychiatric disorders in children?
2. Write down the characteristics of autistic child
3. Mention the etiology of autism.
4. How will you treat a child with autism?
5. Write down the clinical manifestation of ADHD
6. Write down the treatment plan of a child with ADHD

Multiple choice questions [MCQ]

1. Habit disorders are

☐ a) Autism	☐ b) Head banging	☐ c) Trichotillomania
☐ d) ADHD	☐ e) Breath holding attacks	
2. In autism

☐ a) Impaired social interaction & communication	☐ b) Language development is normal
☐ c) Restricted & repetitive behavior	☐ d) there may be underlying organic causes
☐ e) fails to response to his/her name	
3. Characteristics features of ADHD

☐ a) Inattentiveness	☐ b) hyperactivity	☐ c) Restricted & repetitive behavior
☐ d) poor impulse control	☐ e) Lack of communications	

SHORT STATURE

NORMAL VARIANTS SHORT STATURE	257
GROWTH HORMONE DEFICIENCY	258
TURNER SYNDROME	259

Whenever a child presents with short stature (*i.e. the child's height is more than -2 SD's for age and sex*), one should consider the following causes. The causes can be brought under two headings-

A. Normal variants

- (i) Familial (genetic) short stature
- (ii) Constitutional growth delay

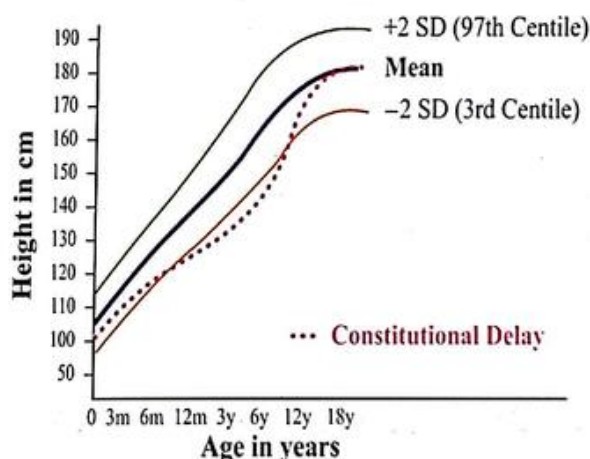
B. Pathological causes

- (i) Idiopathic short stature
- (ii) Endocrinopathies *e.g. growth hormone deficiency, thyroid hormone deficiency, diabetes mellitus, diabetes insipidus, cushing syndrome*
- (iii) Psychogenic *e.g. psychosocial deprivation*
- (iv) Nutritional deficiency *e.g. malnutrition, rickets*
- (v) Chronic illnesses *e.g. inflammatory bowel disease, coeliac disease, chronic kidney disease*
- (vi) Chromosomal abnormalities *e.g. Down syndrome, Turner syndrome, Noonan syndrome*
- (vii) Skeletal dysplasias *e.g. achondroplasia, mucopolysaccharidosis*

In this section, we will discuss familial short stature, constitutional delay, GH deficiency and Turner syndrome. The other causes of short stature like hypothyroidism, rickets, CKD, Down syndrome, malnutrition etc. are discussed in other sections.

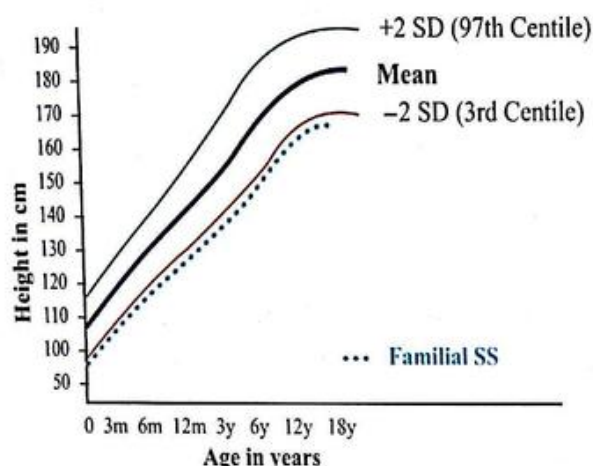
CONSTITUTIONAL GROWTH DELAY

In this condition, babies are born with normal size and grow normally during the 1st few months of life. However, between 6-36 months of age, their growth rate slows for no apparent reason and falls below 3rd centile and continues to grow below 3rd centile. In later part of puberty, growth spurt occur and growth curves re-enter above 3rd centile and results in achieving normal adult height as well as sexual development. The bone age as well puberty is delayed but height age (*the age at which the existing height of the child falls on 50th centile*) corresponds with bone age.



FAMILIAL SHORT STATURE (FSS)

In this condition, short stature of the child is considered to be the influence of parent's height (*genetic influence*). Children with FSS have short parents and the child's height commensurate with his/her genetic potential. They are born small and adopt a place below 3rd centile and continue to grow along that channel with a normal growth velocity. Their bone ages as well as puberty are age appropriate but height age is less. The adult height is short but consistent with the familial pattern.



To determine the causes of short stature either genetic or others is evaluated at bedside by calculating & interpreting mid parental height (MPH)

MID PARENTAL HEIGHT (MPH)

It is the average height of both father and mother. Since men are genetically pre determined to be taller than women by about 13 cm, one must add 13 cm to mother's height before averaging it with fathers height to calculate MPH for a boy. On the other hand calculating MPH for a girl 13 cm need to be subtracted from the father's height, before averaging it with mother's height. Thus formula for MPH is as follows:

MPH for a boy

$$\frac{\text{Fathers height} + (\text{mother's height} + 13 \text{ cm})}{2}$$

MPH for a girl

$$\frac{(\text{Father's height} - 13 \text{ cm}) + \text{mother's height}}{2}$$

From this MPH, we calculate **target height** by following formula: $\text{MPH} \pm 8.5 \text{ cm}$

Then target height is plotted on child's growth chart corresponding to 18 years.

Next the existing height of the child is plotted on the growth chart & **projected height** is determined by a curved line parallel to 3rd centile joining the existing height & the anticipated adult height at **18 years** of age.

If the projected height of the child falls below the range of target height, then it is **true** or

pathological short stature but if child's projected height, falls within the target height then it is considered as **genetic short stature**.

GROWTH HORMONE DEFICIENCY

Aetiology

- Idiopathic
- Secondary *e.g. CNS irradiation, histiocytosis, craniopharyngioma*

Clinical Manifestations

- Short stature (slow growth)
- Features of pituitary insufficiency *e.g. manifestation of adrenal, thyroid and gonadal insufficiency*
- Features of raised ICP as in pituitary tumor *e.g. headache, vomiting, visual disturbances, polyurea, seizure etc.*

Diagnosis

Based on C/F & relevant investigations.

Investigations

Parameters	Results
* X-ray wrist & hand	* Bone age is delayed than chronological age
* RBS	* Low
* CT/MRI of brain	* Calcification/tumor of pituitary region
* Insulin like growth factor-1	* Decreased (if normal, it excludes GH deficiency)
* Growth hormone provocation test	* Confirmatory

Treatment

- Replacement therapy with recombinant human growth hormone (rhGH)

Dose & administration: 0.07 - 0.1 IU/kg/day, given daily/every alternate day subcutaneously at night till adequate growth.

TURNER SYNDROME

Karyotype: 45X0

Incidence: 1 in 2500- 3000 female births

Sex: Female

Aetiopathogenesis

It is caused by a missing or incomplete X chromosome. Some of the genes on the X chromosome are involved in growth and sexual development and that is why girls with the disorder are shorter than normal and have incompletely developed sexual characteristics.

Clinical Manifestations

- Short stature
- Characteristic features

Regions	Features
Eyes	Inner canthal folds, ptosis, blue sclerae
Ears, Nose, Mouth	Low-set prominent auricles, high arch palate, narrow mandible
Neck	Low posterior hairline, webbing
Chest	Shield chest <i>e.g. Broad, widely spaced nipples</i> . Pectus excavatum
Skeleton	Short stature, cubitus valgus, short fourth metacarpal and/or metatarsal, scoliosis, hypoplastic nails
Hand & Feet	Lymphoedema of hand and feet (at birth)



Newborn with oedema of leg and foot

Courtesy: Dr Iffat Ara Shamshad



Webbing of neck



Newborn with oedema of hand

Courtesy: Dr Iffat Ara Shamshad



Low posterior hair line

Courtesy: Dr Malika Alam

Associated defects

- Learning disabilities
- Delayed pubertal development/failure of sexual maturation
- Congenital heart diseases *e.g. coarctation of aorta*
- Renal malformations *e.g. horse-shoe kidney*
- Hypothyroidism & diabetes mellitus
- Ovarian failure and infertility

Diagnosis

Based on C/F & relevant investigations.

Investigation

Karyotyping: confirmatory



Source: Internet

Treatment

- Counseling parents about the disease
- Growth hormone replacement, beginning at 3-4 years of age
- Female sex hormone (Oestrogen & Progesterone) replacement in adolescence



Widely spaced nipples



Newborn with webbing of neck and low-set ear

References

1. Cohen P, Rogol AD, Deal CL, et al. Wit JM: 2007 ISS Consensus Workshop participants. Consensus statement on the diagnosis and treatment of children with idiopathic short stature: a summary of the Growth Hormone Research Society, the Lawson Wilkins Pediatric Endocrine Society, and the European Society for Paediatric Endocrinology Workshop. *J Clin Endocrinol Metab.* 2008;93:4210-4217.
2. Melissa L. Loscalzo, Turner Syndrome. *Pediatrics in Review.* 2008;29:219-27.
3. Maria G. Vogiatzi, Kenneth C. Copeland. The Short Child. *Pediatrics in Review* 1998;19:92-9.
4. Turner syndrome 2011[updated, 2011 August 20; cited 2011 Dec 18]. Available from: in <http://www.mayoclinic.com/health/turner-syndrome/DS01017>.
5. Agarwal KN et al. The Growth: Infancy to adolescence, 2nd ed '2007, CBS Publisher New Delhi. pp50-60

SELF ASSESSMENT

Short answer questions [SAQ]

1. Name five important causes of short stature.
2. How will you diagnose and treat a child with Turner syndrome?
3. What are the common physical findings of Turner syndrome?
4. A 10 years old girl presented with short stature
 - a) Write down 5 important differentials
 - b) What relevant history will you expect?
 - c) How will you investigate the child?

Multiple choice questions [MCQ]

1. The major clinicopathological outcome of Turner syndrome are

☐ a) diabetes mellitus	☐ b) short stature	☐ c) renal failure
☐ d) infertility	☐ e) hypothyroidism	
2. Turner's syndrome is characterized by

☐ a) female dominance	☐ b) Tall stature	☐ c) 45XO karyotype
☐ d) absence of anti-androgen therapy response		☐ e) hypertension
3. The characteristic clinical features of Turner's syndrome are

☐ a) shield chest	☐ b) infertility	☐ c) webbing of neck
☐ d) simian crease	☐ e) brushfield spots	
4. The following are the normal variant short stature

☐ a) constitutional growth delay	☐ b) genetic short stature	☐ c) GH deficiency
☐ d) psychosocial deprivation	☐ e) achondroplasia	

DIFFICULTIES IN MOVEMENT AND POSTURE

CEREBRAL PALSY	262
DUCHENNE MUSCULAR DYSTROPHY	264
WILSON DISEASE	266

When a child presents with difficulties in movement & posture i.e. activity limitation, one should consider cerebral palsy (CP) as the commonest possibility.

However, diseases of muscles *e.g. Duchenne muscular dystrophy (DMD)* and of brain & spinal cord *e.g. spinocerebellar ataxia, subacute sclerosing panencephalitis (SSPE), Wilson disease, adrenoleukodystrophy etc.* also gives rise to such presentation.

In this chapter CP, DMD and Wilson disease will be highlighted.

CEREBRAL PALSY (CP)

Cerebral palsy is a diagnostic term used to describe a group of permanent disorders of movement and posture causing **activity limitation**, that are attributed to non-progressive disturbances/insults in the developing foetal & infant brain.

Although the brain damage involves the motor system predominantly, it is often accompanied by disturbances of sensation, perception, cognition, communication, behaviour as well as by epilepsy and secondary musculo-skeletal problems.

Types

- Spastic diplegia
- Spastic quadriplegia
- Spastic hemiplegia
- Spastic monoplegia & triplegia
- Dyskinetic CP: This includes athetoid, choreoathetoid movements

Aetiology & Risk factors

In many cases no definite cause is identified. However, the known causes are-

- * Abnormal brain development
- * Intrauterine hypoxia
- * Intrauterine exposure to maternal infection
- * Perinatal asphyxia & hypoxic ischaemic encephalopathy
- * Intracerebral haemorrhage, infarction, periventricular leukomalacia
- * Neonatal sepsis
- * Extreme low birth weight & prematurity
- * Kernicterus
- * Hypoglycaemia or other metabolic abnormalities

Clinical Manifestations

Symptoms

- Not achieving or delay in achieving age appropriate motor skills *i.e. neck control, sitting, standing, crawling, walking, holding things etc.*
- Involuntary *e.g. choreoathetoid movements*
- Other symptoms those occur in variable frequencies are-
 - * Seizure
 - * Intellectual disability
 - * Abnormal behaviour
 - * Problems of-
 - Speech *e.g. dysarthria, dysrrhythmia*
 - Vision *e.g. squint, refractive error, defect in choroid/retina and blindness*
 - Hearing
 - Interaction
 - Feeding

Physical Examination

The findings are related to involvement of pyramidal, extra-pyramidal system and cerebellum.

The usual findings are-

- Spasticity *e.g. scissoring, tight tendoachilis*
- Hyperreflexia, brisk or exaggerated deep jerks *e.g. knee, ankle jerks*
- Ataxia
- Involuntary movements
- Hypotonia, sometimes but deep tendon reflexes are brisk as in hypertonic CP
- Associated findings
 - * Microcephaly (OFC <-3SD for age)
 - * Squint from cranial nerve palsy
 - * Persistence of primitive reflexes *e.g. palmar grasp, moro reflex etc.* beyond the age of disappearance
 - * Malnutrition



CP with hypertonicity of both upper and lower limbs & fisting

Diagnosis

Diagnosis of CP is clinical and after exclusion of other neurological disorders. Investigations have limited value. However, **imaging studies (MRI)** and **metabolic screening** may be done to exclude neurometabolic disorders and other pathologies.

Management

A. Counseling parents regarding the disease, its treatment and outcome. Make it clear that it is-

- A non progressive disease
- Not a mental illness and
- Not curable

Management aims at minimizing the disability and improving the quality of life.

B. Integrated management of motor and other associated illnesses by a group of experts from multiple disciplines. Here the paediatrician will play the pivotal role. This group will collectively offer maximum specialized services so that the child does not become a burden to the society but can contribute actively to the society. The role of different specialties are given in the table -

Paediatrician	• Advice on appropriate nutrition • Treat common illnesses • Ensure complete immunization • Make timely referral to appropriate authority
Physio-therapist	• Specific training <i>e.g. sitting, standing, stepping & walking</i> • Exercise designed to increase muscle strength • Prevention of contractures • Control of movement
Speech – language therapist	• Develop communication skills especially speaking
Occupational therapist	• Develop fine motor skills <i>e.g. dressing, feeding, writing and other daily activities</i>
Psychologist	• Improve cognitive and behavioural development
Audiologist	• Assist in hearing problems
Ophthalmologist	• Correct refractive error, squint and advice on eye exercise
Orthopaedic surgeon	• Correct deformities which are beyond medical treatment • Surgical release of heel cord contractures
Special school and teachers	• Mild CP may attend normal school • Moderate to severe CP needs special schools
Social worker	• Create social awareness to establish the right of the affected children & arrange various economic aids and legislative support

C. Management of feeding difficulty

- Use a shallow spoon and give soft food
- Place the food on the middle of the tongue

D. Pharmacotherapy

- For spasticity -
 - * Drugs: Tizanidine, Baclofen, Clonazepam, Diazepam etc.
 - * Inj. Botox is used to treat spasticity. It blocks the transmission of overactive nerve impulses to the targeted muscle by selectively preventing the release of Acetylcholine (ACh) at the neuromuscular junction. Thus temporarily preventing muscle contraction
- Dyskinetic CP: Trihexiphenidyl hydrochloride (Pacitane)
- Convulsion: Give standard anticonvulsants (avoid Phenobarbitone)

E. Follow up: To assess efficacy of treatment by looking at status of disabilities

- Clinical examination shows -

- * Pseudohypertrophy of calves (due to hypertrophy of some muscle fibers, infiltration of muscle by fat and proliferation of collagen)



Pseudohypertrophy of calf muscle

- * Wasting of thigh muscles (proximal myopathy)
- * Lordotic posture and Trendelenburg gait or hip waddle (**Waddling gait**)
- * Presence of **Gower sign**

DUCHENNE MUSCULAR DYSTROPHY

Incidence: 1 in 3600 male births

Defect: Mutation of the gene at Xp21 locus

Mode of inheritance: X linked recessive trait

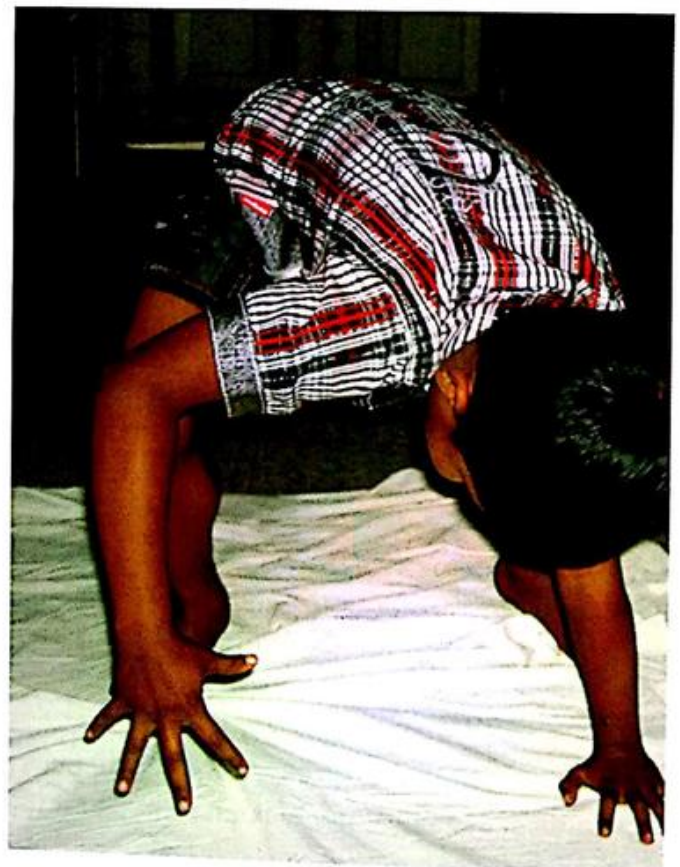
In this disease boys suffer and females carry the disease (*only Turners are female sufferers*)

Net Clinico-pathological Consequence

- Deficient production of 'Dystrophin' leading to progressive weakness of muscles, particularly proximal muscles (*proximal myopathy*)

Clinical Manifestations

- Normal at birth or during early infancy
- Clinical manifestations usually appear by 3 years of age, *e.g. frequent falls, trouble running, difficulties in climbing stairs as well as rising from floor*
- H/O recurrent respiratory infections



Gower sign

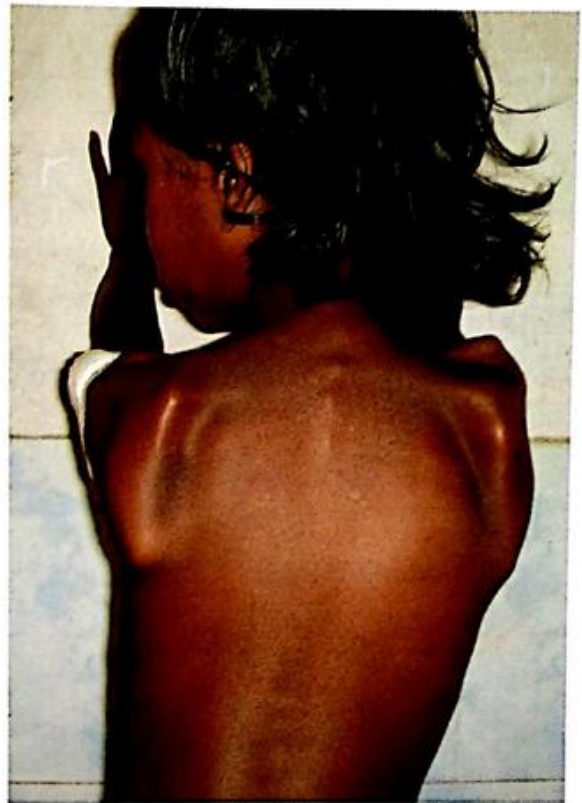


Gower sign



Gower sign

- * Presence of **slip through sign** (As the child is lifted up by holding around the sides of his chest right up under his arms, the weak shoulders move upward, almost allowing him to slip through the physician's hands)
- * Presence of **winging sign** (winging of scapula)



Winging of scapula

- * Hypertrophy of tongue and forearm may be present but no fasciculation
- Other features -
 - * Contractures involving ankles, knees, hips & elbows
 - * Scoliosis
 - * Cardiomyopathy, presenting as *cardiac failure, persistent tachycardia, murmur*
 - * Intellectual impairment

Diagnosis

Based on C/F and investigations.

Investigations

- Serum CK level: Greatly elevated (15,000 -35,000 IU/L, (normal: < 150 IU/L))

- Electromyogram (EMG): Characteristics myopathic feature but not specific for DMD
- X-ray chest: May show evidence of pneumonia and/or cardiomyopathy (cardiomegaly)
- ECG & Echocardiography: For evidence of Cardiomyopathy
- Muscle biopsy shows –
 - * Endomysial connective tissue proliferation
 - * Scattered degenerating and regenerating myofibrils
 - * Foci of mononuclear cell infiltration
- Polymerase chain reaction (PCR): To see dystrophin gene mutation

Treatment

Counseling parents about the disease and its outcome.

Supportive

- Diet
 - * Maintain good nutrition and to prevent obesity
 - * Minimize osteoporosis by adequate calcium and fluoride supplementation
- Physiotherapy to delay contractures
- Prompt treatment of
 - * Pulmonary infections
 - * Cardiac decompensation (Digoxin)
- Steroid may be used to slow the progression of the disease (10 days of each month)
- Immunization against influenza virus in addition to other routine vaccinations

Prognosis

The relentless progression of weakness continues into the 2nd decade. Most patients continue to walk with increasing difficulty until 10 yrs of age and some are wheelchair bound by 7 years. Death occurs usually around 18-20 yrs of age. The common causes of death are respiratory failure, intractable heart failure, pneumonia or occasionally aspiration and airway obstruction.

WILSON DISEASE

Incidence: 1/5000 to 1/100,000 population

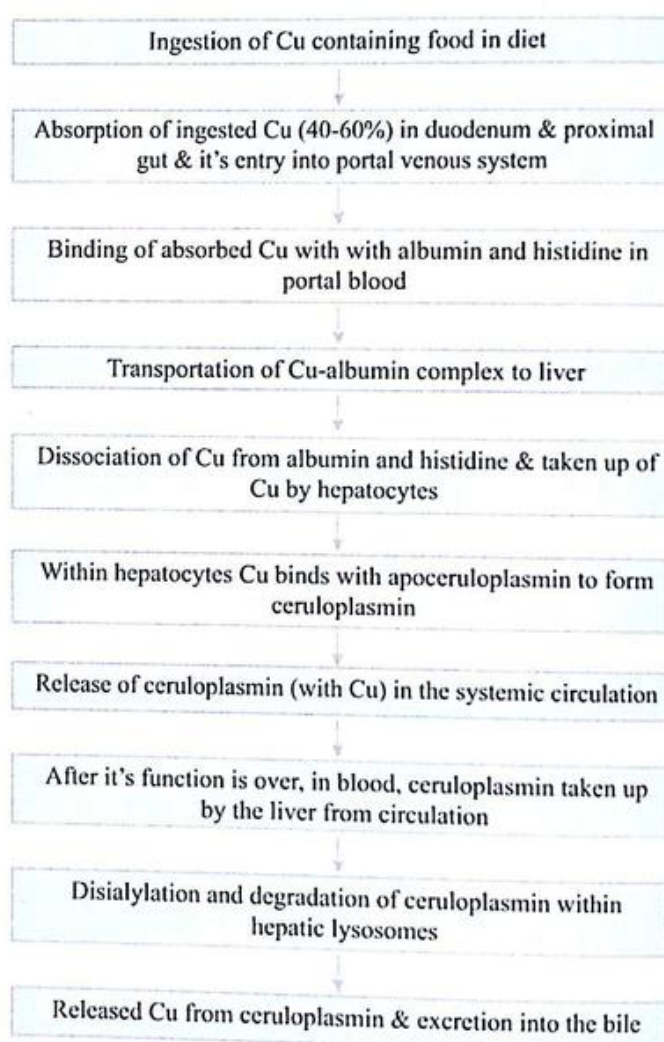
Mode of inheritance: Autosomal Recessive

Defect: Mutation of ATP7B gene on chromosome 13

To learn Wilson disease, knowing normal copper metabolism is important.

Normal Copper (Cu) metabolism

In Wilson disease, because of mutation of ATP7B gene, patients become deficient of



ATP7B protein which leads to -

- * failure of copper to be incorporated into ceruloplasmin and thus decreased secretion of ceruloplasmin into blood
- * decrease in excretion of copper into bile

The net results are

- * Reduction of ceruloplasmin in blood
- * Accumulation of free Cu in hepatocytes with toxic injury to hepatocytes
- * Spilling over of free Copper from liver into the circulation
- * Copper induced toxic injury of RBC (haemolysis), brain, cornea, kidney, bone, joints & parathyroids
- * Concomitant increase in urinary copper excretion

Clinical Manifestations

Hepatic & haematological manifestations appear early & later on neurological manifestations.

Organs	Manifestations
Liver	* Acute hepatitis * Fulminant hepatic failure * Chronic liver disease, portal hypertension, ascites
Nervous system	* Extrapyramidal manifestations <i>e.g.</i> <i>dystonia, choreoathetosis</i> * Psychiatric manifestations <i>e.g.</i> <i>dementia</i> * Deterioration of handwriting, school performance * Speech disturbances
Eyes	* KF (Kayser-Fleischer) ring (<i>Greenish brown ring due to Copper deposition in descemet's membrane of sclero-corneal junction (limbus)</i>) * Sunflower cataract
Others	* Haemolytic anaemia * Rickets * Renal tubular acidosis * Arthritis * Cardiomyopathy * Endocrinopathy <i>e.g.</i> <i>Hypoparathyroidism</i> * Infertility/Recurrent miscarriages



KF (Kayser-Fleischer) ring
Courtesy: Dr Farzana Sharmeen

Diagnosis

Based on C/F & relevant investigations.

Investigations

Parameters	Results
Haemoglobin	Decreased
S. ceruloplasmin	< 20 mg/dl (normal 40 mg/dl)
24 hours urinary Copper	> 100 µg/day (normal < 40 µg/day)
SGPT, S. Bilirubin, Prothrombin time	May be raised
MRI of brain	Reveals change in basal ganglia
D- penicillamine challenge test. Patient will take Penicillamine (500 mg) 12 hourly for 24 hours and during this period all urine has to be collected in a jar for Copper estimation	If urinary Copper exceeds > 1600 µg in 24 hours then it is suggestive of Wilson disease (done only when 24 hours urinary Cu is < 100 µg/day)
Liver biopsy to measure hepatic copper content	>250 µg/gm of dry weight of liver is confirmatory (normal <10 µg/gm dry weight)

Treatment

A. Specific (copper chelating agents)

- D-penicillamine

Dose: 10-30 mg/kg/day twice daily before meal. To start with lower dose and increase over 1 to 2 weeks to the desired dose

Duration of treatment: Life long

- Other drugs

- Tri ethylene tetramine dihydrochloride
e.g. Trien, TETA, Trientine at a dose of 20 mg/kg/day
- Ammonium Tetrathio-molybdate

B. Supportive

- Diet

- * Allow diet deficient in copper *e.g. milk & milk products, green leafy vegetables, sugar, cold drinks, lemon juice, tomato juice*

- * Avoid diet rich in copper *e.g. meat, chicken, honey, jam, chillie, garam masala, pulses, wheat-flour, chocolates, dried nuts, mushroom*

- Pyridoxine: 25 mg/day (as Penicillamine is an antimetabolite of vit B₆)
- Zinc: 25 mg, 3 times a day with meal (should not be given with D-penicillamine)

References

- Physical Growth and Development. In: Molla MR. Concise Textbook of Pediatrics. 2nd ed. Dhaka: Child friendly publications; 2007. p5-29.
- Hutchinson JH et al. Practical Pediatric Problems. 6th ed. Singapore: PG Asian Economy Edition; 1989.
- Moe PG et al. Cerebral palsy. In: Hay WW, Levin MJ, Sondheimer JM, Deterding RR, editors. Current Diagnosis and Treatment in Pediatrics. 18th ed. New York: The McGraw-Hill Companies; 2007. p784-86.
- Robbins and Cotran. Pathologic Basis of Diseases, 8th ed. 2010, Saunders, p863-64

SELF ASSESSMENT

Short answer questions [SAQ]

- What are the cardinal features of cerebral palsy?
- Write five important cardinal features of DMD.
- Write two important investigations and their interpretations for diagnosing DMD.
- What do you mean by pseudohypertrophy? Where does this occur in DMD?
- Mention four important clinical consequences of DMD.

Multiple choice questions [MCQ]

- The 2 common types of CP are-
☐ a) spastic ☐ b) ataxic ☐ c) choreoathetoid
☐ d) hypotonic ☐ e) mixed
- The known risk factors of cerebral palsy are -
☐ a) severe neonatal jaundice ☐ b) infants of diabetic mother ☐ c) birth weight of 1000 gram
☐ d) neonatal sepsis ☐ d) hypoxic ischaemic encephalopathy
- Drugs found useful in the management of cerebral palsy are -
☐ a) Beclofen ☐ b) Diazepam ☐ c) Botulinum toxin
☐ d) Multivitamin ☐ e) Amoxicillin
- Features characteristic of DMD are
☐ a) distal myopathy ☐ b) enlargement of calf muscles ☐ c) high CK level
☐ d) convulsion ☐ e) recurrent chest infection

CHAPTER 34

ACCIDENTS AND EMERGENCIES

KEROSENE POISONING	269
OPC POISONING	270
SNAKE BITE	271
DROWNING	273
DOG BITE	277

Children are the frequent victims of various accidents and these pose them to a life threatening emergencies. The common accidents and emergencies (A&E) of children are-

- * Accidental ingestion of poisons, household substances, drugs etc.
- * Drowning
- * Foreign body aspiration in the airway
- * Burn & scald
- * Road traffic accidents
- * Snake, dog/insect biting
- * Electrocution
- * Injury by sharp objects & domestic animals

In this chapter, accidental poisoning, drowning snake and dog bite will be discussed.

Accidental Poisoning

Accidental ingestion of poisonous agents is the most common way of poisoning among children. Of the different agents, the following substances are commonly associated with accidental poisoning.

- * Kerosene
- * Household products *e.g. bleach cosmetics, toiletries, detergents, disinfectants, petroleum distillates etc.*
- * Drugs taken by other members of the family
- * Organophosphorus compounds (OPC)

KEROSENE POISONING

- Commonest childhood poisoning (37% of all poisoning)
- At risk children: age 1-5 years, due to their natural curiosity to explore
- Easy access to children due to its availability in most poor households and wrong storage in beverage bottles
- Ingestion occurs more during summer months

Pathogenesis

The principal concern of kerosene oil poisoning is its aspiration into lungs that may occur during initial ingestion or during vomiting. Following aspiration, it causes inflammation to lungs parenchyma (**chemical pneumonitis**) which may progress to atelectasis, pneumothorax or pleural effusion. This interferes with gaseous exchange and causes hypoxia affecting CNS and other vital organs.

Fatal dose: 30 ml and fatal period is 24 hours.

Clinical Manifestations

The child may -

- Be asymptomatic, just only have history of kerosene ingestion
- Cry excessively because of pain and irritation in the throat
- Have sensation of choking, nausea or vomiting and characteristic odour in breaths & vomitus
- Have features of pneumonia *e.g. cough, breathlessness, wheeze, fever*
- Have colicky abdominal pain, diarrhoea
- Have arrhythmias, congestive cardiac failure, seizure and coma (rare)

Physical Examination

- General condition & vital signs are usually normal

- Sometime, high fever is present
- Features of pneumonia may be present *e.g. fast breathing, chest indrawing, nasal flaring, creps etc.*
- Pupils are usually normal but may be either constricted or dilated if coma supervenes

Diagnosis

Based on C/F and investigations.

Investigations

a. X-ray chest

- * Early stage: Fine, punctuate mottling present in perihilar areas



Patchy opacities in lungs

- * Later stage: Patchy ill-defined opacities may develop in both lungs particularly the lower lobes
 - * Sometimes there may be evidence of pneumatocoele and later pneumothorax
- b. CBC: Neutrophilic leukocytosis but may be normal

Treatment

Mainly supportive and includes -

- Care of airway & breathing (*see page 241*)
- IV saline if patient is dyspnoeic or unable to tolerate oral or NG feed
- Oxygen inhalation, if there is respiratory distress/low SPO₂
- Observation for at least 24 hours to note evidence of respiratory or other complications (CNS) as an initial asymptomatic child may develop full-blown picture of kerosene oil

poisoning after 24 hours of ingestion

- Antibiotics may be used when there is suspicion of secondary pneumonia

Gastric lavage is contraindicated as it is associated with aspiration of kerosene into the lungs.

ORGANOPHOSPHORUS COMPOUND (OPC) POISONING

Pathogenesis

Organophosphorus compounds causes neurotoxicity through inhibition of acetylcholinesterase. So Acetylcholine is not metabolized. As a result, there is persistent cholinergic discharge at the neuromuscular junctions.

Clinical Manifestations

- Smell of OPC are usually felt
- Clinical features appear within an hour of exposure. The typical features are -

* Profuse sweating	* Pulmonary congestion
* Increased salivation	* Constricted pupils
* Muscle twitching	* Flaccid paralysis & deep coma in the late stage of the disease
* Convulsion	* Variable haemodynamic status
* Muscle cramp	
* Diarrhoea or vomiting	
* Headache	
* Blurring of vision	

Treatment

- Immediate hospitalization
- Counseling parents about the nature and fate of OPC poisoning
- Removal of contaminated clothes and washing the body thoroughly

- Gastric lavage, if patients arrive within 30 minutes of ingestion
- Quick assessment of vital signs *e.g. pulse, BP, capillary refilling time, pupils etc.*
- Clearing airway and support breathing
- Keeping the patients in lateral position
- IV infusion to maintain circulation, for nutritional support and administration of drugs
- O₂ inhalation: 1-2 liter/minute
- Inj Atropine (1 amp = 0.6 mg): It is started at a dose of 0.05 mg/kg IV and repeated every 10-15 minutes to a maximum of 2-5 mg till the pupils are dilated (*i.e. full atropinization*)

Signs of atropinization

- * Mydriasis (dilated pupil)
- * Tachycardia
- * Flushing
- * Dry mouth and nose
- * Anhydrosis (absence of sweating)
- * Bronchodilatation

Then the dose is gradually tapered and maintained for at least 2-3 days based on the size of the pupils.

- Inj. Pralidoxime (30 mg/kg IV) should be given in addition to Atropine and may be repeated every 30 minutes if necessary. Recently inj. Obidoxime (3 mg/kg IM) was found more effective
- Antibiotics may be needed to prevent pneumonia and other infections
- Catheterization should be done before starting atropine, as it constricts the sphincters
- Monitoring the patient to note the signs of atropinization & other vital parameters
- Other supportive care -
 - * Maintenance of hygiene (including oral hygiene)
 - * Care of bowel and bladder
 - * Oropharyngeal & nasopharyngeal suction when needed

SNAKE BITE

Incidence

- Global: 5.5 million/year; Deaths: 1,00,000/year
 - Bangladesh: 8,000/year; Deaths: 1,600/year
- Of the 3000 known species of snakes, only 200 are poisonous*

Snake venom

It is modified saliva comprised of proteins and different enzymes. These enzymes determine the toxicities.

Toxins of venom & clinical manifestations

Types of venom	Snake	Clinical manifestations
Neuro-toxin	Cobra and Coral snakes	• Generalized muscle weakness as manifested by • Lethargy • Ptosis  <i>Bilateral ptosis</i> • Paralysis of eye ball muscles • Broken neck sign  <i>Broken neck sign, Courtesy: Prof M A Faiz</i> • Difficulties in speech • Opening of mouth • Protrusion of tongue • Shallow respiration
Haemo-toxins	Vipers	• Haemolysis • Haemorrhage and consequent shock
Myo-toxins & Nephrotoxins	Sea snakes	• Severe bodyache • Black urine because of myoglobinuria from muscle breakdown • Scanty urine

Management

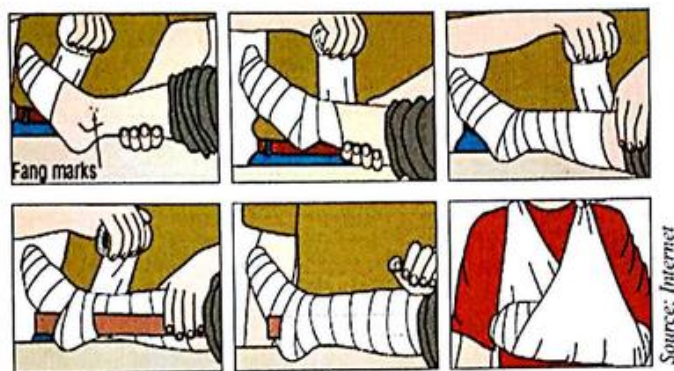
At Community

- Reassure the victim who may be very anxious
- Immobilize the bitten limb with splint and sling as practiced in fracture of long bone

If the bite is in lower limb, not allow walking.

If the bite is in upper limb, do not allow moving the limb.

Ideally pressure immobilization method (by simple crepe bandage or any long strips of clothes (e.g. gamcha, shart) can be helpful.



Pressure immobilization

- Quick transfer to the nearest health facility/hospital. During transfer, do not allow anything by mouth and keep the bitten part immobilized

At Hospital

- **Rapid clinical assessment of vital parameters** e.g. respiration, cyanosis, pulse, BP, capillary refilling time
- Resuscitation e.g. maintenance of-
 - * Airway (clearing airway) See page 241
 - * Breathing (Bag & Mask ventilation or endotracheal intubation and artificial ventilation)
 - * Circulation (IV crystalline fluid e.g. DNS, NS, Hartman solution etc.
- Detailed clinical assessment
- Identification of the species (if dead snake is brought)

Investigations

- 20 minutes whole blood clotting test (WBCT)
- ECG
- Complete blood counts
- Blood urea, S creatinine
- S. CPK
- Urine R/M/E
- Immuno-diagnosis by ELISA



Blood in left test tube did not clot after 20 minutes

Source: Internet

Further Treatment

- Antibiotics and tetanus prophylaxis
- Administration of **polyvalent antivenom** (effective against Cobra, Krait, Russel viper & Saw scaled viper) and frequent monitoring for its toxicities and response

- * Dose: 10 vials irrespective of age and sex
- * Preparation: Each vial is diluted with 10 ml distilled water. Then all 10 diluted vials (100 ml) are further diluted with 100 ml of IV fluid e.g. DA/DNS/NS (total 200ml)
- * Administration: through IV drip over 1 hour (@ 50 drops/min)

Indications for using polyvalent antivenom

- * Neurotoxic signs
- * Rapid extension of local swelling
- * Acute renal failure
- * Acute circulatory failure
- * Bleeding abnormalities
- * Hemoglobinuria/myoglobinuria

Other Treatment

- Neostigmine-atropine combination (for neurotoxic features only) -
- Inj. Atropine 15 µgm/kg IV followed by Inj. Neostigmine 50-100 µgm/kg SC, every 4 hours until neurotoxic features are overcome

- Fresh blood transfusion for patients with coagulopathy
- Care of the bitten part -
 - * Wash with antiseptic solution
 - * In case of local necrosis & gangrene surgical debridement and skin grafting may be needed

Treatment of non venomous snake bite

- Reassurance
- Tetanus prophylaxis
- Observation for 24 hours

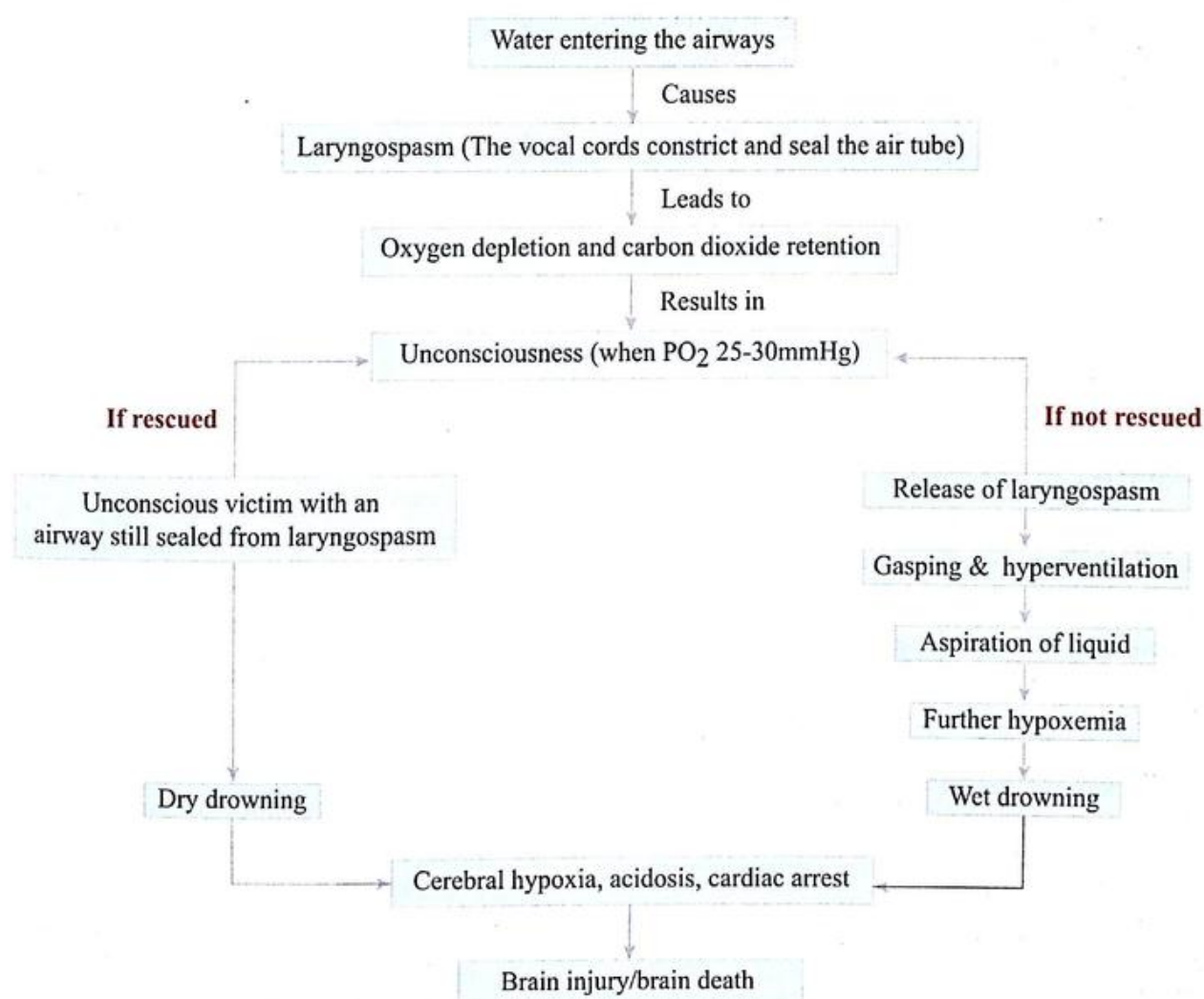
DROWNING

Drowning is a process that results in respiratory impairment from submersion/immersion in a liquid medium. In drowning, a liquid-air interface develops at the entrance of victim's airway, which prevents the individual from breathing oxygen. Outcome of drowning includes death, morbidity or complete recovery.

Incidence

In Bangladesh, 20% of all deaths are from drowning and is more among under 5 children.

PATHOPHYSIOLOGICAL EVENTS OF DROWNING

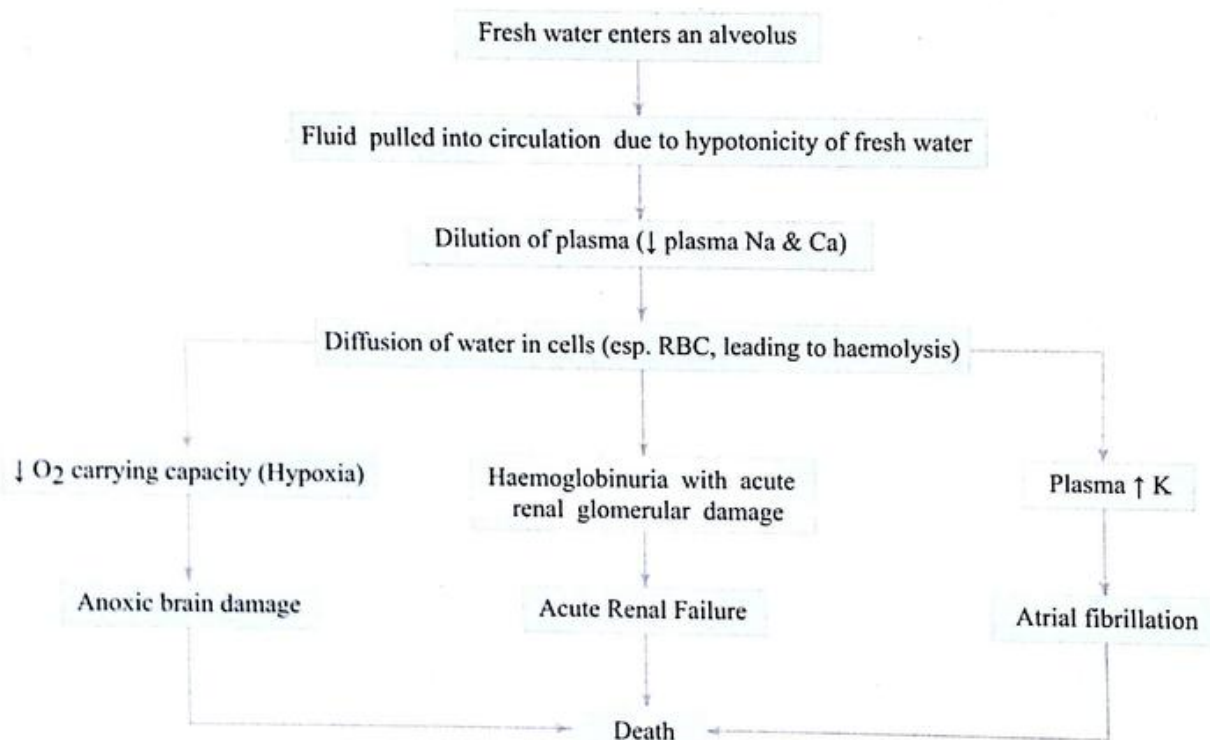


FRESH WATER DROWNING

Drowning in fresh water leads to the rapid passage of large quantities of water from the lungs to the blood (as fresh water is hypotonic compared to the blood). This leads to haemodilution and hyponatraemia. The

diluted hypotonic blood causes diffusion of water in the cells, (mainly RBC) causing *haemolysis*, *hyperkalaemia* and, in severe cases, haemoglobinuria with glomerular damage. Severe hypoxia (due to haemolysis) results in severe anoxic brain damage and atrial fibrillation (due to *hyperkalaemia*) leading to immediate death.

FRESH WATER DROWNING



SALT WATER DROWNING

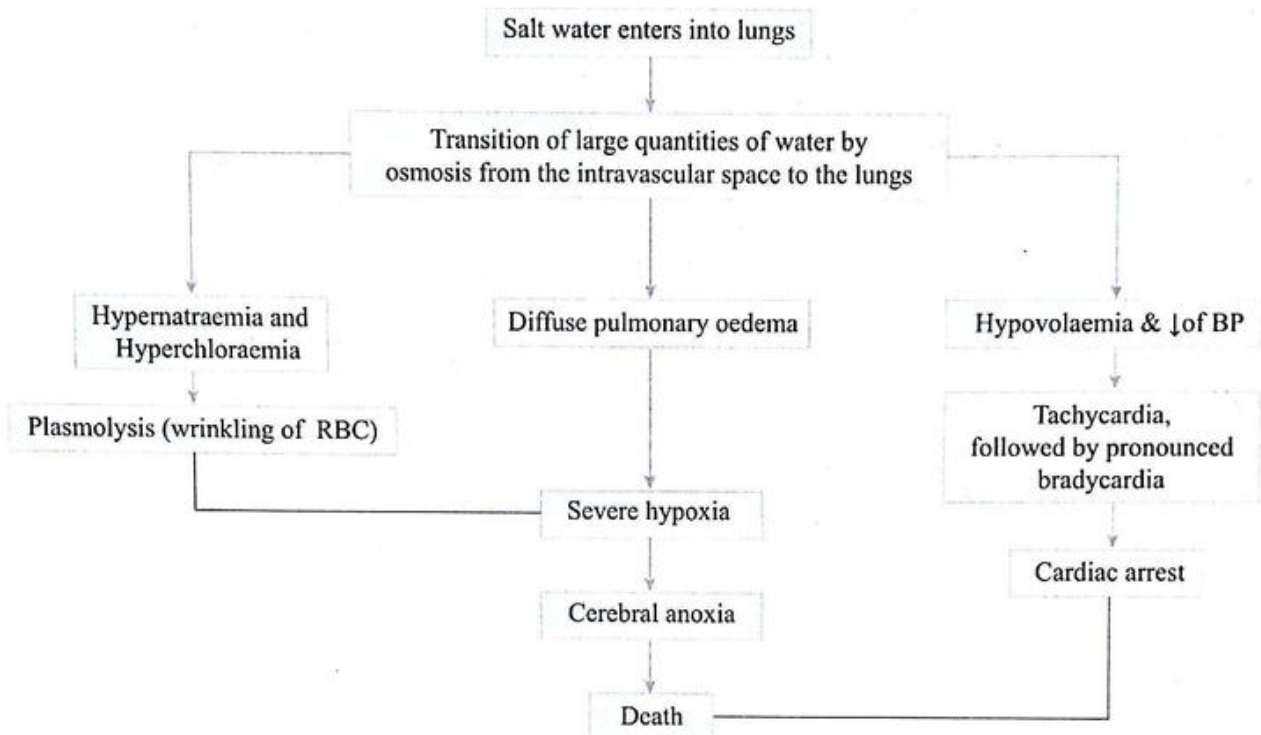
Drowning in sea water leads to rapid transition of large quantities of water by osmosis (as salt water is hypertonic compared to the blood) from intravascular space to the lung parenchyma. The net results are -

- Pulmonary oedema
- Increased blood osmolality & crenation of RBC
- Hypovolaemia

All these events cause hypoxaemia, cardiac arrest, cerebral anoxia and death.

The clinical presentation, complications and outcome of the patients depend upon -

- Submersion time -
 - * Submersion duration <5 min - associated with favourable outcome
 - * Submersion duration >10 min - highly associated with poor outcome
- Water temperature
- Water tonicity (fresh water/salt water)
- Degree of water contamination
- Associated injuries (especially cervical spine and head)
- Type and timing of rescue and resuscitation efforts and
- Response to initial resuscitation

SALT WATER DROWNING**Clinical Manifestations**

- Anxious appearance of victim
- Symptoms related to associated complication-
 - * Altered vital signs *eg, hypothermia, tachycardia, bradycardia*
 - * Tachypnoea, dyspnoea (pulmonary oedema)
 - * Altered level of consciousness, neurological deficit (cerebral oedema, cerebral hypoxia, stroke)
 - * Acidotic breathing (metabolic acidosis)
- Apnoea, Asystole (cardiopulmonary arrest)
- Renal failure
- Death

Investigations

- CBC, coagulation profile: May be altered
- Blood gas analysis: Acidosis
- Serum electrolytes: Hypernatraemia, hyponatraemia, hyperkalaemia
- Random blood sugar: Decreased
- SGPT, SGOT: May be raised
- BUN, Serum creatinine: May be altered
- Chest X-ray -
 - * For evidence of aspiration, pulmonary oedema, or segmental atelectasis suggesting foreign body(s) *e.g. silt or sand aspiration*
 - * For evaluation of endotracheal (ET) tube placement
- X-ray cervical spine or CT scan of neck (if trauma suspected)
- ECG, if evidence of significant tachycardia, bradycardia, or dysrhythmia or risk of underlying cardiac disease

Management

At Community

Basic life support at the scene of event is the most important determinant of outcome.

- Rescue the patient from water as soon as possible
- Remove wet cloth & wrap the victim in warm blankets
- Assess vital signs *e.g. pulse, BP, respiration*



Source: Internet

- Open the airway & remove visible debris if present in the oropharynx with a **finger-sweep** maneuver
- Initiate rescue breathing immediately (mouth to mouth/mouth to nose), if required
- Start chest compressions and bag & mask ventilation (CPR) if definite pulse is not felt within 10 seconds
- Give O₂ with face mask @ 5-6 L/min as soon as available
- Arrange for quick transfer to hospital

At Hospital

- Give O₂ with face mask-5-6 L/min.
- Respiratory support: Intubate and start mechanical/AMBU ventilation in any patient who has-

- * Poor respiratory effort
- * Altered sensorium
- * Severe hypoxaemia
- * Severe acidosis
- * Severe dyspnoea

- IV infusion of normal saline or Ringer's lactate (10-20 ml/kg) in case of poor perfusion for volume expansion
- Maintain body temperature (between 32°C to 34°C) by warm saline infusion, wrapping with blankets etc
- Antibiotic: Not indicated unless the patient was submerged in contaminated water or sewage
- Follow up: SPO₂, BP, blood sugar & temperature
- Patients should be observed for 6-12 hours before discharge

Complications

Cardiac arrest, bradycardia

Prognosis

- Irreversible brain damage occurs after 4-6 minutes of submersion
- Most children who survive are rescued within 2 minutes of submersion
- Most children who die are found after 10 minutes of submersion
- Patients who are alert or mildly obtunded at presentation have an excellent chance of full recovery
- Of hospitalized victims
 - * 15% die
 - * 20% survive with severe neurologic sequelae

Prevention

- Appropriate barriers must be built around ponds
- Parents should supervise children around water
- Children should be taught safe conduct around water and during boating

For more details of management of ABC See also page no. 241.

DOG BITES

- Children (boys > girls) of ages, between 6-12 years are attacked more
- Injuries are of 3 types *e.g. abrasions, puncture wounds and lacerations.*



Source: Internet

The major concern is acquiring rabies with cent percent mortality

Diagnosis: Mainly clinical.

Whenever a child is brought with history of dog bites, the following questions should be asked for clinical evaluation.

- What is the type of the animal? Domestic/wild
- Was it provoked/unprovoked attack?
- What is the tetanus immunization status?
- What is the status of the wound/underlying structure?
- Is there any H/O drug allergy

After clinical assessment, the case should be further assessed by X-ray of the affected part and sending wound swab culture & sensitivity

Treatment

- Proper wound toileting
- Antibiotics prophylaxis to avoid secondary infection
- Tetanus prophylaxis if tetanus vaccination status is uncertain
- Anti-rabies vaccine (ARV): Cell culture vaccines *e.g. Purified Vero Cell Rabies Vaccine & Purified Chick Embryo Cell Vaccine*, total 4 doses
 - * 0.1ml/dose intradermally into 2 sites (in case of adult: in each deltoid muscle and in case of children < 2 years: at antero-lateral thigh), on **Day 0, Day 3, Day 7 and Day 28**
- Rabies immunoglobulin (RIG): In Category III injury *e.g. single or multiple transdermal bite or scratches, licks or broken skin*

Pre exposure prophylaxis

- Indication: Laboratory workers and health care providers who take care of infected animals (mainly dog) and human
- Inj. Anti-Rabies Vaccine, total 3 doses
 - * Dose: 0.1ml/ dose intradermally in a single site on **Day 0, Day 7 and Day 28**

References

1. Utpal KS, Layland FC. Poisoning in children. 3rd ed. New Delhi: Jaypee Brothers; 2006.
2. National guideline for management of snake bites, DGHS, Bangladesh, 2000.
3. Zuckerbraun NS et al. Pediatric drowning: Current management strategies for immediate care. *Clinical Pediatric Emergency Medicine* 2005; 6: 49-56.
4. Caglar D, Quan L. Drowning and Submersion Injury. In: Kliegman RM, Stanton BF, Geme III JWS, Schor NF, Behrman RE. Editors. *Nelson Textbook of Pediatrics*, 20th Edition. New Delhi: Elsevier; 2016: 560-568.

5. Suzanne Moore Shepherd SM, Drowning. [Internet]. 2010 [updated 2010 June 28; cited 2011 Nov 4]. Available from: <http://emedicine.medscape.com/article/772753>.
6. Michael J Verive, Near Drowning. [Internet]. 2010 [updated 2009 April 29; cited 2011 Nov 4]. Available from: <http://emedicine.medscape.com/article/908677>.
7. 2005 American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care, Part 10.3: Drowning; Circulation. 2005; 112: IV-133-IV-135.
8. Batra RK, Paddle JJ; Therapeutic hypothermia in drowning induced hypoxic brain injury: a case report: Cases Journal 2009; 2:9103.
9. Drowning. [Internet]. 201: <http://www.thailand-divers.com.au/scuba-diving/d/drowning/all-pages.html>.
10. R. Azzolina, G. La Camera et Al, Pathophysiology, prevention and treatment of drowning syndrome, Acta Medica Mediterranea, 2011; 27: 31.
11. National Guideline for Dog/Animal Bite Management, DGHS, Bangladesh, June 2014.

SELF ASSESSMENT

Short answer questions [SAQ]

1. Write down the basic pathophysiology of OPC poisoning.
2. What agents are commonly involved in accidental poisoning in children?
3. Name five common accidents and emergencies in children.
4. Write down the pathological events of drowning.
5. Write down the management of Snake bite.
6. Write down the important complications and treatment of a child with kerosene poisoning.

Multiple choice questions [MCQ]

1. Agents commonly associated with childhood poisoning are-
☐ a) corrosive agents ☐ b) alcohol ☐ c) kerosene
☐ d) drugs ☐ e) datura
2. The following antidotes are recommended in OPC poisoning -
☐ a) Atropine ☐ b) Pralidoxime ☐ c) Obidoxime
☐ d) Naceylcysteine ☐ e) Flumazenil
3. The pathognomonic features of organophosphate poisoning include -
☐ a) miosis ☐ b) dry mouth ☐ c) fasciculation
☐ d) bronchospasm ☐ e) Central stimulation of respiratory center
4. First line management of snake bite in the community includes -
☐ a) assurance ☐ b) antivenom ☐ c) tight tourniquet
☐ d) quick referral to hospital ☐ e) immobilization of affected limb
5. Cardinal features of OPC poisoning include
☐ a) Miosis ☐ b) Fasciculation ☐ c) Bronchospasm
☐ d) Diarrhoea ☐ e) Dry mouth
6. Anaphylactic shock
☐ a) Can be triggered by bee sting ☐ b) Is a type III immune response
☐ c) Is characterized by vasodilatation ☐ d) Is due to neurogenic vasomotor disturbance
☐ e) best treated with anti-histamine

PARASITIC INFESTATIONS

AMOEBIASIS	279
GIARDIASIS	280
ASCARIASIS	281
ENTEROBIASIS	282
ANCYLOSTOMIASIS	283

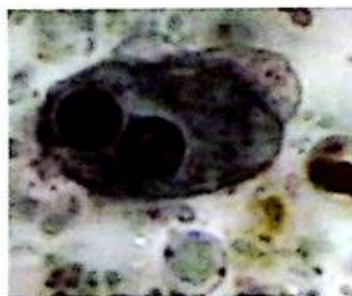
Intestinal infestation of parasites is quite common among children in a country like Bangladesh. In this chapter, the following common intestinal parasitic diseases will be discussed.

- * Amoebiasis • Giardiasis • Ascariasis
- * Enterobiasis • Ankylostomiasis

AMOEBIASIS

Causative parasite:

Entamoeba histolytica

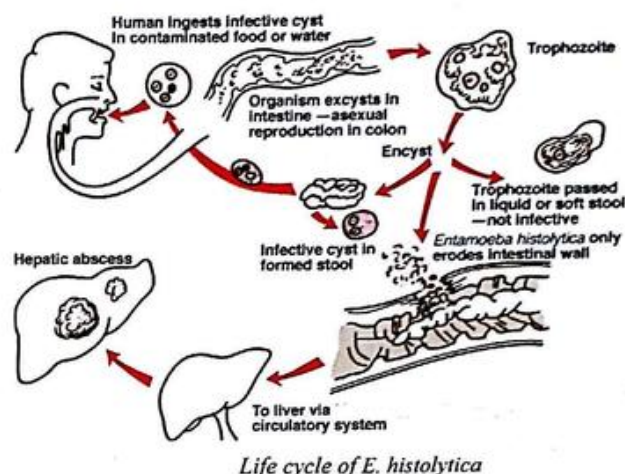


Source: Internet

Transmission

- Faecal-oral route i.e. ingestion of *Entamoeba* cyst
- Faecal contamination of drinking water, vegetables and foods
- Eating of uncooked vegetables and fruits which have been fertilized with infected human feces
- Handling of food by infected individual (cyst carriers)
- House flies and cockroaches passing from faeces to unprotected food

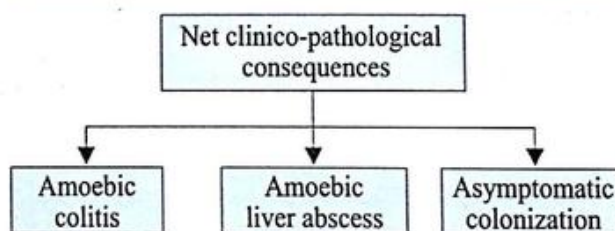
Pathogenesis



Source: Internet

Life cycle at a glance

- * Host: Man is the only host (definitive)
- * Infective from: Mature quadrinucleate cyst
- * Route of infection: Faecal – oral
- * Pathogenic form: Trophozoite
- * Site of lesion: Large intestine
- * Diagnostic stage: Cyst & trophozoite



Amoebic Colitis

Gradual onset of colicky abdominal pain, tenderness & fever

- Diarrhoea: 6–8 motions/day and frequently associated with tenesmus (painful sudden bowel evacuation)
- Stool: Blood stained and contain a fair amount of mucous
- Occasionally, there is severe diarrhoea resulting in dehydration and electrolyte disturbances

Amoebic Liver Abscess

The most common extraintestinal amoebiasis. It results from spread of the organisms from the intestine to the liver via the portal vein.

- High grade fever
- Pain: Constant, dull aching pain located in right upper abdomen or epigastrium
- Non specific symptoms *e.g. nausea, vomiting, abdominal distention, diarrhoea, and constipation*
- Jaundice is usually absent

Investigations

- Stool R/M/E: Shows trophozoites containing ingested RBCs.
- Complete blood count:

- * Moderate Leukocytosis
- * Mild anaemia
- * Raised ESR



Ingested RBCs in trophozoites

Source: Internet

Others

- * Chest X-ray: An elevated right hemidiaphragm and a right-sided pleural effusion may be seen
- * Ultrasonogram of hepatobiliary system
- * CT scan of abdomen : Shows position and size of the abscess



USG showing abscess cavity

Complications

- Intestinal
 - * Fulminant colitis with perforation
 - * Toxic megacolon
 - * Chronic nondysenteric colitis



CT of abdomen showing abscess cavity

Source: Internet

- * Amoeboma
- * Perianal ulceration
- Hepatic: Rupture of liver abscess may lead to-
 - * Granuloma cutis
 - * Haemoptysis of anchovy sauce pus
 - * Empyema thoracis
 - * Generalized peritonitis
 - * Fatal purulent pericarditis
- Metastatic lesion
 - * Pulmonary amoebiasis
 - * Cerebral amoebiasis
 - * Cutaneous amoebiasis
 - * Splenic abscess

Treatment

Intestinal Amoebiasis or Amoebic Liver Abscess:

- Metronidazole: 35–50 mg/kg/day 8 hourly -10 days

(IV Metronidazole can be used in severe infection or if patient is unable to take orally)
or

- Tinidazole: 50 mg/kg/day once daily for 3–5 days

Followed by either -

- Paromomycin: 25–35 mg/kg/day 8 hourly -7 days
or

- Diloxanide furoate 20 mg/kg/day 8 hourly -7 days

- Alternatively Nitazoxanide (7.5 mg/kg/dose 12 hourly for 3 days) can be used, which is very effective for intestinal amoebiasis

GIARDIASIS

Causative parasite: *Giardia intestinalis*

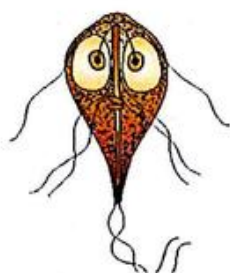
Transmission

Faecal oral route through ingestion of foods contaminated with cyst.

Life cycle

Cyst of giardia produce trophozoites that colonize the lumen of duodenum and proximal jejunum where they attach to the brush border of the intestinal epithelial cells and multiply by binary fission.

The parasites cause inflammation and partial villous atrophy there. This ultimately leads to malabsorption of foods and related morbidity.



Life cycle at a glance

- * Host: Man is the only host (definitive)
- * Infective form: Cysts
- * Route of infection: Faecal – oral
- * Pathogenic form: Trophozoites
- * Site of lesion: Small intestine

Clinical Manifestations

Recurrent attacks of -

- Diarrhoea
- Flatulence
- Abdominal discomfort or pain and sometimes abdominal distension
- There may be nausea, vomiting or lethargy

Complications

- Malabsorption syndrome
- Reiter's syndrome
- Reactive arthropathy
- Liver granuloma

Diagnosis

Based on C/F and identification of the cysts or trophozoites of the parasite in stool.

Treatment

- Anthelmintics: Options are
 - * Tinidazole: >3 yr: 50 mg/kg/day once daily single dose
 - * Nitazoxanide
 - 12-48 mo: 100 mg, 12 hourly for 3 days

- 4-12 years: 200 mg, 12 hourly for 3 days
- >12 years : 500 mg, 12 hourly for 3 days
- * Metronidazole: 15 mg/kg/day, 8 hourly for 5-7 days

ASCARIASIS

Causative parasite: *Ascaris lumbricoides*.

Transmission

Faecal oral route through ingestion of foods contaminated with mature ova containing developing embryos.



Life cycle

Life cycle starts with ingestion of eggs. After ingestion, larvae are liberated from the eggs which penetrate the gut wall to enter into portal vein and then into liver and right heart. From there larvae enter into pulmonary artery and penetrate into the alveoli and then crawl up through bronchi and then coughed up and swallowed to enter again into small intestine to grow up as adult worm.

Life cycle at a glance

- * Host: Man is the only host (definitive)
- * Infective from: Embryonated egg
- * Route of infection: Faecal – oral
- * Pathogenic from: Adult & larva
- * Site of lesion: Small intestine

Clinical Manifestations

- Non specific e.g. nausea, colicky abdominal pain and irregular motions
- Sometimes, worms may pass through vomitus or in the stools
- Sometimes patients present with urticarial rash, cough, respiratory distress (Löfller's syndrome)

Complications

- Malabsorption & nutritional deficiency
- Intestinal obstruction (ascariasis crisis)
- Appendicitis
- Pancreatitis
- Acute cholecystitis
- Allergic reactions (urticaria)

Diagnosis

Based on –

- Clinical suspicion
- Stool examination: Ova of the parasite or adult worms
- Complete blood counts: May show eosinophilia

Treatment

- Anthelmintics: Options are
 - * Albendazole: < 2 years - 200 mg and >2 years - 400 mg as single dose, or
 - * Levamisole: 3 mg/kg as single dose, or
 - * Pyrantel pamoate: 10 mg/kg as single dose, OR
 - * Mebendazole: 100 mg 12 hourly for 3 days.

All the family members should be treated simultaneously.

- Good nutritional support

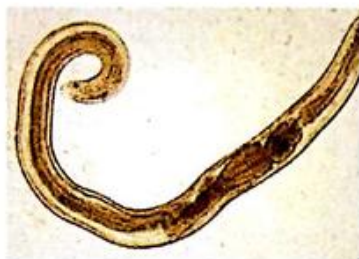
ENTEROBIASIS

Causative parasite: *Enterobius vermicularis*

Transmission

Faecal-oral route. The gravid female worm lays ova around the anus, especially at night.

The ova are then carried to the mouth by the fingers and so re-infestation takes place.



Life cycle at a glance

- * Host: Man is the only host (definitive)
- * Infective from: Embryonated egg
- * Route of infection: Faecal – oral, retrograde through anus, autoinfection from hand to mouth
- * Pathogenic from: Adult female & sticky eggs
- * Site of lesion: Caecum

Clinical Manifestations

- Perianal pruritus especially at night is the commonest symptom
- Mild gastrointestinal symptoms like abdominal pain, nausea, vomiting, diarrhoea
- Sometimes adult worms are found moving over the stool

Complications

- Loss of appetite
- Weight loss
- Restlessness & irritability
- Vulvovaginitis, urethritis
- Appendicitis (rare)

Diagnosis

Based on –

- Clinical presentation
- Stool examination: Adult worms on naked eye examination
- Perianal skin swabs: Detection of ova

Treatment

Drug of choice

- * A single oral dose of Mebendazole (100 mg PO for all ages) repeated in 2 weeks results in cure rates of 90-100%

Alternative regimens include

- * A single oral dose of Albendazole (400 mg PO for all ages) repeated in 2 weeks or
- * A single dose of Pyrantel Pamoate (11 mg/kg PO, maximum 1 g)

ANCYLOSTOMIASIS

Causative parasites

Ancylostoma duodenale or *Necator americanus*

Transmission

Transmission occurs through penetration of skin by the filariform larvae. When child walks bare foot on the contaminated soil, the filariform larvae penetrate directly through the skin, commonly through the thin skin between toes, dorsum of feet and inner side of sole.



Life cycle

Larvae from soil, after penetration through skin enter into lymphatics and then into blood stream. From blood, they enter into alveoli and then into bronchi and trachea. From trachea, larvae enter into oesophagus and then into small intestine to grow as adult worm. In the intestine, they suck blood and cause blood loss resulting in iron deficiency anaemia.

Life cycle at a glance

- Host: Man is the only host (definitive)
- Infective from: Filariform larva
- Route of infection: Penetration through skin
- Pathogenic from: Adult & larva
- Site of lesion: Small intestine

Clinical Manifestations

- Symptoms related to skin *e.g.* Hook worm dermatitis (ground itch)
- GIT symptoms *e.g.* Loose stools, vomiting or upper abdominal pain
- Respiratory symptoms *e.g.* Paroxysmal cough with blood stained sputum
- Features of anaemia and oedematous swelling particularly in untreated patients

Complications

- Anaemia secondary to blood loss
- Pulmonary eosinophilia (Löfller's syndrome)
- Pruritus
- Cutaneous larva migrans
- Gastrointestinal bleeding

Diagnosis

Based on C/F and demonstration of eggs in stool examination.

In addition

- Complete blood counts with PBF: Hb% (low), microcytic hypochromic anaemia and eosinophilia
- Serum albumin: Low
- X-ray chest: May be done when patients present with respiratory symptoms

Treatment

- Anthelmintics: Options are
 - * Albendazole: < 2 years - 200 mg and >2 years - 400 mg as single dose, OR
 - * Levamisole: 3 mg/kg as single dose, OR
 - * Pyrantel pamoate: 11 mg/kg, PO, once daily for 3 days, OR
 - * Mebendazole: 100 mg 12 hourly for 3 days

All the family members should be treated simultaneously

- Good Nutritional support
- Correction of anaemia oral iron. Blood transfusion may be considered in severe anaemia

References

1. Chatterjee KD. Parasitology in relation to Clinical Medicine 12th ed. India 1980.
2. Hossain MA, et al. Medical Parasitology-Basic and Clinical. 2nd ed. Mymensingh: Ittadi Book Center; 2008.
3. Molla MR. The Concise Text Book of Pediatrics 2nd edition Dhaka, Child Friendly Publications., 2007.
4. Maurice E, Salvana T, Salata RA. Amebiasis. In: Kliegman RM, Stanton BF, Geme III JWS, Schor NF, Behrman RE. Editors. Nelson Textbook of Pediatrics, 20th Edition. New Delhi: Elsevier; 2016: 1689-1692.
5. Dhawan VK, Steele RW, Pediatric Amebiasis. [Internet]. 2011 [updated 2012 May 10; cited 2012 May 29]. Available from: <http://emedicine.medscape.com/article/996092-overview>.
6. Kimura M, Nakamura T, Nawa Y. Experience with Intravenous Metronidazole to Treat Moderate-to-Severe Amebiasis in Japan. Am. J. Trop. Med. Hyg. 2007; 77(2):381-385.
7. Cabello R.R., et al. Nitazoxanide for the treatment of intestinal protozoan and helminthic infections. Trans Royal Soc Trop Med Hyg. 1997; 91: 701-3.
8. Reed SL. Amebiasis and infection with free living amebas. Harrison's Principles of Internal Medicine. 16th ed. New York: McGraw-Hill Medical Publishing Division; 2005. p. 1214-1218.

SELF ASSESSMENT

Short answer questions [SAQ]

1. What are the clinical features of amoebic liver abscess?
2. How will you investigate a case of amoebic liver abscess?
3. Write down the complications & treatment plan of amoebic liver abscess
4. Write down the clinical features & treatment plan of giardiasis

Multiple choice questions [MCQ]

1. Parasites enter the body through faecal-oral route are -
☐ a) *G. Intestinalis* ☐ b) *E. Vermicularis* ☐ c) *A. Duodenale*
☐ d) *N. Americanus* ☐ e) *A. Lumbricoides*
2. Microcytic hypochromic anaemia commonly occurs in -
☐ a) ancylostomiasis ☐ b) giardiasis ☐ c) enterobiasis
☐ d) ascariasis ☐ e) amoebiasis
3. Löffler's syndrome is associated with-
☐ a) ancylostomiasis ☐ b) ascariasis ☐ c) giardiasis
☐ d) enterobiasis ☐ e) amoebiasis
4. Complications commonly associated with ascariasis are -
☐ a) haemorrhage from gut ☐ b) vulvo-vaginitis ☐ c) intestinal obstruction
☐ d) ground itch ☐ e) urethritis
5. The following are antihelmentics-
☐ a) Metronidazole ☐ b) Tinidazole ☐ c) Albendazole
☐ d) Mebendazole ☐ e) Pyrantel pamoate

COMMON SURGICAL PROBLEMS OF CHILDREN

CLEFT LIP AND/OR CLEFT PALATE	285
ESOPHAGEAL ATRESIA WITH OR WITHOUT TRACHEOESOPHAGEAL FISTULA	286
CONGENITAL DIAPHRAGMATIC HERNIA	287
EVENTRATION OF DIAPHRAGM	287
INFANTILE HYPERTROPHIC PYLORIC STENOSIS	289
DUODENAL ATRESIA	290
INTUSSUSCEPTION	291
HIRSCHSPRUNG DISEASE	292
ANORECTAL MALFORMATIONS	294
UNDESCENDED TESTIS	295
POSTERIOR URETHRAL VALVE	295
HYDROCEPHALUS	296
OTHER SURGICAL PROBLEMS	297

In this chapter the common surgical problems of children are discussed. Diseases like appendicitis, pancreatitis etc are *discussed in chapter 13*.

CLEFT LIP

It is a congenital defect in the upper lip. It results from failure of union between medial nasal and maxillary processes (from which upper lip is developed). It may be either unilateral or bilateral.



CLEFT PALATE

It is a congenital defect of hard palate that results from failure of fusion of the palatine processes of the developing maxilla.



The major concerns of clefts -

- * Feeding difficulty
- * Aspiration pneumonia
- * Middle ear infection

Treatment

Medical

- Feeding:
 - * Isolated cleft lip: Help the baby to 'latch on' i.e attach to the nipple at the beginning of the feeding
 - * Cleft lip and palate: Feeding by long handled spoon in upright position
- Respiratory tract infection and middle ear infection should be treated promptly with antibiotics

Surgical

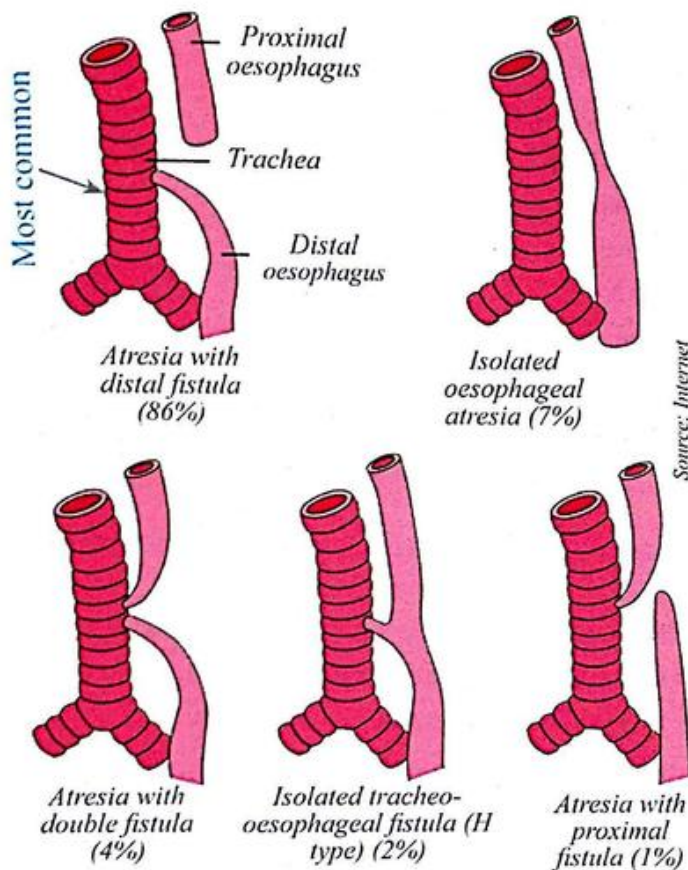
There is a conventional 'Rule of 10' applied for surgical correction of cleft lip and palate

	Weight	Age	Haemoglobin
Cleft lip	10 lb (~4.5 kg)	10 weeks	10 gm/dl
Cleft palate	10 kg	10 months	10 gm/dl

OESOPHAGEAL ATRESIA WITH OR WITHOUT TRACHEOESOPHAGEAL FISTULA

The commonest malformation of upper gut

Types



Cardinal Features

- * Excessive salivation/frothing from mouth after birth
- * Choking when feeding started, particularly if associated with fistula
- * Respiratory distress as a consequence of aspiration of saliva
- * Failure to pass a nasogastric tube to the stomach

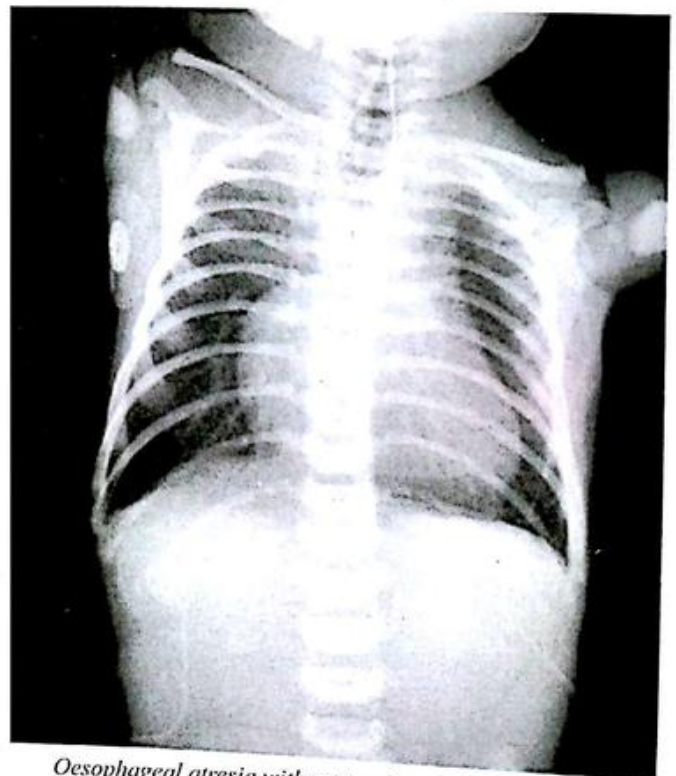
Investigations

- X-ray chest and abdomen shows -
 - * Presence of coiled nasogastric tube in the upper pouch. Along with it, if gas shadow is

found in stomach & intestine, it means there is associated tracheoesophageal fistula



Oesophageal atresia with tracheoesophageal fistula (presence of gas shadow in gut)



Oesophageal atresia without tracheoesophageal fistula (no gas shadow in gut)

Treatment

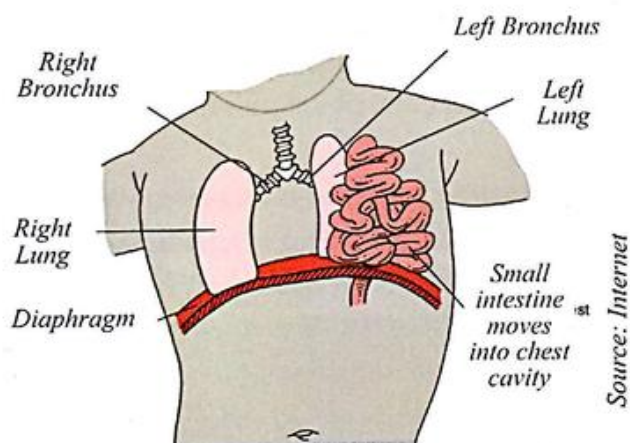
A. Medical

- Counsel the parents about the nature of the anomaly, treatment options and prognosis
- Keep the baby warm by either keeping inside incubator or under overhead warmer
- Keep the baby nothing per oral (NPO)
- Give maintenance IV fluid (10% DA /Baby saline)
- Give IV Ampicillin plus Gentamicin
- Place a soft nasogastric tube in upper pouch uncoiled and set to continuous suction
- Consult Paediatric surgeon immediately

B. Surgical: Definitive treatment

CONGENITAL DIAPHRAGMATIC HERNIA (CDH)

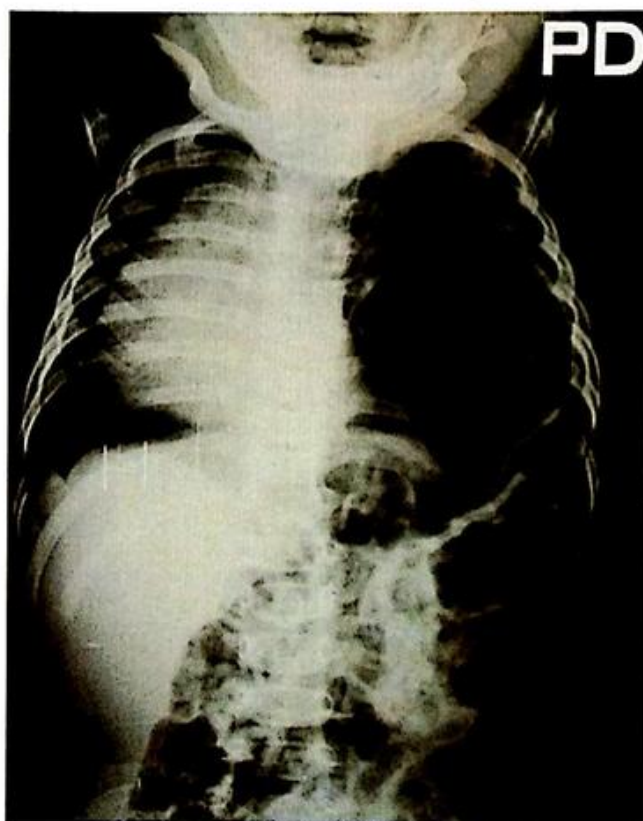
A congenital defect of the diaphragm through which coils of intestine from the abdominal cavity herniate up into the chest. This results in-



- * Respiratory distress due to compression of the lung on the affected side
- * Shifting of the heart and mediastinum to the side opposite to herniation

EVENTRATION OF DIAPHRAGM

This is another condition giving rise to similar clinico-pathological consequence like that of congenital diaphragmatic hernia where there is protrusion of the bowel loops into thorax due to weakness of diaphragm.



Gut in left side of chest under intact left diaphragmatic dome with shifting of mediastinum to right chest

The main difference between these two conditions is that *in case of eventration, the dome of diaphragm remains intact* unlike that of hernia.

Cardinal Features

Severe respiratory distress and cyanosis from the first minutes of birth.

Signs

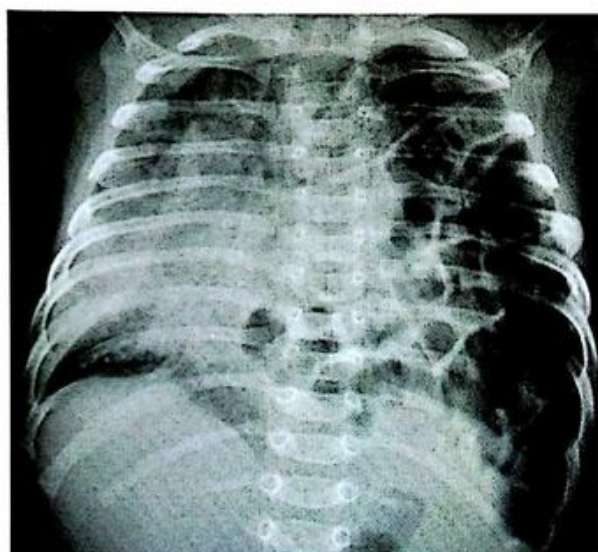
- Baby is severely dyspnoeic and cyanosed
- Chest
 - * Inspection: Severe chest indrawing, fast breathing
 - * Auscultation
 - Breath sounds are diminished on the affected side

- Bowel sounds may be heard on the affected side of the chest
- Tachycardia
- Heart sounds are displaced
- Abdomen: Scaphoid shaped if significant visceral herniation is present

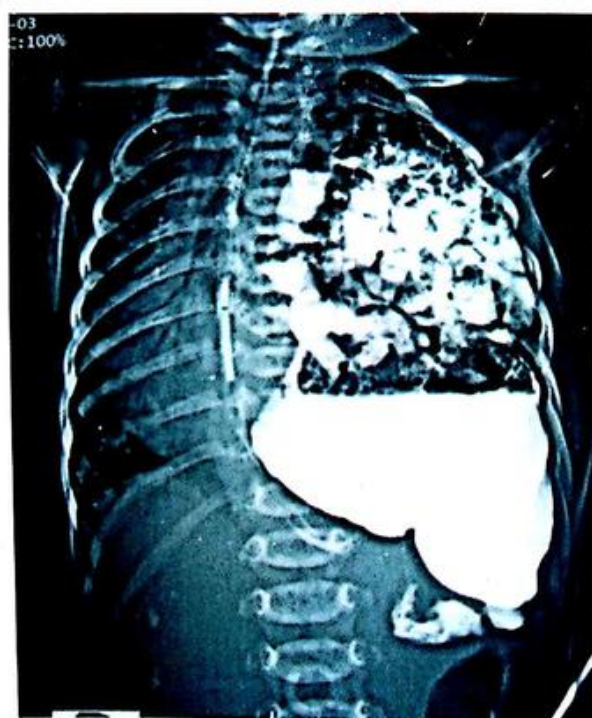
Investigations

- Chest X-ray

Shows bowel loops in the affected side of the chest with mediastinal shifting to opposite side



Coils of intestine in the left side of chest with shifting of mediastinum (left dome absent)



Contrast X-ray of upper GI showing coils of intestine in left hemithorax

- Arterial Blood gas: May show respiratory and/or metabolic acidosis

Treatment

A. Medical

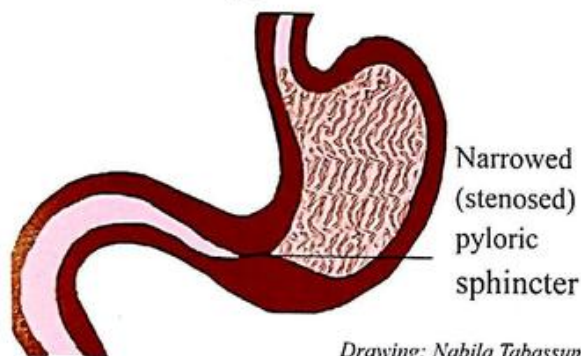
- Counsel the parents about the nature of the anomaly, treatment options and prognosis
- Keep the baby warm by either keeping inside incubator or under overhead warmer
- Keep the baby nothing per oral (NPO)
- Maintain an upright position so that head and chest is higher than abdomen and feet
- Give O₂ through a nasal cannula (not by mask) to avoid aerophagia (as it may distend the bowel loops which further compresses the lungs)
- If artificial ventilation is needed, avoid bag mask ventilation and immediately intubate the baby
- Insert NG tube for gastric decompression and thereby to prevent bowel distension and further lung compression
- Give maintenance IV fluid (10% DA /Baby saline)
- Give IV Ampicillin plus Gentamicin
- If baby is in shock (weak pulse, CRT >3 sec) give-
 - * Normal Saline 10-20 ml/kg over 30 min
 - * Inotropic agents such as Dopamine (5-10 µgm/kg/min) or Dobutamine (10-15 µgm/kg/min) after volume correction
- Monitor oxygen saturation, blood pressure, and capillary perfusion
- Consult Paediatric surgeon immediately
- Prepare the patient with pre-operative measures

B. Surgical: Definite treatment

INFANTILE HYPERTROPHIC PYLORIC STENOSIS (IHPS)

It is a congenital gastric outlet obstruction occurring in early infancy.

It results from diffuse hypertrophy and hyperplasia of the smooth muscles of the antrum of the stomach and pylorus.



Drawing: Nabila Tabassum

Cardinal Features

- * Projectile non bilious vomiting, almost after every feed usually start around 3 weeks of age
- * The baby remains hungry and sucks vigorously after the episodes of vomiting

Signs

- Visible peristalsis is seen passing from left to right of the abdomen and more obvious after a meal
- The enlarged pylorus, classically described as an "olive," may be palpated in the right upper quadrant of the abdomen or epigastrium



Olive shaped mass moving from left to right

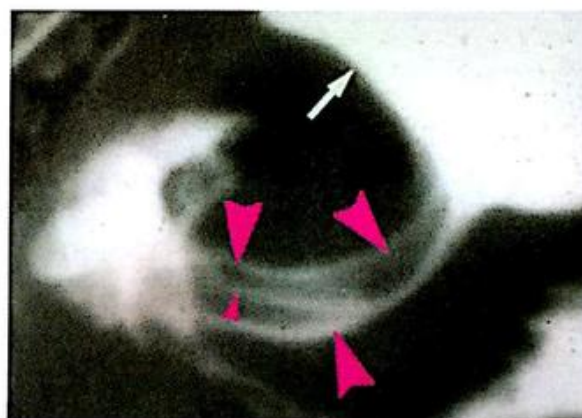
- The baby may be **dehydrated** due to repeated vomiting

Investigations

- Ultrasonography of abdomen: Diagnostic features are-

Pyloric muscle thickness	>4 mm
Diameter of pylorus	10-14 mm
Pyloric channel length	15-19 mm

- Barium meal X-ray: Shows an elongated pylorus with contrast material coursing through the mucosal interstices of the canal, forming the double-track sign/string sign (large arrowheads), with an additional central channel along the distal portion (small arrowhead). Mass impression on the gastric antrum (arrow), best seen during peristaltic activity, is termed the shoulder sign.



Source: Internet

- Serum electrolytes to assess any dyselec-trolytemia e.g. hyponatraemia, hypokalaemia, hypochloraemia and metabolic alkalosis

Treatment

Medical

- Counsel the parents about the disease and its outcome
- Keep the infant NPO
- Decompress stomach by NG suction
- If the infant is dehydrated -
 - * Infuse Normal Saline bolus 10-20 ml/kg over 30 minutes
 - * Continue IV fluid (10 % Baby saline) 1.25 - 2 times the normal maintenance requirement until the baby is well hydrated (as assessed by good urine output)

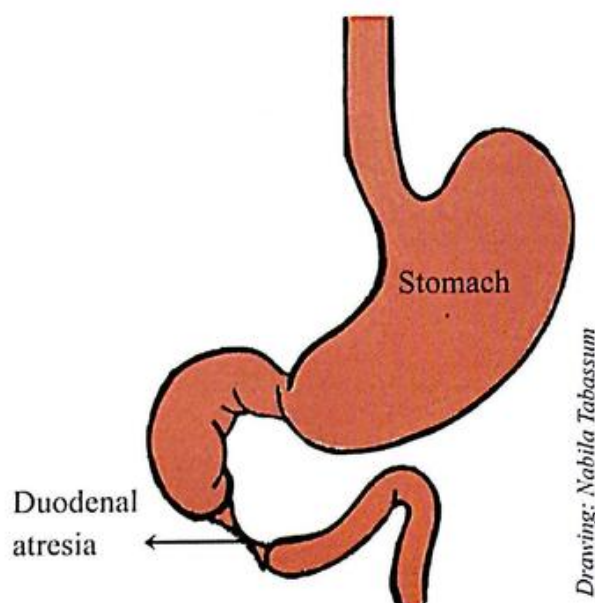
- * Add 2-4 mEq of Potassium Chloride(1-2ml of Inj. KCl) per 100 ml of IV fluid once a good urine output is achieved
- Consult Paediatric surgeon

Surgical

Pyloromyotomy is the standard procedure. It may be open (Ramstedt pyloromyotomy), laparoscopic or endoscopic.

DUODENAL ATRESIA

Congenital occlusion of duodenal lumen due to failure of the primitive solid gut tube to canalize. The occlusion may be complete or partial.



Cardinal Features

Recurrent attacks of vomiting (bilious in most cases) within hours of birth.

Signs

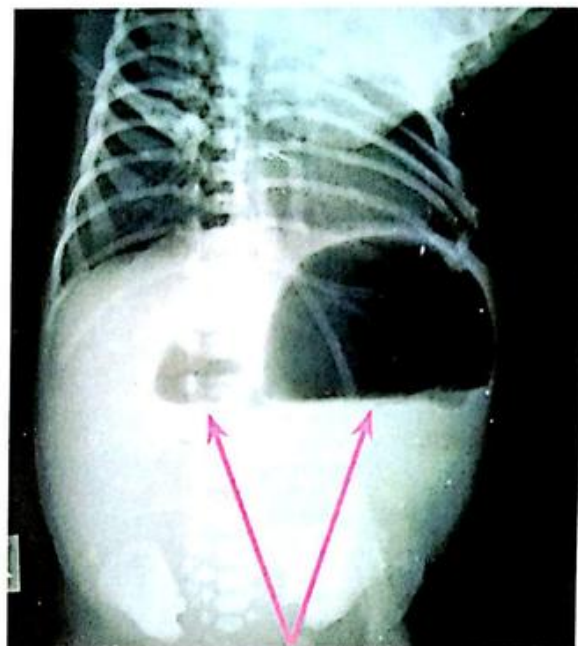
- Abdomen:
 - * May be scaphoid shaped
 - * Epigastric fullness (due to dilation of the stomach and proximal duodenum)

The baby may be dehydrated due to repeated vomiting

Investigations

- Plain X - ray abdomen erect posture: Shows "double bubble shadow"

- Contrast X-ray of upper GIT: Shows that no dye has passed beyond duodenum



Double bubble shadow.



No dye beyond duodenum

- Serum electrolytes to assess any dyselectrolytemia e.g. hyponatraemia, hypokalaemia, hypochloraemia and metabolic alkalosis

Treatment

A. Medical

- Counsel parents about the disease and its outcome
- Keep the infant NPO
- Insert an NG tube & decompress stomach by

NG suction

- Give IV fluid (10% DA or 10% Baby saline) (give Potassium correction if necessary)
- Give IV Ampicillin plus Gentamicin
- Consult Paediatric surgeon immediately

B. Surgical

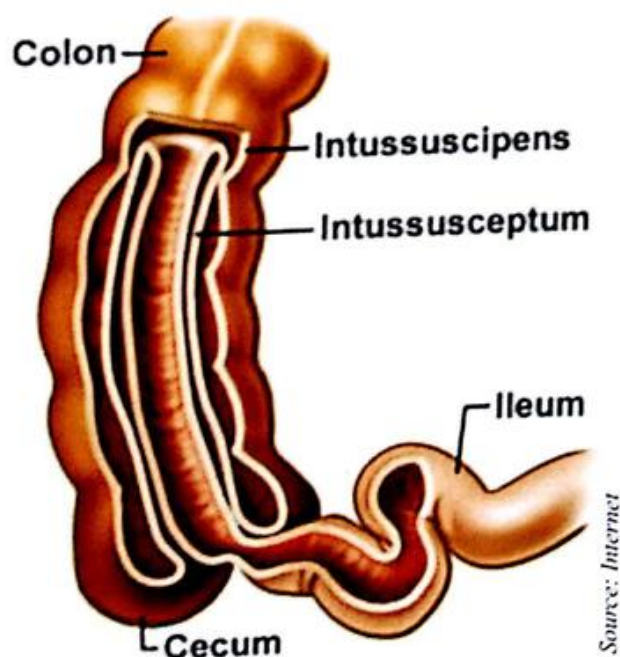
- Duodenoduodenostomy, either open or laparoscopic

INTUSSUSCEPTION

In intussusception, a segment of intestine invaginates into the adjoining intestinal lumen, causing bowel obstruction. It is the most frequent cause of intestinal obstruction in children under 1 year, mostly occurring around 6 months when complementary foods are introduced.

Pathology

The proximal portion of bowel (the intussusceptum), invaginates into the distal portion of bowel (the intussusciens), pulling its mesentery along with it. In most cases, ileum invaginates into the caecum.



Intussusceptum: Ileum invaginates into caecum

Source: Internet

This causes constriction of mesenteric blood vessels resulting in obstructed venous return and engorgement (oedema) of the intussusceptum leading to its necrosis and bleeding. On rare occasions, the advancing intestine may be prolapsed through the anus.

Cardinal Features

- Intermittent, severe colicky abdominal pain in a previously well child
- The child appears calm and relieved in between attacks
- Non-bilious followed by bilious vomiting
- Stool looks like red currant jelly. This is a mixture of mucous, sloughed mucosa and blood

Signs

- Abdomen is distended
- A tender sausage-shaped mass is felt in right hypochondrium & empty right lower quadrant (Dance sign)
- Bowel sound may be absent
- Digital rectal examination: The presence of bloody mucus on the finger as it is withdrawn after rectal examination supports the diagnosis of intussusception



Stool looks like red currant jelly

Courtesy: Prof. Md. Ashraf Ul Haq Kizal

Investigations

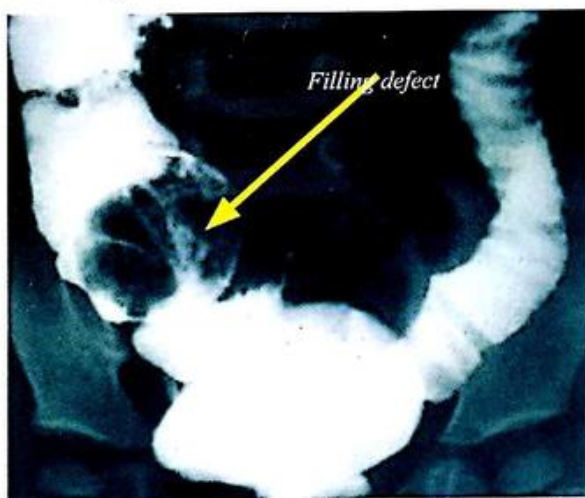
- Plain X-ray abdomen: Small bowel dilatation



X-ray abdomen showing distended bowel loops

Source: Internet

- Air or barium contrast enema: Shows intussusception in the caecum



Contrast X-ray abdomen showing filling defect at caecum

Source: Internet

- USG of whole abdomen: Classic doughnut or target appearance of an intussusceptum inside an intussusciens



USG abdomen showing doughnut sign

Source: Internet

Treatment

A. Medical

- Counsel parents about the disease, its natural history and outcome
- Keep the baby nothing per oral (NPO)
- Give maintenance IV fluid (10% DA /Baby saline)
- Give Potassium correction if necessary
- Give IV Ampicillin plus Gentamicin
- Insert an NG tube & decompress stomach
- Consult Paediatric surgeon immediately

B. Surgical

- Nonoperative reduction with a therapeutic enema (barium or water-soluble contrast, or pneumatic reduction)
- If nonoperative reduction is unsuccessful or if obvious perforation is present, laparotomy should be done

HIRSCHSPRUNG DISEASE (CONGENITAL AGANGLIOSIS, CONGENITAL MEGACOLON)

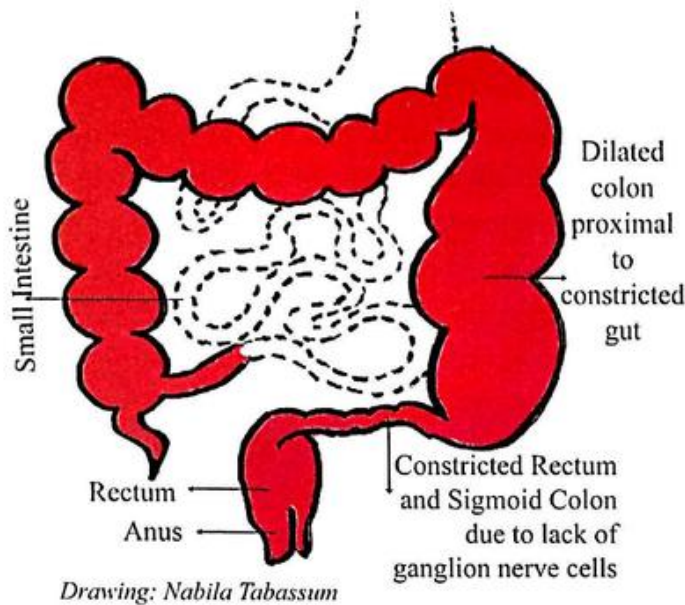
The most common cause of lower intestinal obstruction in neonates (80%) and older children. Most of the children present within 1st year of life.

Pathogenesis

Due to the **failure of neural crest cell migration** during development, there is absence of neurons within submucosal (Meissner) and myenteric (Auerbach) plexus of the large gut. The resulting aganglionic segment has sustained contraction and no peristalsis causing colonic obstruction.

The normal colon proximal to the aganglionic segment gets dilated resulting in abdominal distention, increased intraluminal pressure, which results in decreased blood flow and

deterioration of the mucosal barrier leading to enterocolitis with associated sepsis and signs of bowel obstruction.



Clinical Manifestations

Neonates	Older infants and children
* Delayed passage of meconium beyond the first 24-48 hours of life * Repeated vomiting * Abdominal distension * If a soft rubber catheter is passed through the anal opening its tip is stained with meconium on withdrawal * Infants may also present with enterocolitis, sepsis, and perforation	* History of difficulty with the passage of stools, starting in the 1st few weeks of life * Chronic constipation refractory to usual treatment * Abdominal distention with palpable dilated loops of colon * Rectal examination commonly reveals an empty rectum and forceful expulsion of faecal material upon withdrawal of finger * Gripping of the examining finger (anal grip) may be felt due to spastic zone

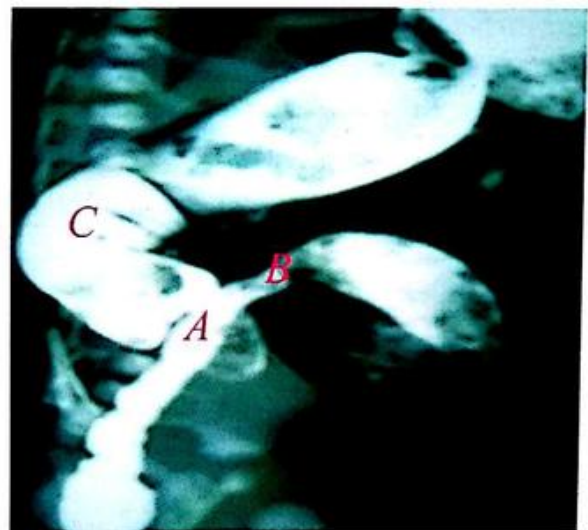
Investigation

- Plain X-ray abdomen: Shows small bowel obstruction and distended bowel loops



Distended bowel loops

- Single-contrast barium enema: Shows a transition zone between normal dilated proximal colon and a smaller-caliber constricted distal colon



A Constricted zone B Transition zone C Dilated proximal colon

Rectal biopsy: Reveals absence of the ganglion cells in the submucosal (Meissner) and myenteric (Auerbach) plexus and hypertrophied nerve trunks

Treatment

A. Medical

- Counsel parents about the disease and outcome
If the child presents with features of obstruction-
- Keep the baby nothing per oral (NPO)
- Give maintenance IV fluid (10% DA /Baby saline)
- Give Potassium correction if necessary
- Give IV Ampicillin plus Gentamicin
- Insert an NG tube & decompress stomach
- Give rectal irrigations with normal saline 3-4 times daily
- Consult Paediatric Surgeon immediately

B. Surgical: Definitive treatment.

ANORECTAL MALFORMATIONS (IMPERFORATE ANUS)

During routine newborn examination it is sometimes found that the baby is born without or misplaced anal opening. These presentations are collectively called anorectal malformations and include a wide spectrum of defects in the development of the lowest portion of the intestinal and urogenital tracts.

Most patients with imperforate anus have a fistulous connection with urethra in males or with vestibule in females.

Clinical Manifestations

- History of failure to pass meconium by 24 hours after birth
- Absence of anal opening or visible anal pit
- Abdominal distention



Absent anal orifice

abnormal openings either in the perineum, urethra (coloured urine - meconium in urine) or sometimes through vagina in females

Investigations

- Cross table lateral pelvic radiography/ invertogram at 24 hours: The baby is held upside down and X-ray is focused from a lateral side. This reveals the level of the gas shadow (rectal pouch) whether below the level of coccyx or not. Pouch above the tip of coccyx are regarded as high variety anomalies



Invertogram showing gas shadow (rectal pouch) below the level of coccyx

- Renal USG: To evaluate urinary tract abnormalities

Treatment

A. Medical

- History of passage of meconium through some

- Counsel parents about the disease and its outcome

If the child presents with features of obstruction

- Keep the baby nothing per oral (NPO)
- Give maintenance IV fluid (10% DA /Baby saline)
- Give Potassium correction if necessary
- Give IV Ampicillin plus Gentamicin
- Insert an NG tube & decompress stomach
- Identify and treat associated co-morbidities promptly
- Consult Paediatric surgeon immediately

B. Surgical: Definitive treatment.

UNDESCENDED TESTIS (CRYPTORCHIDISM)

Cryptorchidism literally means hidden testis. The condition may be unilateral or bilateral. The exact cause is unknown but may be related to either genetic, hormonal or mechanical factors. Prematurity is a risk factor.

When a boy is seen with single or no testicle in the scrotum, one should think of the following possibilities:

- Testis is incompletely descended and remains anywhere in its normal pathway of descent e.g. inguinal canal, superficial and deep inguinal ring or in the abdomen
- Testis is in ectopic position e.g. penis, femoral and perineal areas
- Agenesis of testis
- Testicular retraction, due to a hyperactive cremasteric reflex

Clinical Manifestations

- The scrotum on the side of nondescent will be seen empty and not as well developed as the contralateral normal side

Investigations

- Ultrasound of abdomen: To search the absent testicle
- MRI or CT scan of abdomen: For intra-abdominal testes
- Laparoscopy: Diagnostic



Hypoplastic right hemiscrotum with an undescended right testis.

Complications

- Infertility
- Testicular malignancy
- Associated hernia
- Torsion of the cryptorchid testis

Treatment

A. Medical

- Hormonal therapy with hCG or LH-releasing hormones (LHRH): Controversial

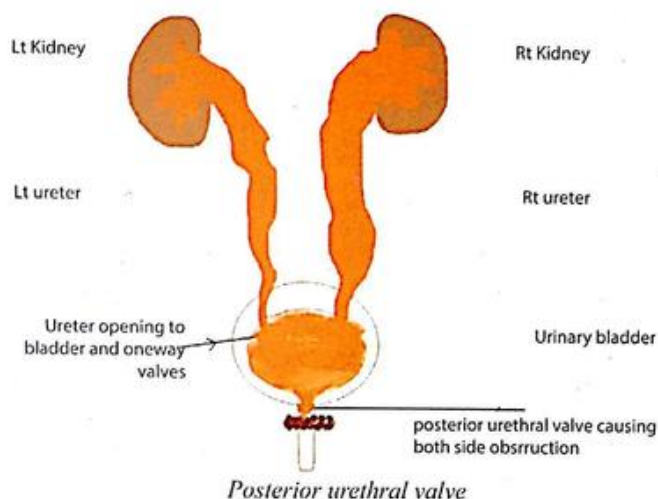
B. Surgical

- Orchiopexy should be performed between 6 and 12 months of age or soon after diagnosis

POSTERIOR URETHRAL VALVE

The most common cause of severe obstructive uropathy among the boys. These are abnormal congenital leaflets in the prostatic portion of the urethra that results in narrowing of the

bladder outlet and obstruction of urine flow. As a result, there is increased pressure and dilatation of organs proximal to the obstruction *e.g. within urinary bladder, ureters, renal pelvis* and finally give rise to vesico-ureteric reflux (VUR), hydroureter, hydronephrosis and renal insufficiency.



Clinical Manifestations

Neonates: Distended bladder, palpable kidneys, vomiting, poor urinary stream, failure to thrive, renal insufficiency

Older children: Vomiting, poor urinary stream, urinary retention, bladder distension, renal insufficiency

Investigations

- Ultrasonogram of genito-urinary system
- Voiding cystourethrogram
- Assessment of renal function



Voiding cysto-urethrogram A/P view showing gross dilatation of ureters and renal pelvis

Courtesy: Prof G. Muinuddin

Treatment

Surgical: Transurethral ablation of the valves

HYDROCEPHALUS

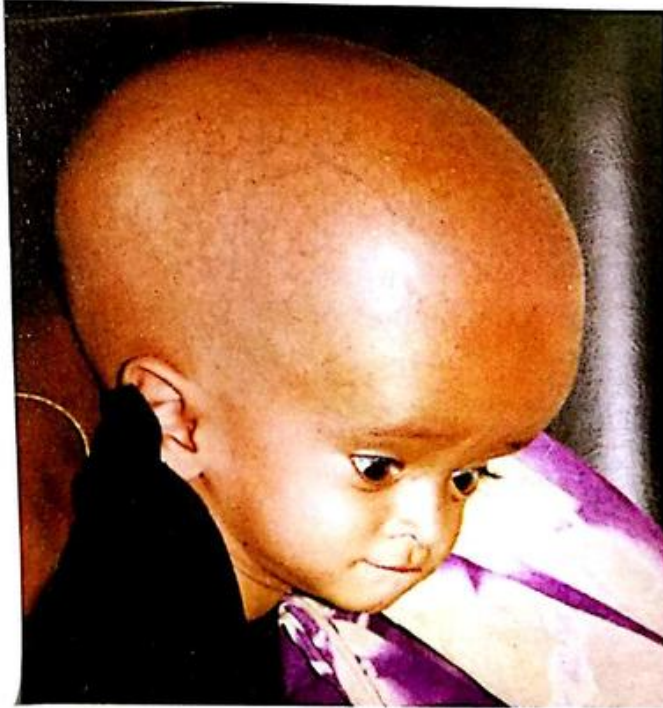
Hydrocephalus is the enlargement of head size from ventriculomegaly due to accumulation of CSF either from overproduction or impaired circulation and absorption.

Types

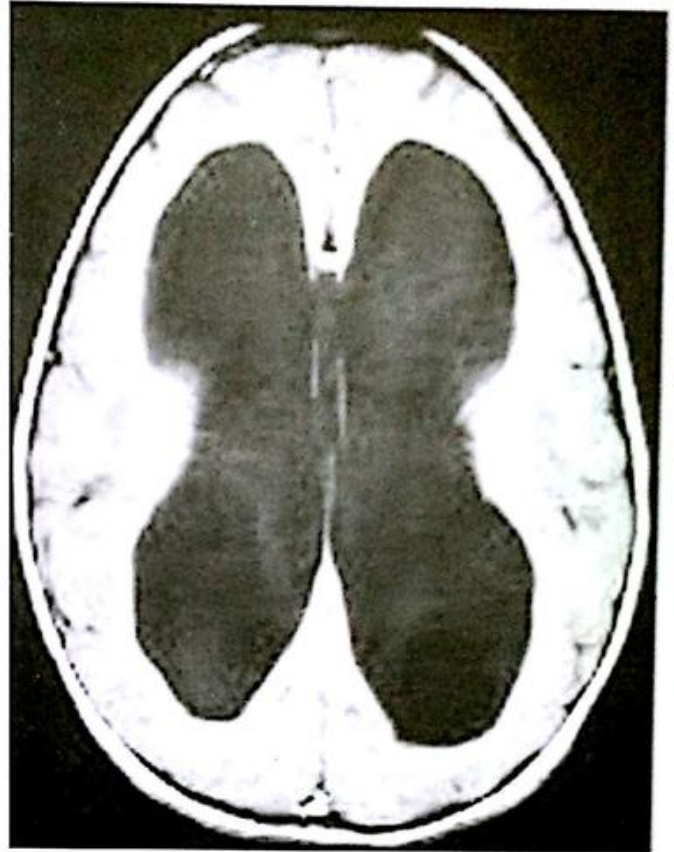
- **Noncommunicating (Obstructive):** Stenosis of aqueduct of Sylvius and CNS tumors pressing over the CSF pathway
- **Communicating** (results from obliteration of subarachnoid cistern or malfunctioning of arachnoid villi) and occurs in meningitis, leukaemia and overproduction of CSF from choroid plexus papilloma.

Clinical Manifestations

Progressive enlargement of head size, frontal bossing, delayed closure of anterior fontanel and or widely split cranial sutures, "sunsetting" of eyes (due to pressure on superior colliculus causing eyes to rotate downward). Sometimes, there may be signs of raised intracranial pressure e.g. vomiting, headache, convulsion



Hydrocephalus

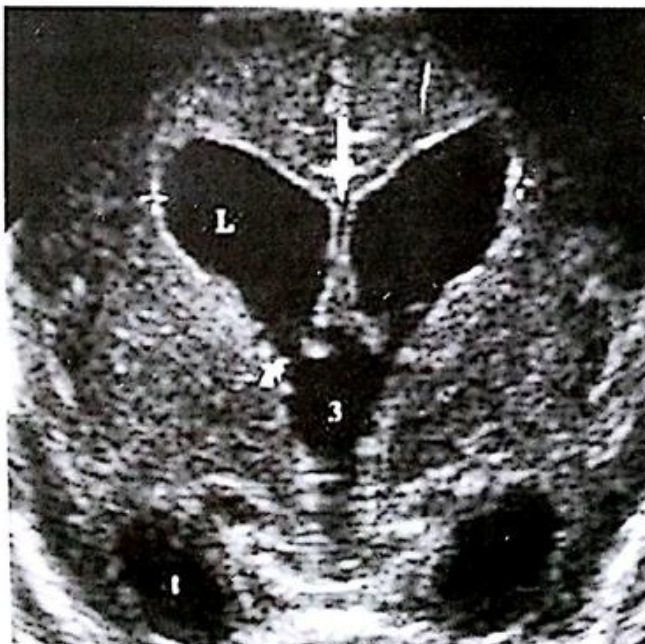


CT scan of brain showing bilaterally enlarged lateral ventricles

Treatment

Surgical: Ventriculo-peritoneal shunt

Investigations



Ultrasonogram of brain showing bilaterally enlarged lateral ventricles

SUMMARY OF OTHER SURGICAL PROBLEMS IN CHILDREN



Spinal defect

- Spina bifida occulta: Bony defect without any herniation of meninges
- Meningocele: Protrusion of the meninges
- Myelomeningocele: Protrusion of the meninges along with portion of spinal cord through a bone defect in the vertebral column. The meninges covered sac is usually filled with CSF



Source: Internet

Tongue tie (Ankyloglossia)

- Too short frenulum lingula resulting in reduced mobility of tongue causing feeding and speech problem
- Treatment : Frenulotomy



Umbilical hernia

- Swelling at the level of umbilicus due to protrusion of intestinal coils through weak periumbilical muscles
- May cause strangulation, otherwise benign
- Most cases usually disappear by 1-1½ years of age



Courtesy: Prof. Md. Ashraf Ul Huq Kazal

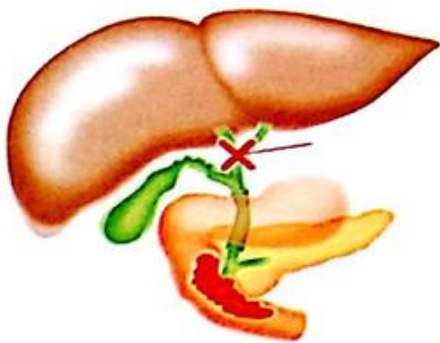
Gastroschisis

- Full thickness defect in abdominal wall resulting in protrusion of intra-abdominal viscera to the exterior
- Protruded organs are not covered by peritoneum
- Treatment: Surgery



Omphalocele

- A midline abdominal wall defect through which intra-abdominal viscera herniate into the base of the umbilical cord
- In contrast to gastroschisis protruded organs are covered by a membrane and contained within the peritoneal sac
- Treatment: Surgery



Source: Internet

Biliary atresia

- A whole or a part of the extrahepatic bile ducts is absolutely atretic
- Usually presents with jaundice (direct hyperbilirubinaemia), pale stool and hepatomegaly
- Treatment: Surgery (*Modified Kasai Portoenterostomy*) should be done as early as possible)



Courtesy: Prof. A Hamif Tablu

Rectal polyp

- Presents with history of passing of few drops of blood after the passage of stool
- Bleeding is painless and not smeared on stool
- Treatment: Polypectomy



Hypospadias

- Urethral opening is ectopically located on the ventrum of the penis proximal to the tip of the glans penis or as far down the scrotum or perineum
- The penis is more likely to have associated ventral shortening and curvature, called chordee
- Older children have difficulty in micturition as the urine 'spray' backwards
- Treatment: Surgery



Epispadias

Courtesy : Prof. Md. Ashraf Ul Huq Kazal

- Malformation of the penis in which the urethra ends in an opening on the upper aspect (the dorsum) of the penis
- This may lead to backward flow of urine into the kidney, repeated UTI and urinary incontinence
- Treatment: Surgery



Phimosis

Courtesy: Prof. A Hanif Tablu

- Inability to retract the foreskin of the penis
- Treatment

Nonsurgical

- Application of topical steroid creams such as betamethasone, mometasone furoate and cortisone: Steroids work by reducing the body's inflammatory and immune responses, and also by thinning the skin
- Stretching of the foreskin can be accomplished manually

Surgical

- Circumcision
- Minor operations to relieve foreskin tightness



Paraphimosis

Courtesy: Prof. A Hanif Tablu

- Entrapment of a retracted foreskin behind the coronal sulcus results in impairment of venous return from the glans with consequent worsening venous engorgement of glans
- Furthermore this causes compromised arterial supply & painful swelling of the glans that may eventually lead to gangrene or autoamputation of the distal penis
- Treatment: Surgery



Courtesy: Prof. A Hanif Tablu

Hydrocoele

- A collection of fluid within the processus vaginalis that produces swelling in the scrotum
- Presents with irreducible swelling in the scrotum
- Transillumination test of the scrotum is positive displaying fluid in the tunica vaginalis
- Usually spontaneous resolution by 18 months, otherwise surgery. (herniotomy)



Courtesy: Prof. A Hanif Tablu

Inguinal hernia

- It results from persistent patency of the processus vaginalis
- Presents with reducible swelling in the groin or scrotum that increase in size on crying or after activity
- Treatment: Herniotomy as soon as diagnosed



Talipes equinovarus

- Congenital deformity involving one foot or both where the affected foot appears rotated internally at the ankle (inverted and adducted)
- Serial plaster cast with gentle manipulation of the foot towards the corrected position before the cast is applied and changed every 1-2 weeks
- Treatment: Surgery (If nonoperative treatment is unsuccessful)

References

1. Kliegman RM, Stanton BF, Geme III JWS, Schor NF, Behrman RE. Editors. Nelson Textbook of Pediatrics, 20th Edition. New Delhi: Elsevier; 2016
2. Khan MR, Rahman ME. Essence of Pediatrics. 4th ed. New Delhi: Elsevier; 2011. Chapter 23 , Common Surgical Problems; p.444-454.
3. Kabir ARML. Pediatric Practice on Parents Presentation, 1st ed. Dhaka: Asian Colour Printing; 2011.
4. Molla MR. Concise Textbook of Pediatrics. 2nd ed. Dhaka: Child friendly publications, 2007.
5. Neville HL. Pediatric Hirschsprung Disease. [Internet]. 2012 [updated 2012 May 8; cited 2012 May 15]. Available from: <http://emedicine.medscape.com/article/929733>.
6. Schwartz DS. Congenital Diaphragmatic Hernias. [Internet]. 2012 [updated 2012 Jan 19; cited 2012 May 15]. Available from: <http://emedicine.medscape.com/article/426142>.
7. Saxena AK. Esophageal Atresia With or Without Tracheoesophageal Fistula . [Internet]. 2012 [updated 2012 Apr 25; cited 2012 May 15]. Available from: <http://emedicine.medscape.com/article/935858>.
8. Nazer H. Pediatric Hypertrophic Pyloric Stenosis. [Internet]. 2012 [updated 2012 Mar 8; cited 2012 May 15]. Available from: <http://emedicine.medscape.com/article/929829>.
9. Raine JE, Cunningham AJ, Walker JM. 100 Cases in Paediatrics. London: Hodder Arnold; 2009.

SELF ASSESSMENT

Short answer questions [SAQ]

1. How will you manage a case of cleft lip & cleft palate?
2. What is eventration?
3. Write down the difference between eventration & congenital diaphragmatic hernia
4. Write down the clinical features of congenital diaphragmatic hernia
5. How will you treat a neonate with congenital diaphragmatic hernia?
6. Write down the clinical features & investigations of infantile pyloric stenosis
7. Write down the clinical manifestation of Hirschsprung disease
8. How will you evaluate a neonate with imperforated anus?

FLUID, ELECTROLYTE AND ACID-BASE HOMEOSTASIS

BODY FLUID	303
DAILY FLUID REQUIREMENT	303
FLUID REPLACEMENT	304
HYPONATRAEMIA	305
HYPERNATRAEMIA	306
HYPOKALAEMIA	307
HYPERKALAEMIA	307
ACID-BASE HOMEOSTASIS	309

BODY FLUID

Our body is composed of solids and water. Total body water (TBW) alone constitutes about 60% of total body weight and the remaining 40% is contributed from solids *e.g. protein (18%), mineral (7%) and fat (15%)*.

Contribution of TBW to body weight according to different stages of life -

Foetus	85%
Neonate	Term- 75%, Higher in preterm
Infant	65%
1 st year-Puberty	60%

Distribution of body fluid

Of the total body fluid, two-third remains within cells (*intracellular fluid*) and one-third outside cells (extracellular fluid) as follows-

Intracellular Fluid (40% of Body Weight)	Extracellular Fluid (20% of body weight) Interstitial fluid (15%) + Plasma (5% of body weight)
--	--

Transcellular fluid is the portion of total body water contained within epithelial lined spaces. It is about 2.5% of the total body water. Examples

of this fluid are *cerebrospinal fluid, ocular fluid, joint fluid and bladder urine*.

The distribution of fluid across plasma, interstitium as well as intracellular space is controlled by -

- **Oncotic pressure:** Exerted by serum protein mainly albumin
- **Osmotic pressure:** Exerted by serum electrolytes mainly sodium

DAILY FLUID REQUIREMENT

Requirement = Maintenance fluid + [Fluid deficit, if any] + [Ongoing fluid loss, if any]

- Maintenance fluids are equal to routine daily loss through urine (50%), skin (30%), respiratory tract (15%) and stool (5%)
- Fluid deficit and ongoing loss are the additional losses apart from daily routine loss through -
 - i) Gastro-intestinal tract *e.g. diarrhoea, vomiting, naso-gastric suction*
 - ii) Third space loss *e.g. burn, trauma, sepsis, abdominal surgery*
 - iii) Urine *e.g. diabetes mellitus, diabetes insipidus etc.*

Maintenance Fluid: How much?

For Neonates (to start with)

- * Term: 60 ml/kg/day
- * Preterm: 80-100 ml/kg/day

Thereafter, **daily increment** for term baby is @ 20 ml/kg/day and for low birth weight baby @ 15 ml/kg/day up to first week of life. In preterm babies' amount of fluid can be raised up to 200 ml/kg/day by 14 days of age.

For Infants and Children

- For 1st 10 kg body weight : 100 ml/kg/day
- For Next 10 kg body weight add 50 ml/kg/day
- Everything over 20 kg body weight add 20 ml/kg/day to a maximum of 2400 ml/day

Example: Maintenance fluid requirement for a 28 kg child will be as follows-

$$(100 \times 10) \text{ ml/day} + (50 \times 10) \text{ ml/day} + (20 \times 8) \text{ ml/day} \\ = (1000 + 500 + 160) \text{ ml/day} = 1660 \text{ ml/day}$$

Age specific maintenance fluids

Age	Birth to 24-48 hours	48 Hours- 1 year	1-10 years	> 10 years
Choice of Fluid	10% DA	5-10% Dextrose in 0.225% NaCl (Baby saline)	5-10% DA in 0.45% NaCl (Junior saline)	5-10% dextrose in 0.9% NaCl (DNS)

Fluid deficit: How to measure?

It is estimated on the basis of degree of dehydration which is assessed clinically and expressed as degree of dehydration and percentage loss of total body weight as follows -

Degree of Dehydration	Approximate percentage loss of total body weight
Mild	3-5%
Moderate	>5-10%
Severe	>10-15%

FLUID REPLACEMENT

The way of fluid replacement depends on the extent of fluid deficit and are corrected either orally or through IV infusion depending on the degree of dehydration (fluid loss) and this includes -

a. Replacement of existing Fluid Deficit and Ongoing Loss

These are replaced at different rates and with different types of fluids *e.g.* ORS, Normal saline, DNS, Baby saline, Cholera saline,

Hartman etc. depending on aetiology, electrolyte profile of the patient & on the severity of dehydration.

b. Replacement of maintenance fluid

It is done **evenly** over 24 hours with the age specific maintenance fluid types.

PRINCIPLES OF FLUID REPLACEMENT

There are different ways on how to replace the fluid. A simple method is discussed below.

Phase I: Immediate **bolus** administration of normal saline 10 ml/kg., if unstable haemodynamic status. Repeated bolus may be administered until stable haemodynamic status and adequate urine output.

Replacement of remaining fluid deficit *i.e.*; Total fluid deficit - the amount administered as a bolus plus Maintenance fluid will be done in another two phases-

Phase II: (Initial 8 hours) Following the fluid bolus administered in phase I the Remaining Fluid Deficit (RD) must be calculated by following formula-

$$\text{RD} = \text{Total deficit} - \text{Amount of fluid given as a bolus in phase I}$$

1st half of the remaining deficit (RD) is replaced over 8 hours in phase II. Maintenance fluid must also be replaced in phase II

Phase III: The 2nd half of the remaining deficit (RD) is replaced over the next 16 hours. Maintenance fluid must also be replaced in phase III

Example: Calculation of fluid replacement

A 22 kg child is hospitalized with severe dehydration due to acute diarrhoea. He is estimated to have 10% weight loss. His serum sodium is 140 meq/l. He has no ongoing losses. How to replace the fluid of this child?

Calculation

$$\text{a) Total fluid deficit} = 10\% \text{ of } 22\text{kg} \\ = 2.2 \text{ L/2200 ml}$$

b) Maintenance fluid:

First 10 kg of body weight- 10×100 ml
= 1000 ml/day

Second 10 kg of body weight- 10×50 ml
= 500 ml/day

Remainder 2 kg of body weight- 2×20 ml
= 40 ml/day

So, total maintenance fluid is 1540 ml and to be replaced within next 24 hours i.e. @64 ml/hours.

The total amount [a+b i.e. deficit + maintenance] has to be given over next 24 hours as follows:

i) Phase I: 2 Bolus doses (as the child does not respond to a single bolus)

1st bolus: $10 \text{ ml/kg} = 10 \times 22 = 220 \text{ ml}$

2nd bolus: $10 \text{ ml/kg} = 10 \times 22 = 220 \text{ ml}$

So, total bolus amount given is 440 ml of Normal saline.

Remaining deficit (RD): $(2200 - 440) \text{ ml}$
= 1760 ml

ii) Phase II: Replacement by 8 hours of -

a. 1st $\frac{1}{2}$ of RD = $1760/2$ i.e. 880 ml

b. Maintenance fluid

= $64 \text{ ml} \times 8 \text{ hours}$ i.e. 512 ml

Total = $(880+512)$

= 1392 ml i.e. 44 drops/minute

iii) Phase III: Replacement by 16 hours of

a. 2nd $\frac{1}{2}$ of RD = $1760/2$ i.e. 880 ml

b. Maintenance fluid

= $64 \text{ ml} \times 16 \text{ hours}$ i.e. 1024 ml

Total = $(880+1024) = 1904 \text{ ml}$ i.e. 30 drops/min.

ELECTROLYTES

Electrolytes are the minerals in the body fluids that dissociate into ions and carry electric charges and exert their effect on maintaining body fluid distribution, acid-base balance, muscle and nervous system function, and other important processes.

Common electrolyte levels in the blood

Cations		Anions	
Name	Serum level	Name	Serum level
Na ⁺	135-145 mmol/L	Cl ⁻	98-106 mmol/L
K ⁺	3.5-5.5 mmol/L	HCO ₃ ⁻	22-30 mmol/L
Ca ⁺⁺	8.4-10.2 mg/dl	PO ₄ ⁻	2.9-5.4 mg/dl
Mg ⁺⁺	1.5-2.4 mg/dl	SO ₄ ⁻	2.4-4.1 mg/dl

The fluid and electrolytes remain in equilibrium within the body. In disease process this balance is altered that leads to dyselectrolytaemia and dehydration or fluid overload.

The electrolyte imbalances commonly encountered in clinical practices are related to abnormalities in sodium and potassium homeostasis. These are hypo or hypernatraemia and hypo or hyperkalaemia. The basic rules of their corrections are discussed below.

HYPONATRAEMIA (*S. Na⁺ <130 mEq/L*)

Causes	Water overload, SIADH, sepsis, excess GIT loss, excess renal loss, congenital adrenal hyperplasia, hypoaldosteronism, relieved obstructive uropathy
Clinical features	Nausea, irritability, malaise, lethargy, headaches, seizures, coma
Calculation on how to correct the Na ⁺ deficit	Na ⁺ deficit (mEq) = (Desired Na ⁺ - Observed Na ⁺) × body weight (BW) in kg. × 0.6 + Daily maintenance Na ⁺ : 2-3 mEq/kg/day for next 2 days

How to correct?

Example: Baby, 7 days, Wt. 1.5 kg. S. Na⁺ 122 mEq/L

a. Deficit of Na⁺ = $(135 - 122) \times 1.5 \times 0.6 = 11.7 \text{ mEq}$.

b. Maintenance Na⁺ = $3 \times 1.5 \times 2 \text{ days} = 9 \text{ mEq}$.

* Total Na⁺ requirements = $11.7 + 9 = 20.7 \text{ mEq} = 21 \text{ mEq}$, to be replaced over 48 hrs

* Fluid requirements for 48 hours

= $1.5 \times 150 \times 2 = 450 \text{ ml}$.

- Total 21 mEq Na^+ has to be replaced in 450 ml fluid over 48 hours
- Appropriate fluid here: 0.3% NaCl as it contains 51 mEq Na^+ /litre or 22 mEq in 450 ml. (see chart on page 308)
- Rate of infusion: 9 micro drops/min as at this rate Na^+ correction will be 11 mEq/day

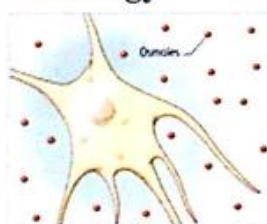
Important notes

- * Avoid rapid correction because it may cause central pontine myelinolysis
- * Rate of correction should not be more than 12 mEq /L/24 hours
- * Maintenance Na^+ should also be provided
- * In symptomatic hyponatraemia e.g. convulsion if $\text{S. Na}^+ < 120 \text{ mEq/L}$, 3% NaCl may be used

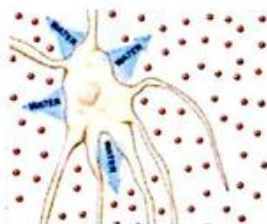
HYPERNATRAEMIA ($\text{S. Na}^+ > 145 \text{ mEq/L}$)

Severity	S Na^+ concentration
Mild	> 145-155 mEq/L
Moderate	> 155-175 mEq/L
Severe	> 175 mEq/L

Pathology



Normal neuron



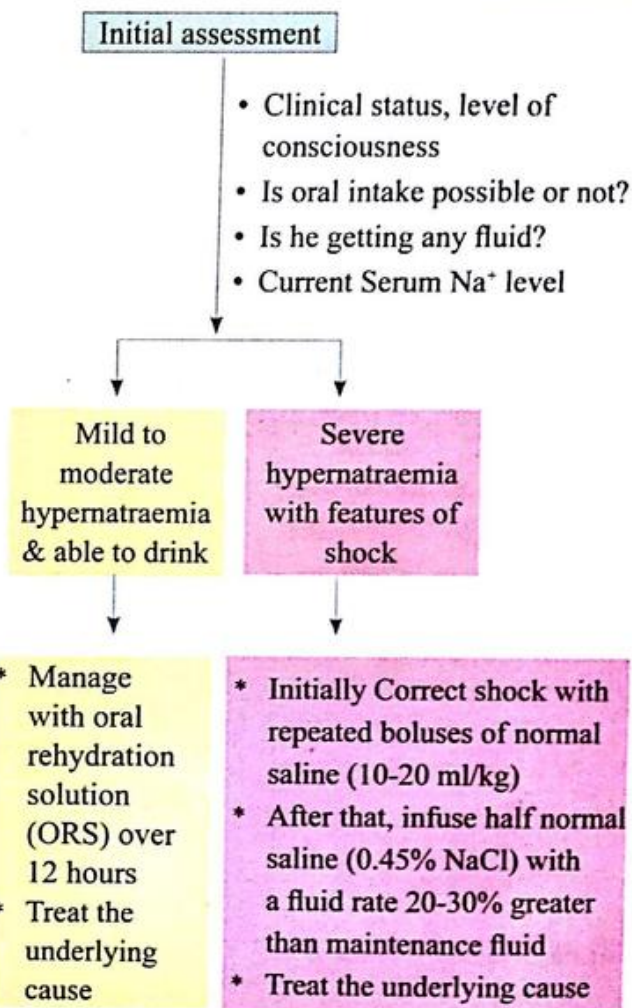
Crenated neuron in severe hypernatremia

Causes	* Water depletion e.g. diabetes insipidus, increased insensible loss, inadequate intake * Water loss $> \text{Na}^+$ e.g. acute diarrhoea * Na^+ excess e.g. improperly mixed formula or ORS, excess NaHCO_3 intake, hyperaldosteronism
Clinical features	Irritable restless, lethargy, high pitched cry, hyperpnea, seizure

How to correct?

Correction depends upon

- * Clinical status of the patients
- * Severity of hypernatraemia
- * Rapidity of Na^+ imbalance
- * Aetiology of hypernatraemia



Important notes

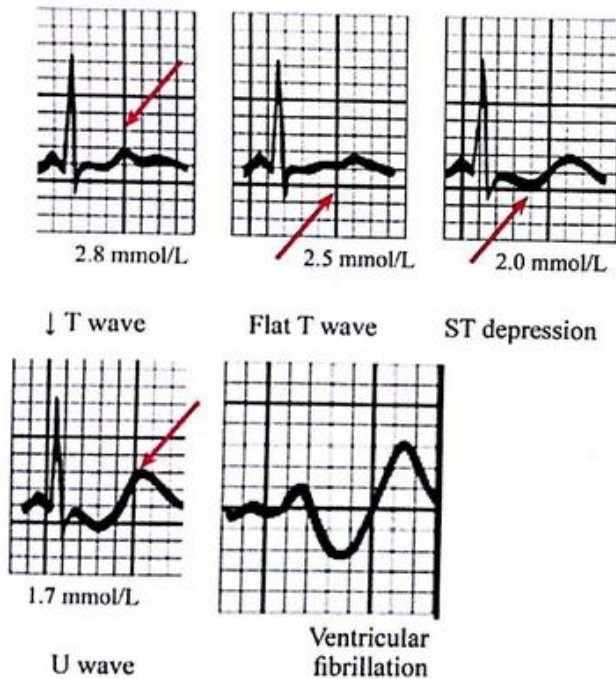
- * Avoid rapid correction except in acute severe hypernatraemia, secondary to Na^+ administration which can be corrected more rapidly

Rapid correction may lead to central pontine myelinolysis (CPM)

- * To decrease S. Na^+ by $< 12 \text{ mEq/L/day}$, @ rate of 0.5 mEq/L/hour
- * Frequent monitoring to provide adequate correction

HYPOKALAEMIA ($S. K^+ < 3.5 \text{ mmol/L}$)

Causes	Nasogastric loss, chronic diuretic use, steroids, persistent vomiting, digoxin, amphotericin B, aminoglycoside
Clinical Features	- Heart e.g. ectopic beats, atrial & ventricular tachycardia/arrest - Skeletal muscle e.g. weakness, cramp, paralysis, respiratory paralysis - Smooth muscle paralysis leading to paralytic ileus, urinary retention

ECG changes according to levels of $S K^+$ (mmol/L)**Management**

Required K^+ (mmol): Body Weight in Kg $\times 0.3 \times (\text{Desired} - \text{measured } K^+ \text{ levels})$

Easy way to correct hypokalaemia as follows -

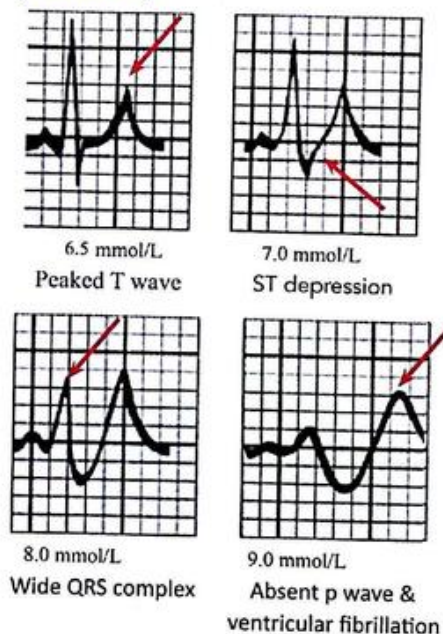
Serum K^+ Level	Inj. KCl to be added in 100 ml IV fluid
3.5-4.5 mmol/L	1 ml = 2 mmol
3.0-3.5 mmol/L	1.5 ml = 3 mmol
2.5-3.0 mmol/L	2 ml = 4 mmol
2.0-2.5 mmol/L	3 ml = 6 mmol
$< 2 \text{ mmol/L}$	KCl drip 0.5-1.0 mmol /kg/hour under close cardiac monitoring

Important notes

- Oral correction should be continued for 5-7 days after acute phase management
- IV correction should be given when strictly needed and provided that the patient is not in renal failure
- Correction of concomitant hypocalcaemia and acidosis should be delayed till potassium level improves as this will further lower down $S. \text{Potassium}$

HYPERKALAEMIA ($S. K^+ > 5.5 \text{ mmol/L}$)

Causes	Haemolysis, acute renal failure, tissue destruction, bleeding
Clinical features	Cardiac arrhythmia, Skeletal muscle weakness, Tingling, Paraesthesia, Paralysis

ECG changes according to levels of $S K^+$ (mmol/L)**Management**

Identify and remove sources of potassium intake or medication that increase potassium concentration

A. Mild hyperkalaemia ($> 5.5-6 \text{ mmol/L}$)

Restrict/avoid intake of extra potassium through potassium containing fluid or foods e.g. fruits

B. Moderate to Severe hyperkalaemia (>6 mmol/L)

Myocardial cell membrane stabilization	Calcium gluconate (10%) Dose: 0.5-1 ml/kg, IV, slowly over 5-10 minutes
Redistribution of extracellular K ⁺ into cells	* Insulin (short acting) Dose: 0.1 unit/kg, IV with 10% DA @ 5 ml/kg, over 30 minutes * Salbutamol nebulization Dose: 2.5 mg (<25 kg) or 5 mg (>25 kg) with normal saline (2 ml) * Sodium bicarbonate Dose: 1-2 mmol/kg, IV over 10-15 min
Enhance elimination of K ⁺ from the body through gut	a. Sodium polystyrene sulfonate resin (Kayexalate) * Oral: 1 month-18 years Dose: 125-250 mg/kg (max. 15 g) in 15-30 mL 70% sorbitol, 3-4/day * Rectal: Neonate-18 years Dose: 125-250 mg/kg, dilute each gm resin in 5-10 ml methylcellulose or water, repeated as necessary, every 6-8 hours
Other ways to eliminate K ⁺ from body (in refractory cases)	Renal replacement therapy * Peritoneal dialysis * Haemodialysis

Electrolytes & ionic concentration and tonicity of commonly used oral and IV fluids

Types	Na ⁺	K ⁺	Cl ⁻	HCO ³⁻	Glucose	Ca ⁺⁺	Acetate	Lactate	Tonicity
Low osmolality ORS/ORS N	75	20	65	20	75	--	--	--	Hypotonic
ReSoMal	45	40	70	7	125	--	--	--	Hypotonic
Plasma	140	45	100	26		2.3	--	--	Isotonic
0.9% Saline/Normal Saline	154	--	154	--	--	--	--	--	Isotonic
0.45% Saline /Junior Saline	77	--	77	--	--	--	--	--	Hypotonic
0.3% Saline	51	--	51	--	--	--	--	--	Hypotonic
0.225% Saline	42	--	42	--	--	--	--	--	Hypotonic
D5 0.9% Saline/Normal Saline	154	--	154	--	5	--	--	--	Hypertonic
D5 0.45% Saline /Junior Saline	77	--	77	--	5	--	--	--	Hypertonic
D5 0.225% Saline	42	--	42	--	5	--	--	--	Hypertonic
D10 0.225% Saline	42	--	42	--	10	--	--	--	Hypertonic
3% Saline	514	--	514	--	--	--	--	--	Hypertonic
Cholera Saline	133	13	98	--	--	--	48	--	Hypertonic
Hartman's Solution	131	5	111	--	--	2	--	29	Isotonic
Ringer's Lactate	130	4	109	--	--	1.5	--	28	Isotonic
D5 in Lactated Ringer's	130	4	109	--	5	1.5	--	28	Hypertonic

ACID-BASE HOMEOSTASIS

Acid-base homeostasis is very crucial to human life. The concentration of H^+ in the body fluid is the main determinant of acid-base homeostasis and is expressed as pH (the negative logarithm of H^+ ion concentration).

The normal pH of blood is 7.35-7.45. Any condition causing addition of H^+ ion in blood leads to fall of pH <7.35 and the state is called acidosis. Conversely the conditions causing loss of H^+ ion from blood leads to rise of pH >7.45 and the status is called alkalosis.

The body is very sensitive to alteration of its pH level and whenever pH is outside the acceptable

range, proteins are denatured, enzymes lose their ability to function, and even death may ensue.

Therefore maintenance of body pH is very crucial and whenever there is a change in it, body tries to stabilize the change by the different buffering systems of body through changing the rate of ventilation (respiratory compensation) and/or by kidneys (metabolic compensation).

However when their capacity cannot cope up with a pathological condition to maintain pH within normal range, acid-base imbalances occur.

To manage cases of acid base imbalance arterial blood gas (ABG) analysis is required.

Normal value of Arterial Blood Gas and interpretation

Analyte	Normal Range	Interpretation
pH	7.35–7.45	The pH or H^+ indicates if a patient is acidaemic (pH <7.35) or alkalaemic (pH >7.45)
PaO_2	80–100 mmHg or 9.3–13.3 kPa	A low PaO_2 indicates that the patient is not oxygenating properly, and is hypoxaemic
$PaCO_2$	35–45 mmHg or 4.7–6.0 kPa	A high $PaCO_2$ (respiratory acidosis) indicates underventilation, a low $PaCO_2$ indicates (respiratory alkalosis) hyper- or over ventilation
HCO_3^-	22–26 mmol/L	The HCO_3^- ion indicates whether a metabolic problem is present. A low HCO_3^- indicates metabolic acidosis, a high HCO_3^- indicates metabolic alkalosis

ABG values in simple acid-base disorders

Parameter	Metabolic acidosis	Respiratory acidosis	Metabolic Alkalosis	Respiratory Alkalosis
pH	Low	Low	High	High
HCO_3^-	Low	High	High	Low
$PaCO_2$	Low	High	High	Low

References

- Greenbaum LA. Pathophysiology of body fluids and fluid therapy. In: Kliegman RM, Stanton BF, Geme III JWS, Schor NF, Behrman RE. Editors. Nelson Textbook of Pediatrics, 20th Edition. New Delhi: Elsevier; 2016: 346-391.
- Khan MR, Rahman ME. Essence of Pediatrics. 4th ed. New Delhi: Elsevier; 2011. Chapter 11, Fluid Electrolyte and Acid-Base disturbances; p. 212-18.
- Kabir ARML. Pediatric Practice on Parents Presentation, 1st ed. Dhaka: Asian Colour Printing; 2011.
- Molla MR. Concise Textbook of Pediatrics. 2nd ed. Dhaka: Child friendly publications, 2007.
- Barrett KE, Barman SM, Boitano S, Brooks HL. Ganong's Review of Medical Physiology. 21st ed. New York: McGraw-Hill Medical Publishing Division; 2003.

SELF ASSESSMENT

Short answer questions [SAQ]

- How can you calculate daily fluid requirement? Calculate the fluid requirement of a child weighing 15 kg.
- What are the causes of hyponatraemia? Write down the principles of management of hyponatraemia.
- Write down the causes and clinical features of hyperkalaemia.
- Name the important causes of hypokalaemia. How can you correct the deficiency of potassium of a baby weighing 10kg (Serum K^+ 2.4 mmol/L)?
- Write down the composition of cholera saline.
- Write down the normal value of ABG.

Multiple choice questions [MCQ]

- While assessing daily fluid requirement, the following should be taken into consideration
☐ a) urinary loss ☐ b) respiratory loss ☐ c) sweating
☐ d) loss with diarrhoea ☐ e) loss with vomiting
- Major cations of plasma
☐ a) Sodium ☐ b) Potassium ☐ c) Magnesium
☐ d) Calcium ☐ e) Ammonium
- Major components of fluid compartments are
☐ a) intracellular ☐ b) interstitial ☐ c) plasma
☐ d) peritoneal ☐ e) transcellular
- The following are examples of transcellular fluid
☐ a) CSF ☐ b) ocular fluid ☐ c) joint fluid
☐ d) plasma ☐ e) peritoneal fluid
- Causes of hypernatraemia
☐ a) diabetes insipidus ☐ b) pancreatitis ☐ c) diarrhoea
☐ d) diuretics ☐ e) hyperaldosteronism
- The ECG changes in hyperkalemia
☐ a) ST elevation ☐ b) narrow QRS complex ☐ c) tall R wave
☐ d) prolonged PR interval ☐ e) T inversion
- Treatment options of hyperkalaemia includes
☐ a) Sodi-bicarb ☐ b) Insulin ☐ c) 10% DA
☐ d) dialysis ☐ e) Calcium gluconate
- The following statement regarding acid-base homeostasis is true
☐ a) normal pH of blood is 7.0 ☐ b) a low HCO_3^- indicates alkalosis
☐ c) hyperventilation causes low PCO_2 ☐ d) pH is proportionate to H^+ content of the body
☐ e) acid imbalances are controlled by kidney alone

INSTRUMENTS & PROCEDURES IN PAEDIATRICS

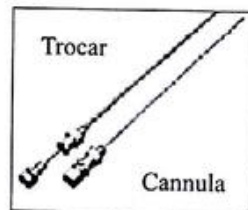
LUMBER PUNCTURE NEEDLE	311
SALAH BONE MARROW ASPIRATION NEEDLE	312
AMBU BAG	313
TONGUE DEPRESSOR	313
THREE-WAY STOP COCK	314
UMBILICAL CATHETERIZATION	314
EXCHANGE TRANSFUSION	314
MOBILE BLOOD TRANSFUSION	316
NASOGASTRIC TUBE	316
NEBULIZATION & PEAK FLOW METER	317
CAPILLARY BLOOD COLLECTION FOR GLUCOSE MONITORING	318
OXYGEN THERAPY	318

LUMBER PUNCTURE NEEDLE

Identification of Instrument

- Lumber puncture needle having -
 - * Trocar (stilette) with knob
 - * Cannula

Use: Lumber puncture



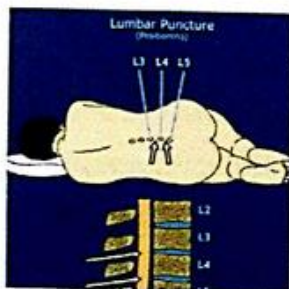
LUMBER PUNCTURE (LP)

Site

Usually done in 3rd intervertebral space (between 3rd & 4th lumbar vertebra).

Procedure

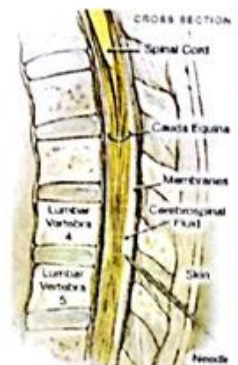
- First consent should be taken before doing the procedure
- Patient should be lying on his side on a firm table with the knees and chin as nearly apposed as possible (restrained position)



- Back of the patient should be right at the edge of the table, its transverse axis that is a line passing through the posterior superior iliac spine should be vertical
- An expert assistant is needed to hold the patient in position
- After positioning, site of lumber puncture is identified by 4th lumbar vertebra, which is in the same plane with iliac crest



- Physician should wear mask, gown and gloves
- After putting skin wash draping, LP is done with all aseptic precautions by putting thumb of left hand on the spine and introducing the needle by right hand firmly through the skin in the mid-line between spines
- Direction of the needle should be forward and slightly towards the head
- As the dura is pierced there is a sense of pressure release
- As the needle enters subarachnoid space CSF comes out
- After withdrawal of LP needle a sterile dressing should be applied
- Patient should lie flat for 8-12 hours without pillow and should be given drink immediately after maneuver



Use

Diagnostic

- Infection *e.g. Meningitis (pyogenic, viral, TBM), Encephalitis, GBS*
- Systemic diseases *e.g. Multiple sclerosis, SLE*
- Sub-arachnoid haemorrhage (in absence of CT/MRI facilities)
- Benign intracranial hypertension
- Infiltrative lesion *e.g. Leukaemia*
- Diagnostic procedure *e.g. myelography, cysternography*

Therapeutic

- Intrathecal chemotherapy- In leukaemia
- Withdrawal of CSF- In pseudotumor cerebri
- Anaesthetic: Spinal anaesthesia

Contraindications

- * Elevated ICP owing to mass lesion of brain or spinal cord due to risk of transtentorial or cerebellar tonsillar herniation
- * Critically ill patient
- * Skin infection at site of LP
- * Thrombocytopenia $<20 \times 10^9/L$

Complications

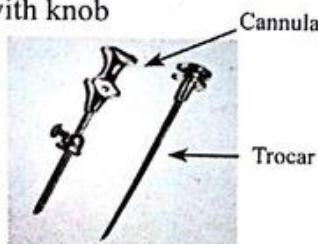
- | | |
|-------------------------|-----------------------------|
| * Headache | * Introduction of infection |
| * Local pain | * Injury to vertebral disc |
| * Brain stem herniation | |
| * Haemorrhage | |

SALAH BONE MARROW ASPIRATION NEEDLE

Identification of Instrument

Bone marrow aspiration needle having -

- * Trocar (stilette) with knob
- * Cannula
- * Adjustable guard



BONE MARROW ASPIRATION

Site

- For children <2 years: Medial aspect of upper end of tibia
- For children >2 years: Posterior iliac crest, spinous process of vertebrae, manubrium sterni (rare)

Procedure

- First consent should be taken before doing the procedure
- The guard of the aspiration needle has to be fixed about $\frac{1}{2}$ the depth of bone
- Then patient has to lie down in prone position for iliac crest site or on his back for manubrium sterni
- Physician should wear mask, gown and gloves
- After putting skin wash and draping, with all aseptic precautions local anaesthesia (2% xylocane) is infiltrated up to periosteum after locating the puncture site
- Then aspiration needle is pushed through the skin vertically down by screwing method until bone is penetrated
- A sudden loss of resistance indicates that the needle entered in the marrow space
- Then the stilette is removed and a syringe is attached to the cannula
- Marrow is aspirated by negative suction



- Then needle is withdrawn and puncture site is pressed and sealed with sterile swab
- Then film is prepared on glass slide and rest of the aspirate is kept in EDTA

Use**Diagnostic**

- Haematological disorders *e.g. leukaemia, ITP, myeloproliferative disorders, plasma cell disorders, non Hodgkin lymphoma, secondary malignancies*
- Infectious diseases *e.g. Kala-azar, Malaria, Enteric fever*

Therapeutic: Bone marrow transplantation.

Contraindications

- Local skin infection
- Known case of haemophilia, thrombocytopenia

Complications

- Shock (vaso-vagal/haemorrhagic)
- Local suction pain
- Introduction of infection (osteomyelitis)
- Haemorrhage
- Injury to deep structures (great vessels, overpuncture)

AMBU (Artificial manual breathing unit)**Identification of Instrument**

Self inflating bag having the following parts -

- Mouth piece/mask
- AMBU bag proper
- O₂ connector
- O₂ reservoir
- Pop-up valve

**Use**

- Neonatal resuscitation in case of -
 - * Perinatal asphyxia
 - * RDS
- Respiratory failure from any cause -
 - * Pneumonia
 - * Severe acute asthma
 - * GBS
 - * Head injury
 - * Poisoning

Contraindications

- Diaphragmatic hernia
- Tracheo-oesophageal fistula (except high variety)

TONGUE DEPRESSOR**Identification of Instrument**

- Metallic right angle tongue depressor

Types: Metallic, Plastic, Wooden

Use

To observe the throat clearly.

Diagnostic

- * Faucal diphtheria
- * Tonsillitis
- * Koplick's spot
- * Pharyngitis
- * Oral thrush
- * Retropharyngeal abscess
- * Cleft palate
- * Palatal palsy

**Therapeutic**

- * Removal of foreign body from posterior part of tongue

THREE-WAY STOP COCK

Identification of Instrument

- Three way stop cock or channel

Use

- To create multiple channels in a single parenteral access
- Exchange Transfusion

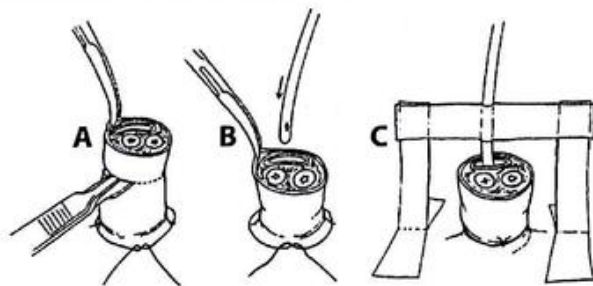


- Administration of medication and infusion of different infusions through same parenteral access at a time
- Facilitate smooth switching of infusion from multiple lines

UMBILICAL VEIN CATHETERIZATION

This procedure can be used for resuscitation or exchange transfusion and is usually possible in neonates in the first few days of life.

- Clean the umbilical cord and surrounding skin with an antiseptic solution. Then tie a suture around the base of the cord



Steps in umbilical vein catheterization

Steps in umbilical vein catheterization

- Cut the cord 1-2 cm from the base with a sterile scalpel (A), Identify the umbilical vein

(larger, thin walled vessel) and umbilical arteries (two thicker walled vessels apart from the vein). Hold the cord near the vein with sterile forceps

- Hold near end of catheter with sterile forceps and advance it into the vein (it should pass easily) for 4-6 cms (B)
- Check that catheter is not kinked and that blood draws back easily; if there is a block, pull gently on the cord, pull back the catheter partly and re-start
- Secure with 2 sutures into the cord leaving 5 cm long suture ends. Tape suture and catheter (C)
- After removal, apply pressure to the umbilical stump for 5-10 minutes

EXCHANGE TRANSFUSION

Indications

- Haemolytic disease of newborn *e.g. Rh or ABO incompatibility leading to severe hyperbilirubinaemia*
- Sepsis
- DIC
- Polycythaemia (partial exchange transfusion)
- Metabolic disorder causing severe acidosis
- Severe fluid-electrolyte imbalance

Aims of Exchange Transfusion in Haemolytic Disease of Newborn

- To correct anaemia
- To remove damaged and antibody coated RBCs
- To remove unfixed antibodies
- To reduce hyperbilirubinaemia

Selection of Blood

- Rh-incompatibility: Rh-negative blood of same group as infant or O blood group compatible with serum of mother and infant
- ABO incompatibility: O group of homologous rhesus type or mother's group should be used

(Ref. Absar N, Kawser CA. *et al. BJCH* 1985; 9(3):180-84)

Procedure

- The whole procedure is done in an isolated room with strict aseptic precautions. An assistant is needed to help, monitor and tally the volume of blood exchanged
- Umbilical catheterization is done first
- 2 three way stop cocks are attached end-to-end to make 4 ways



Exchange transfusion

- One way is connected with distal end of umbilical catheter and another (opposite) end is connected to 20 ml disposable syringe
- Distal sideway from the operator is connected to donor blood set
- Proximal sideway is connected to a saline set leading to an empty saline bag into which patient's blood is expelled out and discarded
- One round should be made to confirm the functioning of the exchange transfusion set up. Then exchange is done by push-pull technique
- The amount of blood is removed that is tolerated by the infant. This is usually-
 - * For <1500 gms: 5 ml.
 - * For 2500 gms: 10 ml.
 - * For <3500 gms 15 ml.
 - * >3500 gms: 20 ml.
- The defined amount of blood is withdrawn first from the patient slowly and steadily, it is then expelled out through proximal sideway outlet, by keeping the inlet closed
- Then 15 ml of donor's blood is drawn from the suspended bag through distal sideway outlet, keeping the proximal one closed and this drawn blood is pushed slowly to the infant
- To prevent metabolic acidosis it was a

common practice to inject Inj. Sodi-bi-carb (8.4%) 1ml after each 100ml of blood exchange, which is not indicated now a days. If the baby is symptomatically hypocalcaemic 1ml/kg of Ca-gluconate can be given very slow I/V under monitoring of heart rate

- During exchange transfusion baby has to be kept warm and preferably done in open warmer. An intake output chart along with monitoring of heart rate, respiratory rate, temperature, colour any important events has to be noted
- At the end of procedure blood sample is sent for post exchange estimation of -
 - * Serum bilirubin
 - * Serum electrolytes
 - * Serum calcium
 - * Blood glucose level
 - * Haemoglobin%
- Serum bilirubin level has to be checked routinely
- If no further exchange is required umbilical catheter is withdrawn and a dry sterile dressing is applied to the umbilicus
- After exchange transfusion photo-therapy may be continued

Complications: Exchange Transfusion

- * Technical problem
- * Volume overload/depletion
- * Electrolyte imbalance *e.g. Hyperkalaemia, Hypocalcaemia, acidosis/alkalosis*
- * Hypoglycaemia
- * Infection
- * Hypothermia
- * Portal vein thrombosis
- * Air Embolism
- * Death

MOBILE BLOOD TRANSFUSION

Requirements

- * 50 cc syringe
- * Butterfly niddle (19G)
- * Blood bag with anticoagulant
- * Blood transfusion set



Procedure

- Mobile transfusion is considered when very small volume of blood is to be transfused in case of infants
- First blood grouping of the donor and recipient is done and cross-matched
- The physician has to wash hands thoroughly then put on gloves
- Then with strict aseptic precautions 3 ml of anticoagulant is drawn for each 20 ml of blood transfusion in a 50 ml syringe from the anticoagulant containing blood bag
- After proper local aseptic care donor's blood is drawn in the syringe by a 19 G butterfly needle with a ratio of anticoagulant: blood = 3:17 (i.e. 3 ml anticoagulant for 17 ml blood, making a total amount of 20 ml). Likewise 6 ml anticoagulant for 34 ml blood and so on
- The blood bag is then emptied of the rest of the anticoagulant and the blood from the syringe is transferred to the blood bag
- Then this blood is transfused to the infant as usual method

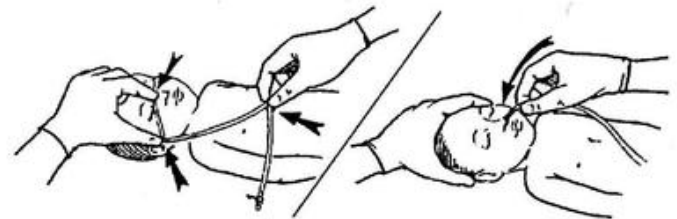
Complications

Minimum complications other than usual hazards of blood transfusion.

NASOGASTRIC TUBE

Procedure: Insertion of a Nasogastric Tube

- Holding the tip of the tube against the child's nose, measure the distance from the nose to the ear lobe, then to the xiphisternum (epigastrium)



- Mark the tube at this point
- Hold the child firmly. Lubricate the tip of the catheter with water and pass it directly into the nostril, pushing it slowly in. It should pass easily down into the stomach without any resistance. When the measured distance is reached, fix the tube with tape at the nose
- Aspirate a small amount of stomach contents with a syringe to confirm that the tube is in place. If no aspirate is obtained, inject air down the tube and listen over the abdomen with a stethoscope
- If there is any doubt about the location, withdraw it and insert again

NEBULIZATION



Parts

- Motor or pump
- Air inlet, air outlet
- Filter
- Air tube
- Mixing chamber or cup
- T piece or mouth piece
- Mask

Procedure

- Clean all parts before use
- At first, attach the air tube to the air outlet of the machine
- Fit the air tube with mixing chamber and mask
- Take measured amount of drugs into the mixing chamber by syringe or dropper & mix with normal saline to make a total volume of 4 ml.
- Connect the electrical line and turn on the switch.
- Look whether fine mist (wet aerosol) is coming out through the mask adequately
- Place the child in upright position & facilitate to take slow deep breaths through mouth
- Put the mask to the face of the child covering nose and mouth adequately (not so tightly)
- Continue nebulization until fine mist is no longer present
- Clean the machine after use & store the drugs in right place

Dose of drugs

- Salbutamol (5 mg/ml): 0.15 mg(0.03 ml)/kg/dose to a maximum 5 mg (1 ml)/ Salbutamol (2.5 mg/2.5ml): 0.15 mg (0.15ml)/kg/dose.

- Ipratropium bromide: 250 µgm/dose

PEAK FLOW METER

Parts

- Mouth piece
- Indicator/Cursor
- Measuring scale

Uses

Peak Flow Meter can be used –

- To classify severity of asthma
- To see whether the management plan is working well or not
- To decide when to add or stop medicine



How to use

1. Place the indicator at the base of the numbered scale
2. Stand up or sit in upright posture
3. Take a deep breath
4. Place the meter in mouth and close lips around the mouth piece. Do not put tongue inside the hole & do not put finger over measuring scale
5. Blow out as hard and fast as can
6. Write down the number you get
7. Repeat the steps 1 to 6 two more times
8. Write down the highest of the three numbers achieved

Peak Flow Meter usually not applicable for <5 years of age.

CAPILLARY BLOOD COLLECTION FOR GLUCOSE MONITORING

Instrument Needed

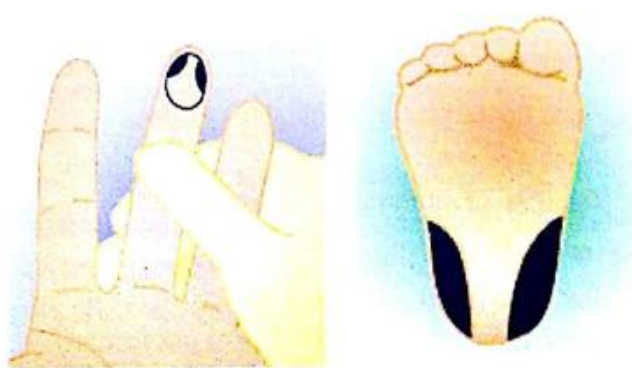
- Lancing device
- Gloves
- Gauze
- Alcohol as antiseptic
- Bandages and micropore tape
- Glucometer and strip



Sites of puncture

- Finger stick (for older child): Palmar surface of the distal segment of the middle finger, ideally of the non-dominant hand
- Heel stick (for neonate and infant): Lateral or medial plantar surface of the heel

Amount of blood needed: 1 drop



The following steps should be performed in accordance with the facilities' recommended procedures.

1. Keep ready the Glucometer and strip with appropriate code number
2. Wash hands and put on gloves

3. The patient should be sitting or lying down.
4. Select appropriate puncture site
5. Warm the puncture site
6. Clean the puncture site with disinfectant and allow it to air dry to provide effective disinfection
7. Puncture the skin with the disposable lancing device
8. Wipe away the first drop of blood with a dry gauze pad
9. Squeeze gently the puncture site to allow free flow of blood
10. Touch the test strip on to the blood drop and allow it to flow into the test strip in capillary action
11. When adequate amount of blood is drawn, Glucometer will automatically produce a beep sound and starts to function. Usually reading will appear within 10-15 seconds
12. Properly dispose of any other contaminated materials (gloves, gauze, etc.) in a container approved for their disposal
13. After removing gloves, wash hands before proceeding to the next patient

OXYGEN THERAPY

Indications

- Central cyanosis
- Grunting with every breath
- Difficulty in feeding due to respiratory distress
- Severe lower chest wall indrawing
- Head nodding
- Respiratory rate $\geq 70/\text{min}$



Ways to give oxygen

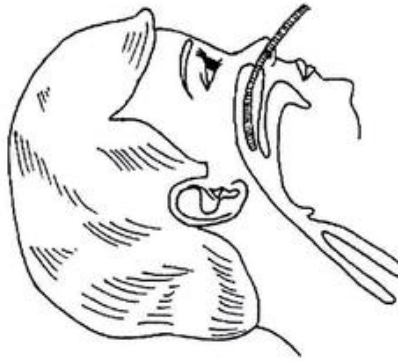
- **Nasal prong:** These are short tubes inserted & placed just inside into the nostrils and secured with a piece of tape on it.
Oxygen delivery: 1-2 L/min and humidification is not required



- **Nasal catheter:** This is a 6-8 FR catheter, which is passed to the back of the nasal cavity. The catheter is placed at a distance equal to that from the side of the nostrils to the inner margin of the eyebrow.

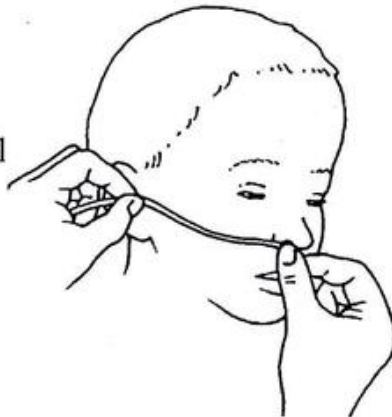
Oxygen

delivery: 1-2 L/min and humidification is not required

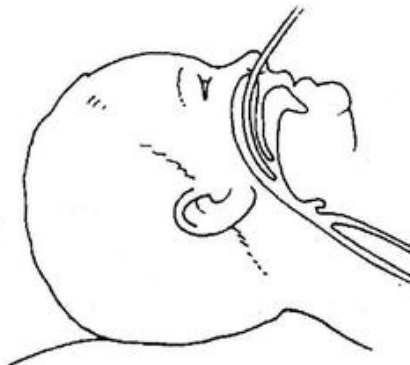


- **Nasopharyngeal catheter:** This is a 6-8 FR catheter, which is passed to the pharynx just below the level of uvula. The catheter is placed at a distance equal to that from side of the nostrils to the front of ear.

Oxygen delivery: 1-2 L/min and humidification is required



- **Face mask:** Oxygen delivery, 5 L/min.



- **Head box:** Oxygen delivery, 7 - 10 L/min.



CHAPTER 39

MODEL OSPE FOR PRACTICE

In this chapter few model OSPE stations are given comprising of X-rays, instruments, photographs, clinical & laboratory data and case scenarios. Students are advised to go through

these and think of other possible questions related to the given OSPE stations. They can also be acquainted with other OSPEs from different other clinical problems in light of these examples to prepare themselves optimally for examination.

OSPE station: 1

Instruction to the student

Please look at the X-ray and answer the questions given below -

1. Name 3 findings in this X-ray.
2. What is the probable diagnosis?
3. Name 2 other radiological features you expect in this disease?
4. What is the basic pathology of the disease?
5. Write 2 common way of presentation.



OSPE station: 2

Instruction to the student

Please look at the X-ray and answer the following questions -

1. Write 3 important findings on this X-ray.
2. What is the likely diagnosis?
3. Write two important investigations to reach a diagnosis.
4. Name the major biochemical change in the blood that determine the pathological consequence of the disease.
5. Outline the principal of management.
6. What is the specific treatment of this condition?



OSPE station: 3

CXR of a 7 years old boy with fever, cough & breathlessness

Instruction to the student

Please look at the X-ray and answer the following questions -

1. Write down 2 important findings in this X-ray.
2. What is your radiological diagnosis?
3. Mention 2 important diseases that may give rise to these findings.
4. Write the findings on chest examination that you expect here
5. What investigations will you do to confirm the diagnosis?



OSPE station: 4**Instruction to the student**

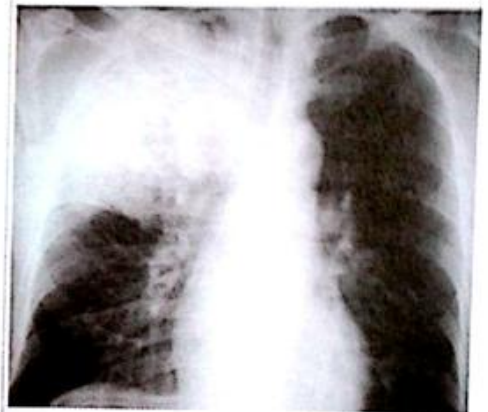
Please look at the X-ray and answer the following questions -

1. Mention 3 findings that you see in this X-ray.
2. What is your radiological diagnosis?
3. Mention 3 important information that you may need in history.
4. Name 5 relevant investigations that will help you to reach the diagnosis.

**OSPE station: 5****Instruction to the student**

Please look at the X-ray and answer the questions given below -

1. Write down the findings present in this chest X-ray.
2. What is your radiological diagnosis?
3. Mention 3 important organisms responsible for this change.
4. Write the findings on chest examination that you expect in this patient.
5. Name 3 important complications those may occur if it remains untreated.

**OSPE station: 6**

This is an X-ray of a 12 months old boy presented with blue lips since birth and growth failure.

Instruction to the student

Please look at the X-ray and answer the following questions -

1. What do you see in this chest X-ray?
2. What is your radiological diagnosis?
3. What the cardiac anomalies that is present in this disease?
4. Write 3 important complications of this disease.

**OSPE station: 7**

This is an X-ray of a 7 months old child admitted with cough, wheeze & breathlessness.

Instruction to the student

Please look at the x ray and answer the following questions -

1. Mention 3 important findings present in this chest X-ray.
2. What is your radiological diagnosis?
3. Name the most important organism responsible for this disease.
4. What is the mainstay of treatment of this illness?



OSPE station: 8**Instruction to the student**

Please look at the photograph and answer the questions -

1. What do you see in the photograph?
2. What is the most likely diagnosis?
3. What organism is responsible for the disease?
4. Write down the systemic complication related to this skin lesion.
5. Write down two drugs used to treat this skin lesion.

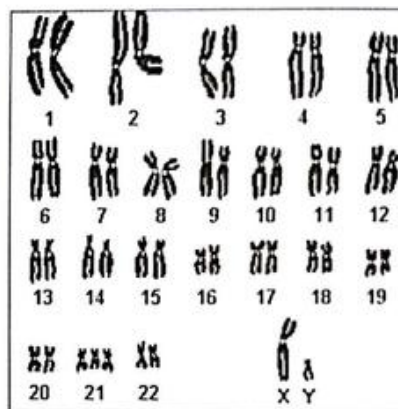
**OSPE station: 9**

This is the karyotype of a 6 month old baby from a 36 years old mother. This baby was not growing properly, facing difficulties to feed and had a systolic murmur on precordial examination.

Instruction to the student

Please look at the photograph and answer the questions -

1. Write comment on the above karyotype.
2. What is your diagnosis?
3. Write 5 important clinical features of this baby.
4. Write 3 important cardiac defects associated with this condition.

**OSPE station: 10**

This photograph is taken from a 6 years old child presented with generalized oedema and scanty urine.

Instruction to the student

Please look at the photograph and answer the questions -

1. What is your provisional diagnosis?
2. Name 4 important investigations with findings that will help to reach the diagnosis.
3. Name 5 important complications that may develop in this disease.
4. Write the treatment of this disease.

**OSPE station: 11****Instruction to the student**

Please look at the photograph and answer the questions -

1. Mention 3 important features evident in this photo.
2. Mention 4 questions that you need to ask the mother to reach a diagnosis.
3. What investigation will you do to diagnose this child?
4. What complications can arise if this patient remains untreated?
5. What is the treatment of the disease and for how long?



OSPE station: 12

This photograph is from 6 years old boy who presented with gum bleeding and purpuric spots following an episode of viral infection 14 days back. O/E he was mildly anaemic and had no organomegaly.

Instruction to the student

Please look at the photograph and answer the questions -

1. What is your likely diagnosis?
2. Write down 2 important investigations with expected findings to reach the diagnosis.
3. Write down the treatment options for this disease.

**OSPE station: 13**

This is a photograph of a 2 years boy from a very poor family weighing 5kg who was admitted with skin change and bipedal oedema.

Instruction to the student

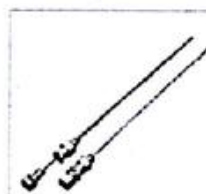
Please look at the photograph and answer the questions -

1. Why these changes happen to the child?
2. What changes in the eyes can occur in this child?
3. Summarize the skin abnormalities you can see.
4. Write down the expected anthropometric findings in this child?
5. Outline the steps of management of this case.

**OSPE station: 14****Instruction to the student**

Please look at the instrument provided and answer the question -

1. Identify the instrument.
2. Write down indications of its use.
3. Mention 4 contraindications of its use.

**OSPE station: 15****Instruction to the student**

Please look at the instrument provided and answer the questions -

1. Identify the instrument.
2. Write 4 important indications of its use.
3. Mention the sites for doing the procedure by this instrument.

**OSPE station: 16****Instruction to the student**

Please look at the instrument provided and answer the questions -

1. Identify the instrument.
2. Mention 2 important clinical use of it in paediatric patients.
3. Mention 5 important differential diagnoses of white patches in throat.



OSPE station: 17

A 7 years old girl presented with fever, swelling of knee and ankle joints one after another for 5 days & chest pain for last 2 days. Her lab reports showed Hb 11gm/dl, TC of WBC 15,000/cmm, neutrophil 78%, lymphocyte 18%, monocyte 2%, ESR 56 mm, CRP 24 mg/L and ASO titre 600 IU/L

Instruction to the student

Go through the scenario and answer the following questions-

1. What abnormalities are present in the data?
2. What is your likely diagnosis?
3. Name 4 other investigations you think relevant to this case.
4. What immediate measure will you take in this case?
5. What long term complications can develop if this patient is not managed properly?

OSPE station: 18

A 6 years old boy presented with irregular fever, anorexia and occasional gum bleeding for last 1 month. His CBC showed Hb 6gm/dl, TC of WBC 32000/cmm, neutrophil 28%, lymphocyte 68% and atypical cells 4%, platelet count 36000/cmm.

Instruction to the student

Go through the scenario and answer the following questions-

1. Summarise the abnormalities in the Haemogram.
2. What is your likely diagnosis?
3. What findings do you expect in physical examination and in the peripheral blood film?
4. How will you confirm the diagnosis?
5. Name the different steps of treatment of the disease.

OSPE station: 19

A 14 months old child presented with high fever and vomiting for 2 days and few attacks of generalized convulsions prior to hospitalization. His CSF was hazy and had glucose 26 mg/dl, protein 130 mg/dl, chloride 98meq/l, cells 200/cmm mostly neutrophil.

Instruction to the student

Go through the scenario and answer the following questions-

1. Comment on the case scenario.
2. What is the diagnosis?
3. Name 2 common organisms responsible for this problem.
4. Outline the treatment plan for this child.
5. Name 4 complications that may occur, if not properly treated.

OSPE station: 20

Lab reports of an 8 years old boy who presented with polyuria and short stature revealed Hb 7g/dl, platelet count 2,00,000/cmm, S. creatinine 260 μ mol/L, Blood urea 10 mmol/L, S. K⁺ 2.6 mmol/L, S. Ca⁺⁺ 2.2 mmol/L, increased S. PO₄ and blood pH 7.2.

Instruction to the student

Go through the scenario and answer the following questions -

1. What abnormalities do you see in the lab data?
2. What is your probable diagnosis?

3. Name 4 important clinical presentations of this patient.
4. Outline 5 principles of management.
5. What is the specific treatment for this patient?

OSPE station: 21

A 20 hours old baby presented with jaundice of face, trunk and palm.

Instruction to the student

Go through the scenario and answer the following questions-

1. Enumerate 2 possible important causes of this jaundice.
2. Write 5 investigations which will help to explain the aetio-pathogenesis.
3. Write down 2 options of treatment required for this baby.
4. What can happen if this baby remains untreated?

OSPE station: 22

A 3 years old boy who had been suffering from recurrent cough and wheeze suddenly developed severe respiratory distress. On examination you noted profuse rhonchi in both lungs.

Instruction to students

Go through the scenario and answer the following questions-

1. What is your diagnosis?
2. Name 5 important parameters to be used to assess the severity of the condition.
3. Outline 5 immediate steps of managing the situation.
4. What informations do you think important to classify the disease?

OSPE station: 23

A 9 months old child weighing 7 kg is admitted with frequent, loose watery stool & vomiting for last 2 days.

Instruction to students

Go through the scenario and answer the following questions-

1. What clinical parameters will you consider to assess the dehydration of this child?
2. Name 3 important organisms responsible for this diarrhoea.
3. Write 2 investigations important for this case.
4. Outline the management of this child if he is severely dehydrated.
5. What fluid can be used to rehydrate this child?
6. Name 3 important complications, those can arise if he is not properly rehydrated?

OSPE station: 24

A 15 months old girl is admitted with low grade fever, runny nose, barking cough, stridor and breathing difficulty.

Instruction to students

Go through the scenario and answer the following questions-

1. What is your likely diagnosis?
2. Write down 3 important organisms responsible for this illness.
3. What simple investigation will help to diagnose the case?
4. Write 4 important options of treatment.

ANNEXURE

RECIPE/COMPOSITION OF

(A) F-75 AND F-1 00	327
(B) ORAL REHYDRATION SALT [ORS]	328
(C) ReSoMAL	328
(D) ELECTROLYTE-MINERAL SOLUTION	328

BILIRUBIN CHARTS

☐ FOR BABIES < 35 WEEKS, < 1000G	329
☐ FOR BABIES < 35 WEEKS, 1000-1499G	330
☐ FOR BABIES < 35 WEEKS, 1500-1999G	331
☐ FOR BABIES < 35 WEEKS, > 1999G	332
☐ FOR BABIES AT 35-37 + 6 WEEKS	333
☐ FOR BABIES AT 38 + 0 WEEKS OR OLDER	334

GROWTH CHARTS

☐ WEIGHT-FOR-AGE PERCENTILE: BOYS, BIRTH TO 36 MONTHS	335
☐ WEIGHT-FOR-AGE PERCENTILE: BOYS, 2 TO 20 YEARS	336
☐ LENGTH-FOR-AGE PERCENTILE: BOYS, BIRTH TO 36 MONTHS	337
☐ STATURE-FOR-AGE PERCENTILE: BOYS, 2 TO 20 YEARS	338
☐ HEAD CIRCUMFERENCE-FOR-AGE PERCENTILE: BOYS, BIRTH TO 36 MONTHS	339
☐ WEIGHT-FOR-LENGTH PERCENTILE: BOYS, BIRTH TO 36 MONTHS	340
☐ WEIGHT-FOR-STATURE PERCENTILE: BOYS, 2 TO 20 YEARS	341
☐ BMI-FOR-AGE PERCENTILE: BOYS, 2 TO 20 YEARS	342
☐ WEIGHT-FOR-AGE PERCENTILE: GIRLS, BIRTH TO 36 MONTHS	343
☐ WEIGHT-FOR-AGE PERCENTILE: GIRLS, 2 TO 20 YEARS	344
☐ LENGTH-FOR-AGE PERCENTILE: GIRLS, BIRTH TO 36 MONTHS	345
☐ STATURE-FOR-AGE PERCENTILE: GIRLS, 2 TO 20 YEARS	346
☐ HEAD CIRCUMFERENCE-FOR-AGE PERCENTILE: GIRLS, BIRTH TO 36 MONTHS	347
☐ WEIGHT-FOR-LENGTH PERCENTILE: GIRLS, BIRTH TO 36 MONTHS	348
☐ WEIGHT-FOR-STATURE PERCENTILE: GIRLS, 2 TO 20 YEARS	349
☐ BMI-FOR-AGE PERCENTILE: GIRLS, 2 TO 20 YEARS	350

RECIPE/COMPOSITION OF

(a) F-75 and F-100

Type of milk	Ingredients	Amount for F-75	Amount for F-100
Dried skimmed milk	Dried skimmed milk	25 g	80 g
	Sugar	70 g	50 g
	Cereal flour	35 g	--
	Vegetable oil	30 g (or 35 ml)	60 g (or 70 ml)
	Electrolyte Mineral mix	20 ml	20 ml
	Water: make up to	1000 ml	1000 ml
Dried whole milk	Dried whole milk	35 g	110 g
	Sugar	70 g	70 g
	Cereal flour	35 g	--
	Vegetable oil	20 g (or 20 ml)	30 g (or 35 ml)
	Electrolyte Mineral mix	20 ml	20 ml
	Water: make up to	1000 ml	1000 ml
Full-cream cow's milk	Full-cream cow's milk	300 ml	880 ml
	Sugar	70 g	75 g
	Cereal flour	35 g	--
	Vegetable oil	20 g (or 20 ml)	20 g (or 20 ml)
	Electrolyte Mineral mix	20 ml	20 ml
	Water: make up to	1000 ml	1000 ml

(b) Oral Re-hydration Salt [ORS]

Composition	WHO ORS (Low osmolarity) g/L	WHO ORS (Old) g/L
Glucose	13.5	20
NaCl	2.6	3.5
Trisodium citrate	2.9	2.9
KCl	1.5	1.5
Molar contents	mmol/L	mmol/L
Glucose	75	111
Na	75	90
K	20	20
Cl	65	80
Citrate	10	10
Total osmolarity	245 mmol/L	311 mmol/L

(c) ReSoMal Oral Re-hydration solution

Ingredients	Amount
Water (boiled and cooled)	850 ml
WHO-ORS (New low osmolarity formulation)	One 500 ml packet
Sugar	20 g
Electrolyte-mineral solution	16.5 ml

(d) Electrolyte content of various body fluids

Fluid source	Na ⁺ (mmol/L)	K ⁺ (mmol/L)	Cl ⁻ (mmol/L)
Stomach	20-80	5-20	100-150
Small intestine	100-140	5-15	90-120
Ileostomy	45-135	5-15	20-120
Diarrhoeal stool	10-90	10-80	10-110

(e) Electrolyte-mineral solution

Ingredients	Quantity (g)	Molar content of 20 ml
Potassium Chloride	224	24 mmol
Tri-potassium Citrate	81	2 mmol
Magnesium Chloride	76	3 mmol
Zinc Acetate	8.2	300 µmol
Copper Sulphate	1.4	45 µmol
Water: make up to	2500 ml	

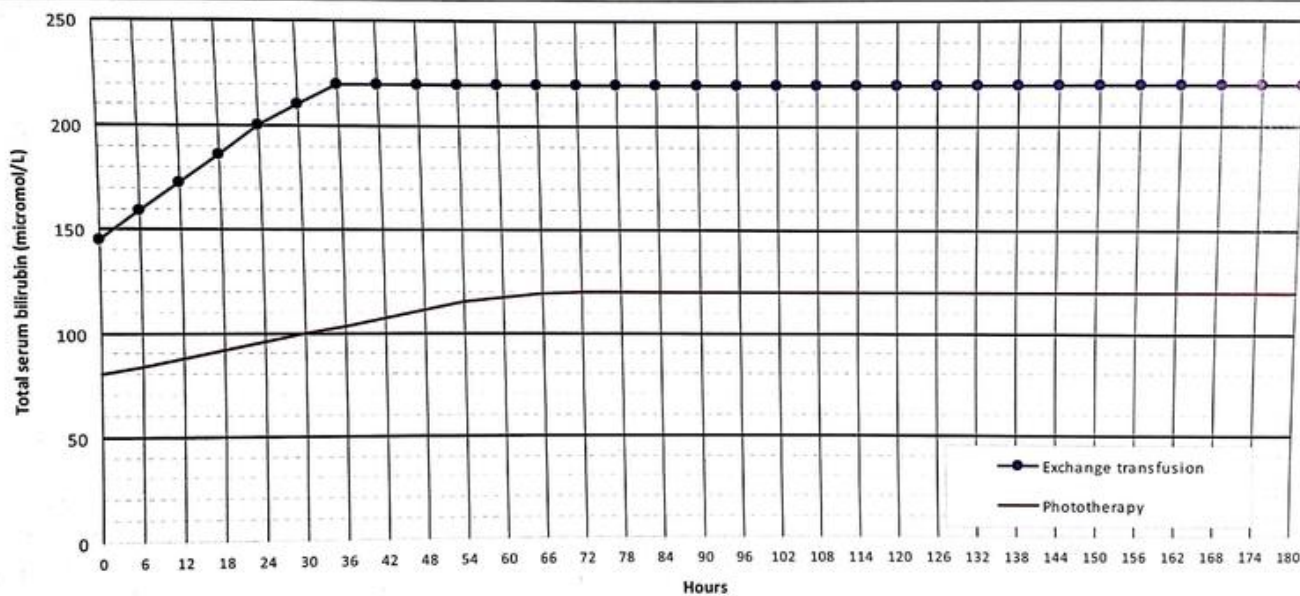
Treatment of TB in children younger than 8 years of age

Body weight	Intensive phase (2 months) RHZ* (60, 30, 150)	Continuation phase (4 months) RH (60, 30)
2-2.9 kg	½ tab	½ tab
3-5.9	1 tab	1 tab
6.8.9	1 ½ tabs	½ tabs
9-11.9	2 tabs	2 tabs
12-14.9	2 ½ tabs	2 ½ tabs
15.19.9	3 tabs	3 tabs
20-24.9	4 tabs	4 tabs
25-29.9	5 tabs	5 tabs
30-35.9	6 tabs	6 tabs

* R – Rifampicin, H – Isoniazid, Z – Pyrazinamide

Jaundice management for babies born at <35 weeks, <1000g

1. In the presence of risk factors (sepsis, haemolysis, acidosis or asphyxia) use the lower line.
2. Infants greater than 12 hours old with total serum bilirubin (TSB) level 1-50 micromol/L below the line should have repeat TSB within 6-24 hours.
3. Babies under phototherapy:
 - a. Consider measuring the TSB 4-6 hourly until the rise of serum bilirubin is known to be controlled, then measure TSB 12-24 hourly
 - b. Stop phototherapy if TSB greater than 50 micromol/L below line and recheck in 12-24 hours.
4. Infants who present with TSB above threshold should have an exchange transfusion done if the TSB is not expected to be below the threshold after 6 hours of intensive phototherapy.
5. An immediate exchange transfusion is recommended if there are signs of bilirubin encephalopathy

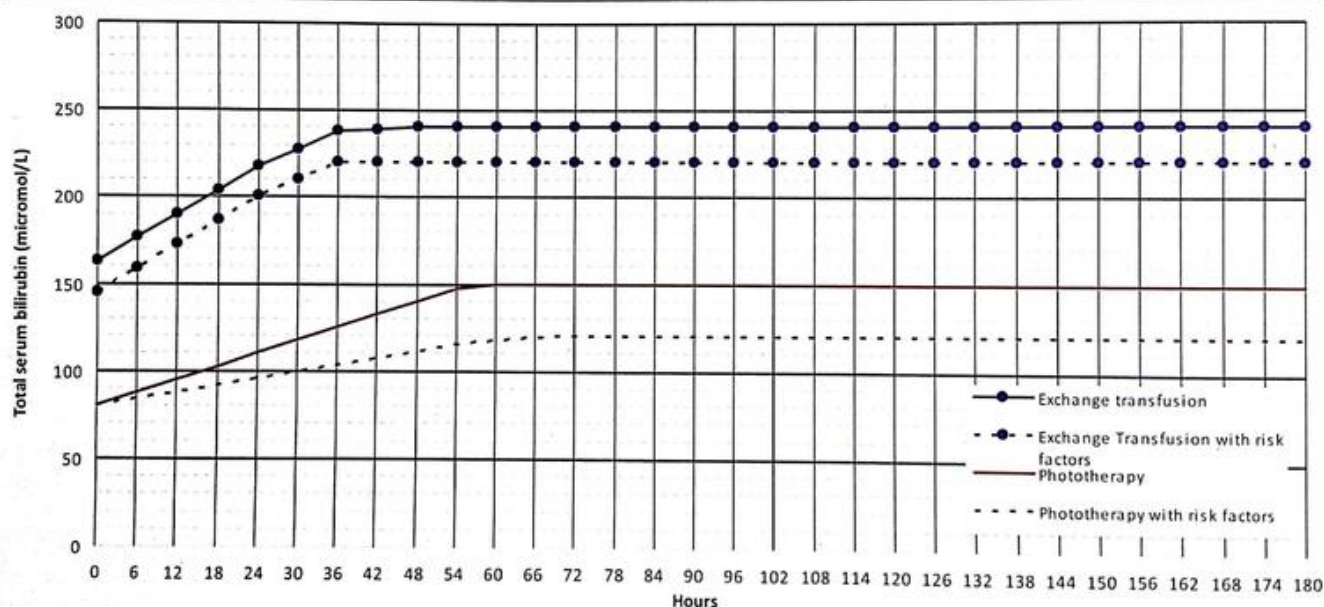


BILIRUBIN CHART 1

BILIRUBIN CHART 2

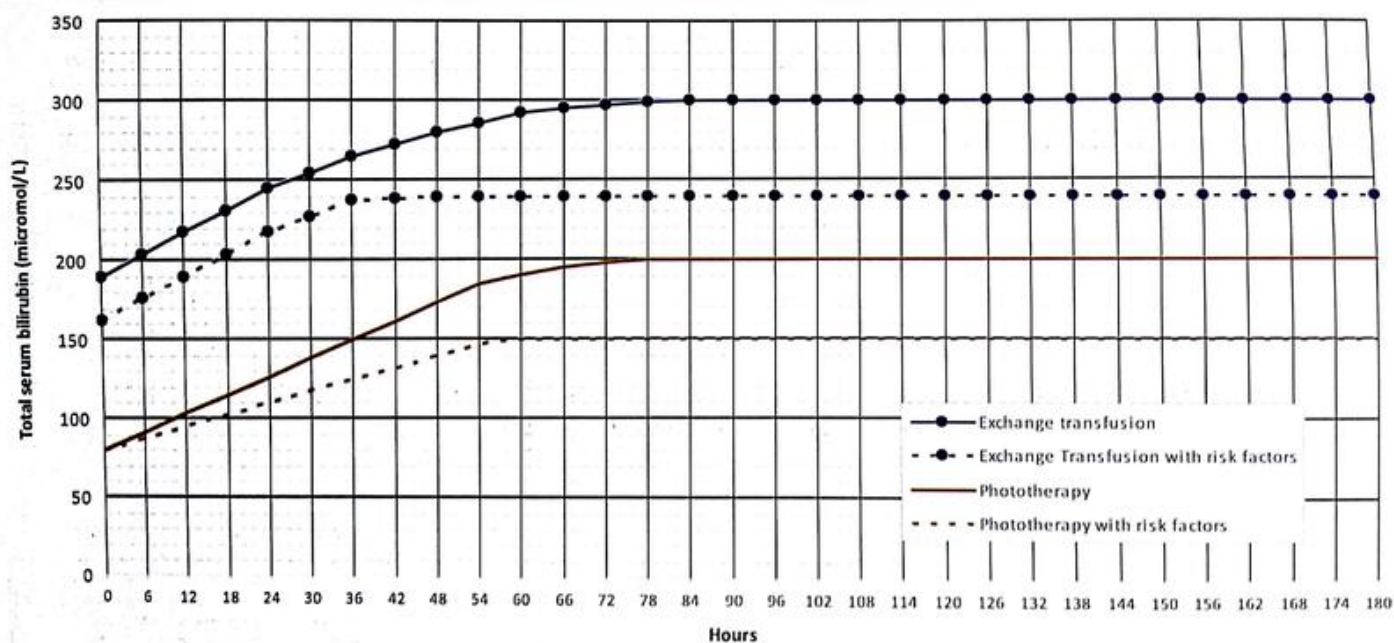
Jaundice management for babies born at <35 weeks, 1000g - 1499g

1. In the presence of risk factors (sepsis, haemolysis, acidosis or asphyxia) use the lower line.
2. Infants greater than 12 hours old with total serum bilirubin (TSB) level 1-50 micromol/L below the line should have repeat TSB within 6-24 hours.
3. Babies under phototherapy:
 - a. Consider measuring the TSB 4-6 hourly until the rise of serum bilirubin is known to be controlled, then measure TSB 12-24 hourly
 - b. Stop phototherapy if TSB greater than 50 micromol/L below line and recheck in 12-24 hours.
4. Infants who present with TSB above threshold should have an exchange transfusion done if the TSB is not expected to be below the threshold after 6 hours of intensive phototherapy.
5. An immediate exchange transfusion is recommended if there are signs of bilirubin encephalopathy



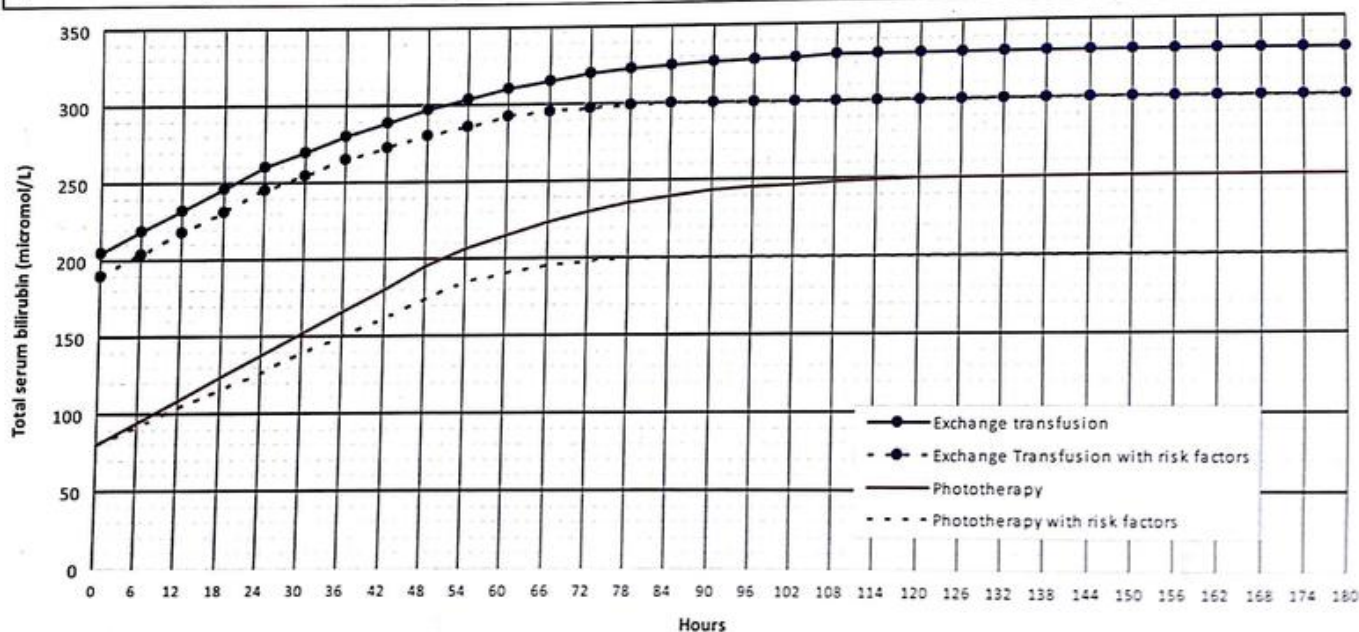
Jaundice management for babies born at <35 weeks, 1500 - 1999g

1. In the presence of risk factors (sepsis, haemolysis, acidosis or asphyxia) use the lower line.
2. Infants greater than 12 hours old with total serum bilirubin (TSB) level 1-50 micromol/L below the line should have repeat TSB within 6-24 hours.
3. Babies under phototherapy:
 - a. Consider measuring the TSB 4-6 hourly until the rise of serum bilirubin is known to be controlled, then measure TSB 12-24 hourly
 - b. Stop phototherapy if TSB greater than 50 micromol/L below line and recheck in 12-24 hours.
4. Infants who present with TSB above threshold should have an exchange transfusion done if the TSB is not expected to be below the threshold after 6 hours of intensive phototherapy.
5. An immediate exchange transfusion is recommended if there are signs of bilirubin encephalopathy



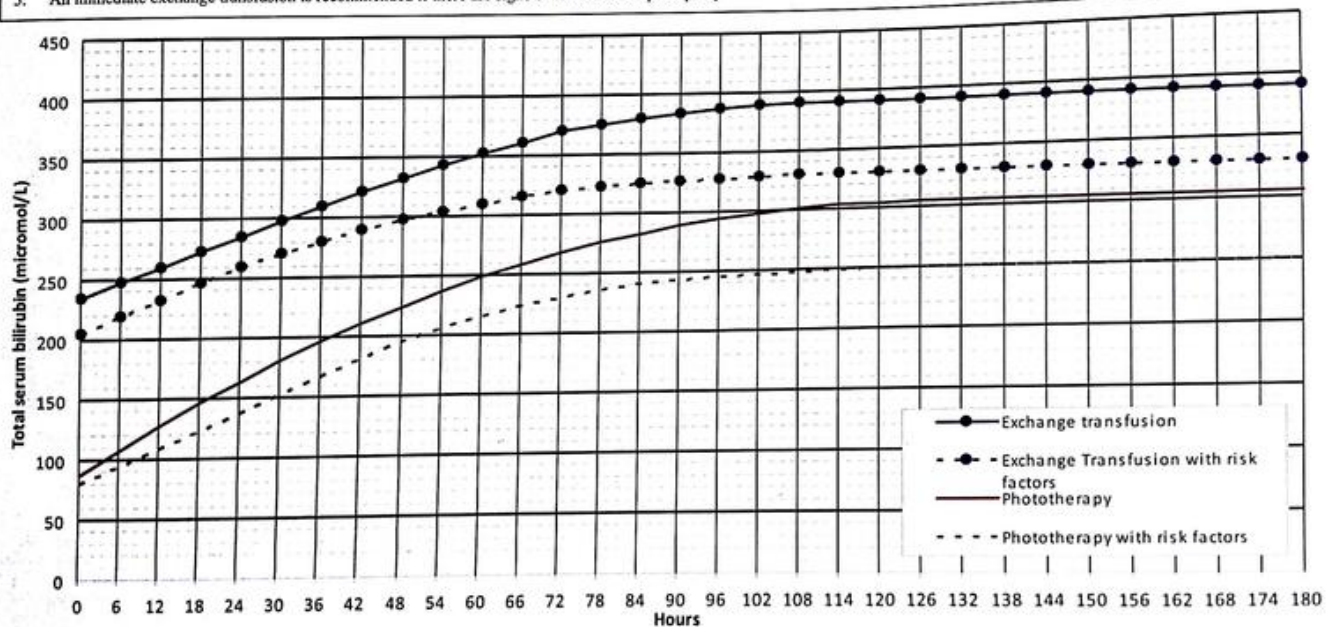
Jaundice management for babies born at <35 weeks, >1999g

1. In the presence of risk factors (sepsis, haemolysis, acidosis or asphyxia) use the lower line.
2. Infants greater than 12 hours old with total serum bilirubin (TSB) level 1-50 micromol/L below the line should have repeat TSB within 6-24 hours.
3. Babies under phototherapy:
 - a. Consider measuring the TSB 4-6 hourly until the rise of serum bilirubin is known to be controlled, then measure TSB 12-24 hourly
 - b. Stop phototherapy if TSB greater than 50 micromol/L below line and recheck in 12-24 hours.
4. Infants who present with TSB above threshold should have an exchange transfusion done if the TSB is not expected to be below the threshold after 6 hours of intensive phototherapy.
5. An immediate exchange transfusion is recommended if there are signs of bilirubin encephalopathy



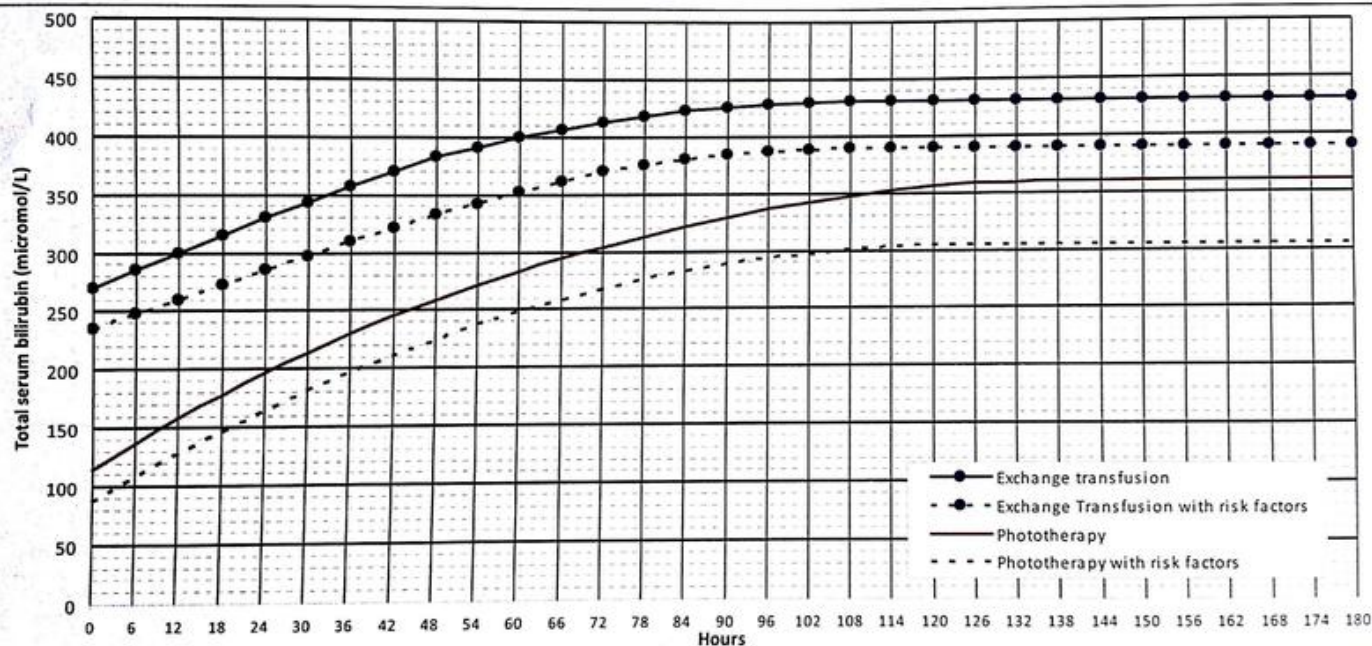
Jaundice management for babies born at 35 - 37+6 weeks

1. In the presence of risk factors (sepsis, haemolysis, acidosis or asphyxia) use the lower line.
2. Infants greater than 12 hours old with total serum bilirubin (TSB) level 1-50 micromol/L below the line should have repeat TSB within 6-24 hours.
3. Babies under phototherapy:
 - a. Consider measuring the TSB 4-6 hourly until the rise of serum bilirubin is known to be controlled, then measure TSB 12-24 hourly
 - b. Stop phototherapy if TSB greater than 50 micromol/L below line and recheck in 12-24 hours.
4. Infants who present with TSB above threshold should have an exchange transfusion done if the TSB is not expected to be below the threshold after 6 hours of intensive phototherapy.
5. An immediate exchange transfusion is recommended if there are signs of bilirubin encephalopathy

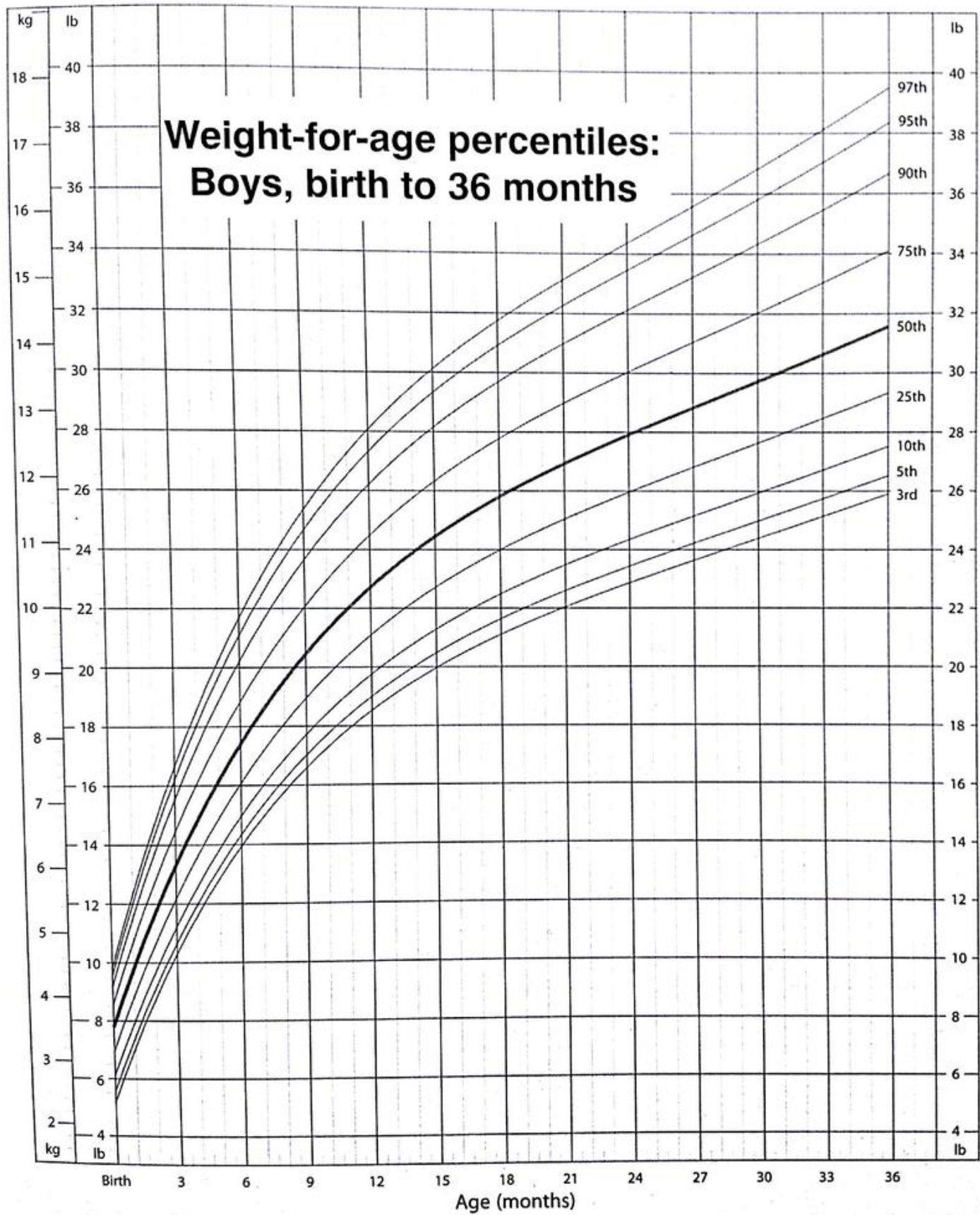


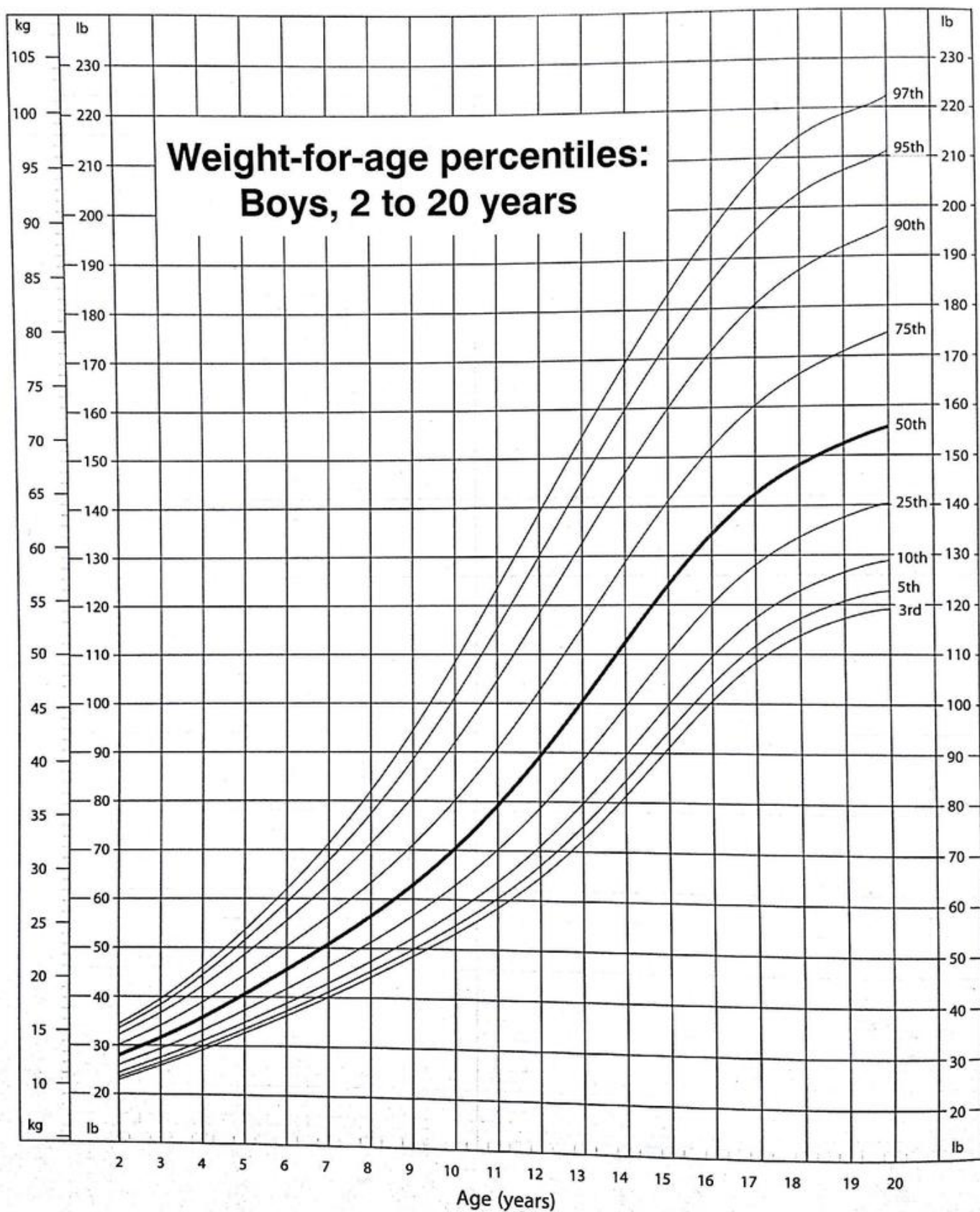
Jaundice management for babies born at 38+0 weeks or older

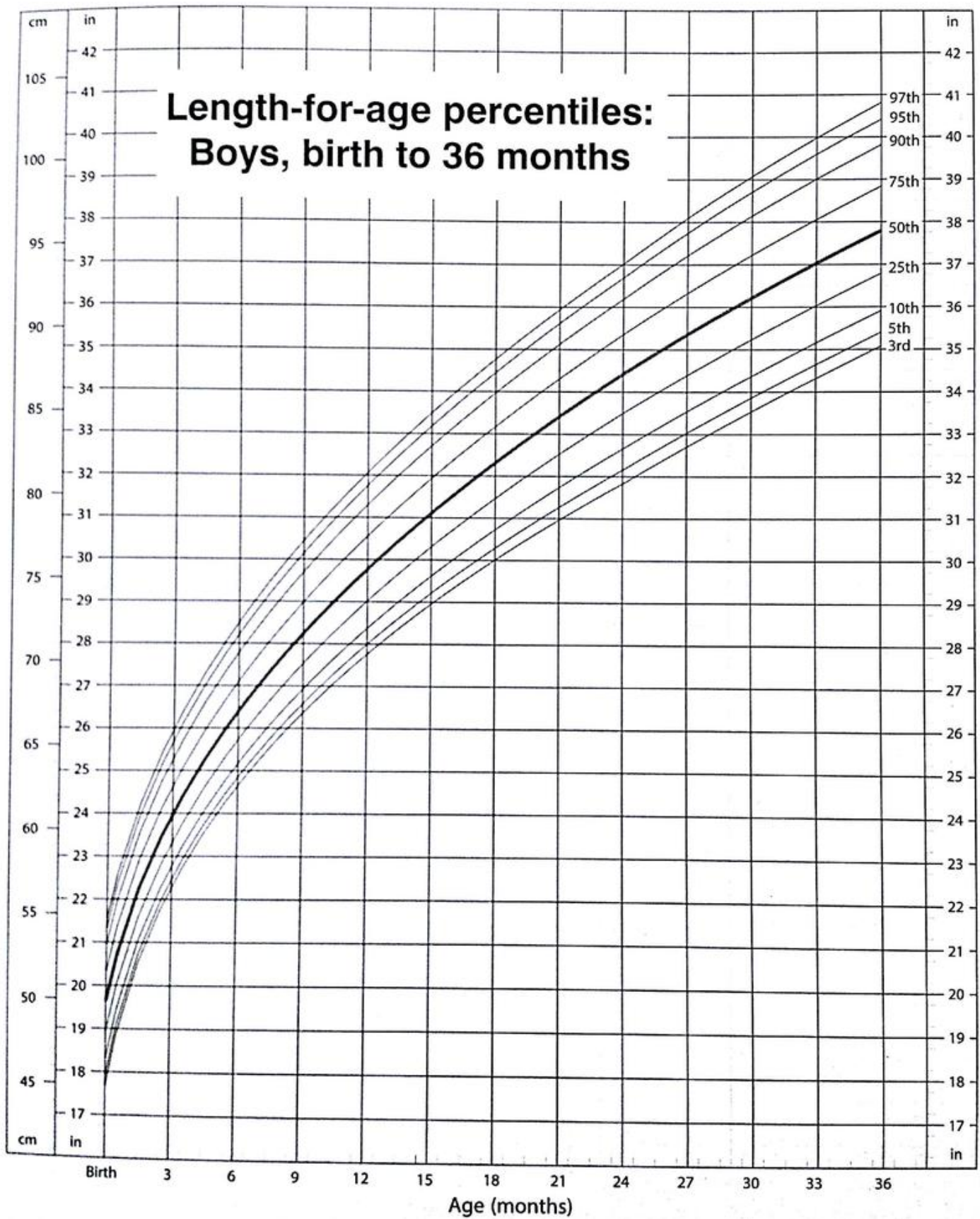
1. In the presence of risk factors (sepsis, haemolysis, acidosis or asphyxia) use the lower line.
2. Infants greater than 12 hours old with total serum bilirubin (TSB) level 1-50 micromol/L below the line should have repeat TSB within 6-24 hours.
3. Babies under phototherapy:
 - a. Consider measuring the TSB 4-6 hourly until the rise of serum bilirubin is known to be controlled, then measure TSB 12-24 hourly
 - b. Stop phototherapy if TSB greater than 50 micromol/L below line and recheck in 12-24 hours.
4. Infants who present with TSB above threshold should have an exchange transfusion done if the TSB is not expected to be below the threshold after 6 hours of intensive phototherapy.
5. An immediate exchange transfusion is recommended if there are signs of bilirubin encephalopathy

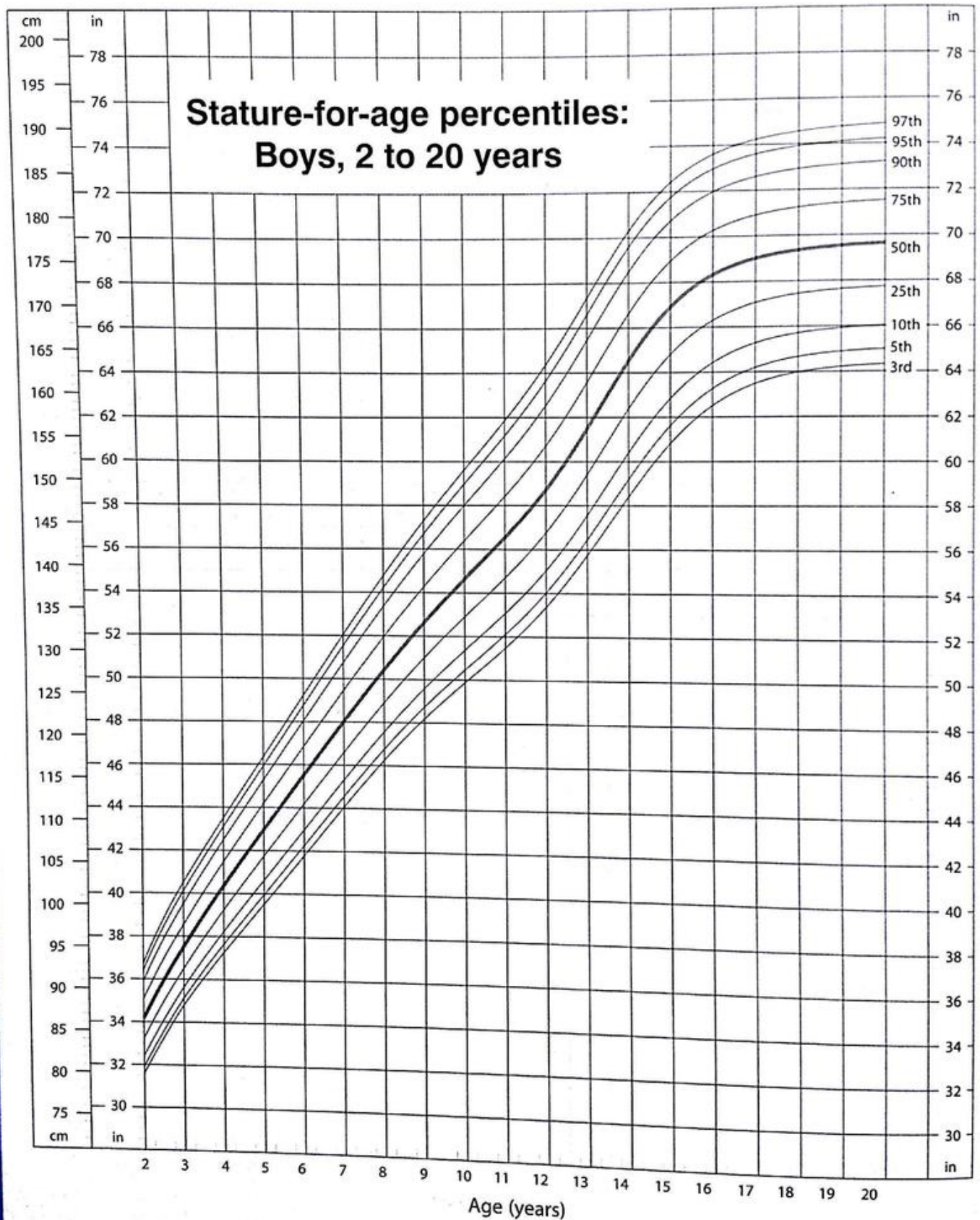


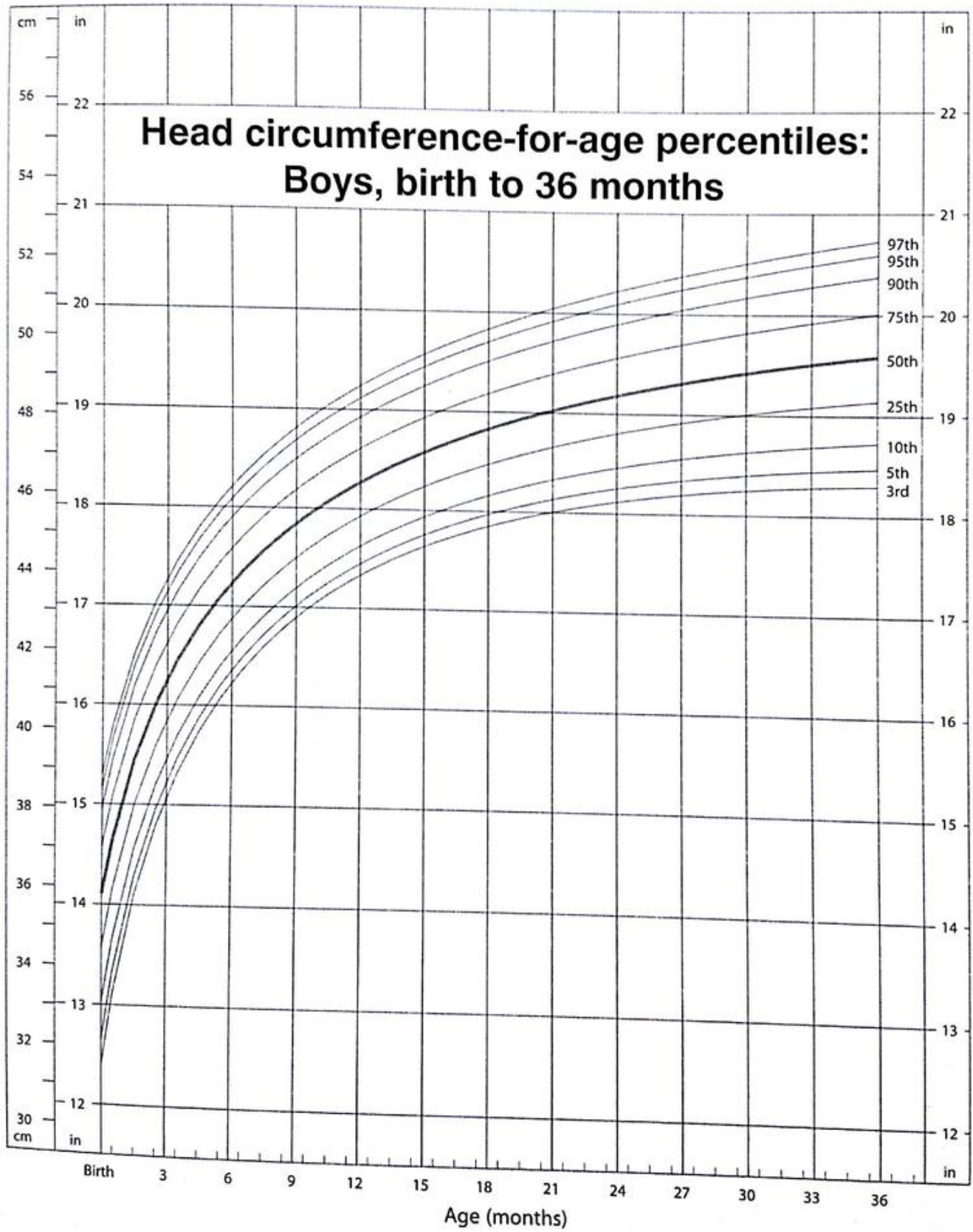
1. American Academy of Pediatrics Subcommittee on Hyperbilirubinaemia. 2. Clinical Practice Guideline: Management of hyperbilirubinaemia in the newborn infant 35 or more weeks of gestation. *Pediatrics*.2004; 114:297-316. 3. Horn A. et al. Phototherapy and exchange transfusion for neonatal hyperbilirubinaemia: neonatal academic hospitals' consensus guidelines for South African hospitals and primary care facilities. *South African Medical Journal*, 2006; 96(9):819-24. 4. Morris BH et al. Aggressive vs conservative phototherapy for infants with extremely low birth weight. *New England Journal of Medicine*. 2008; 359(18):1885-96. 5. Queensland Maternity and Neonatal Clinical Guideline: MN12.7-V4-R17 Neonatal jaundice

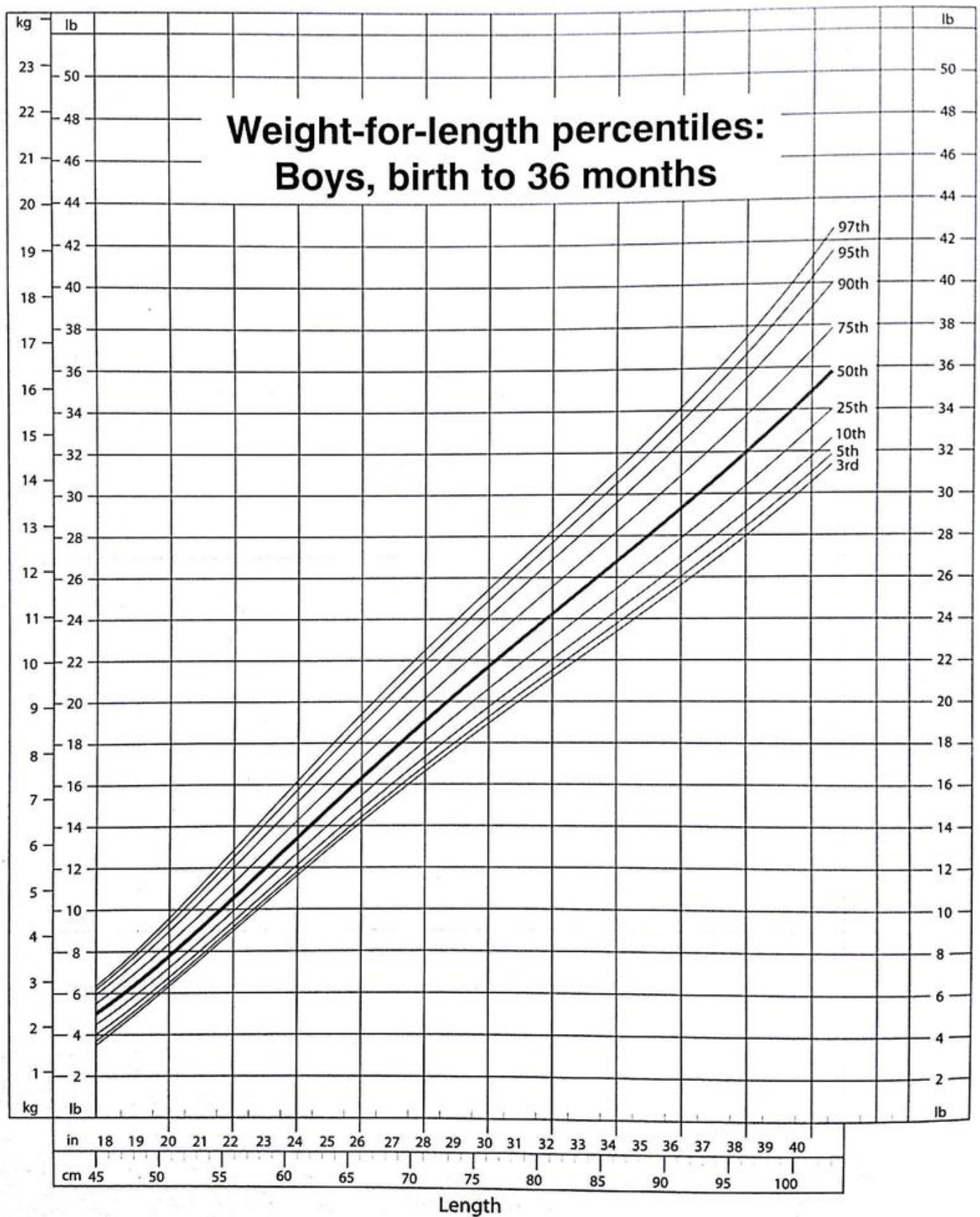




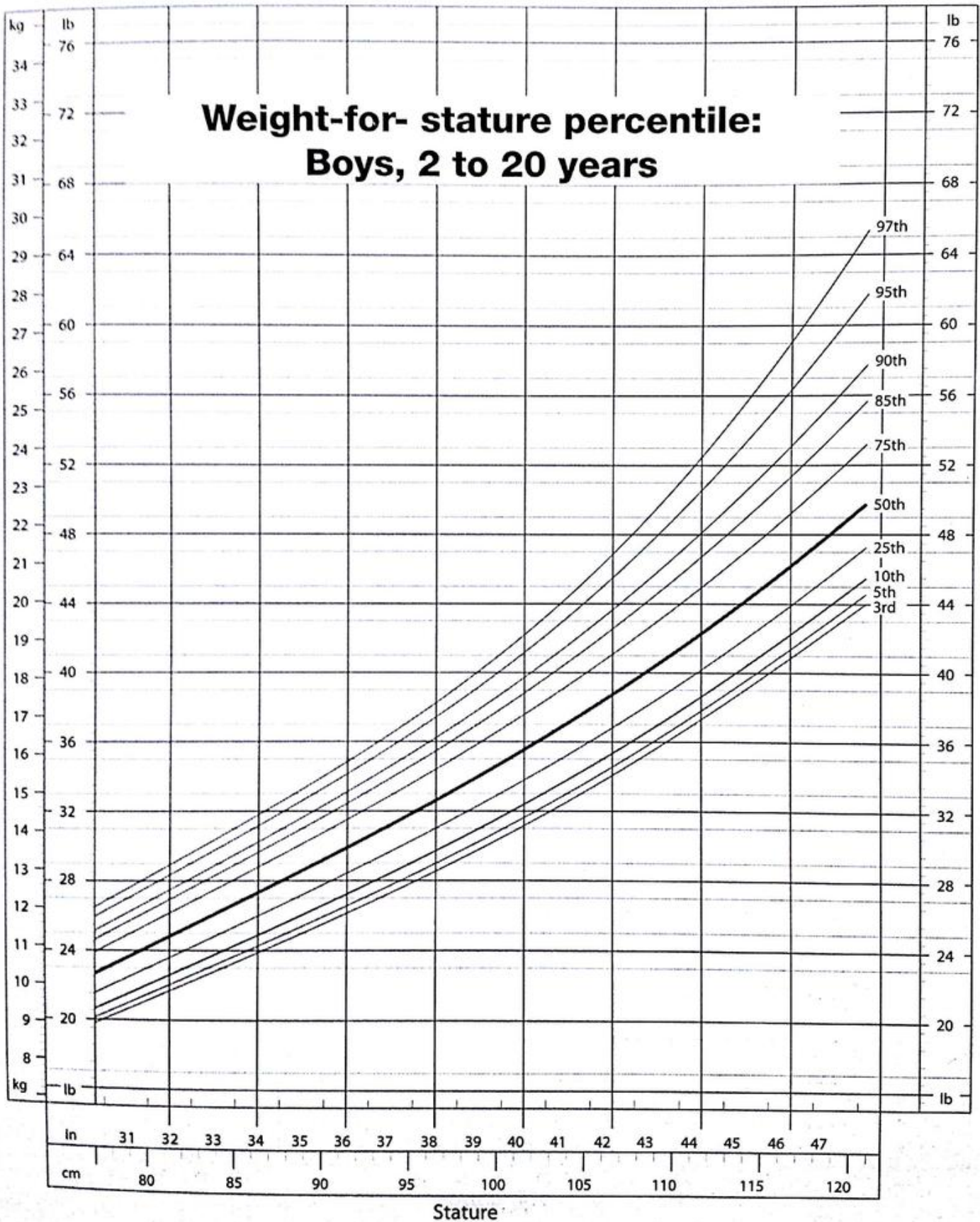


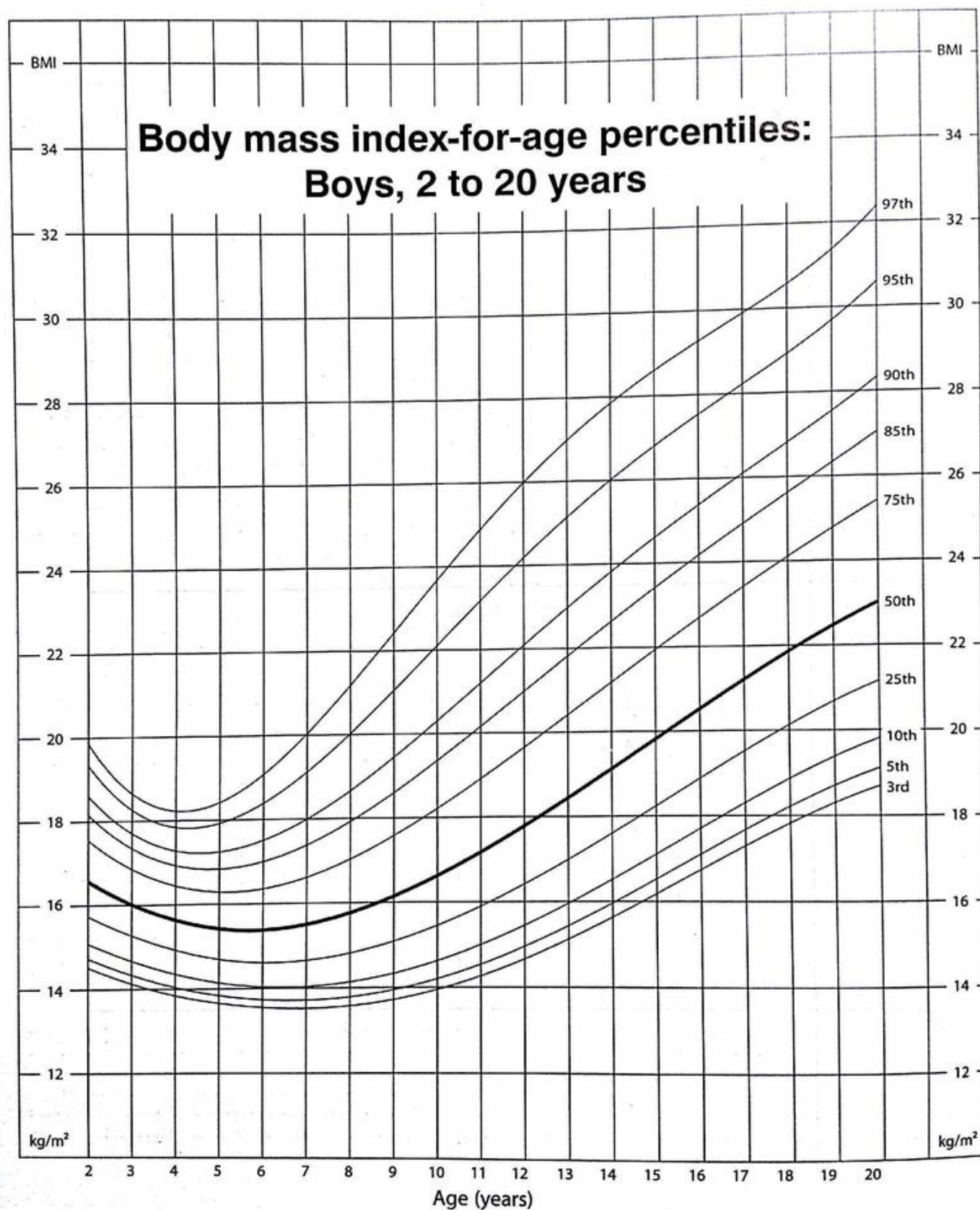


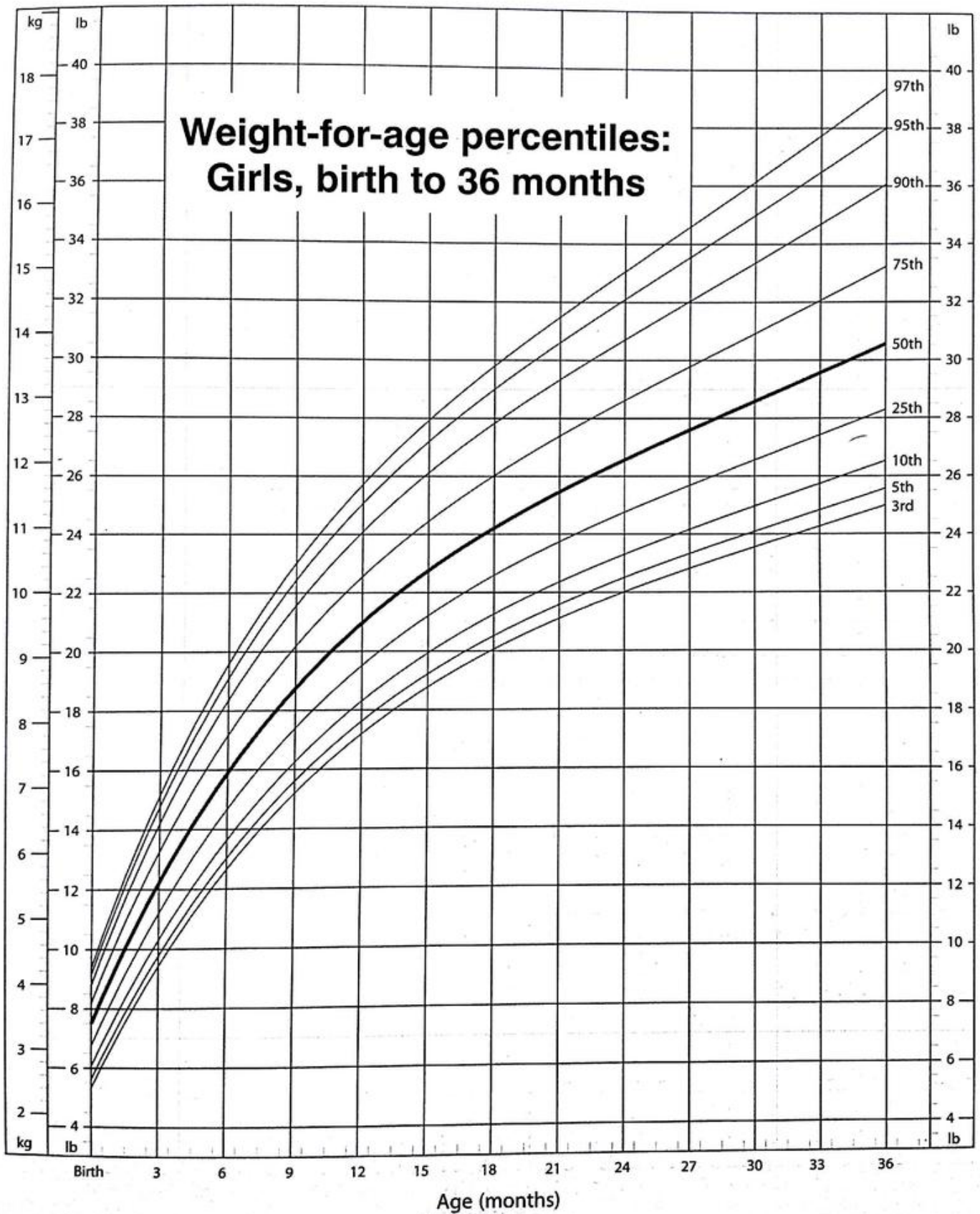


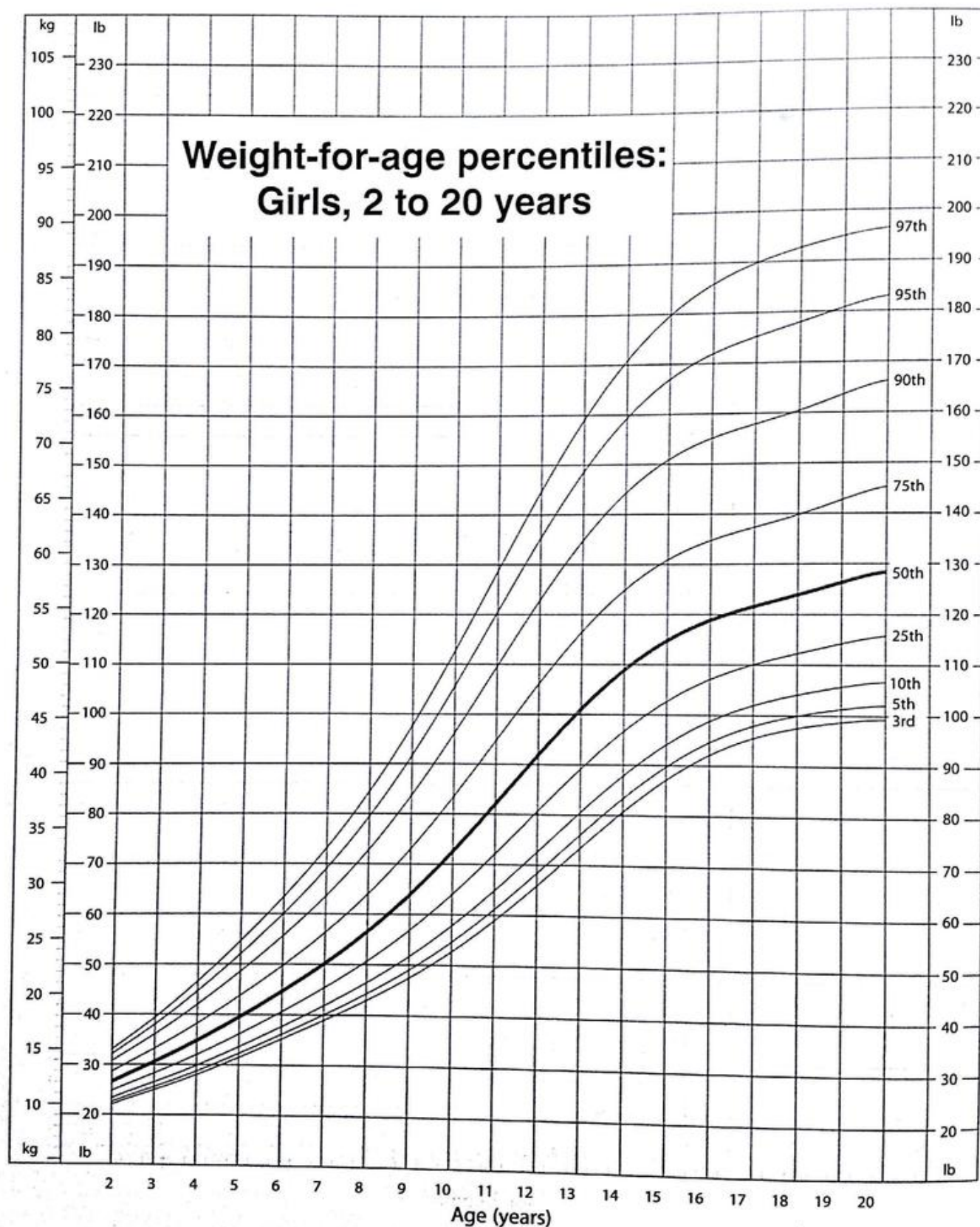


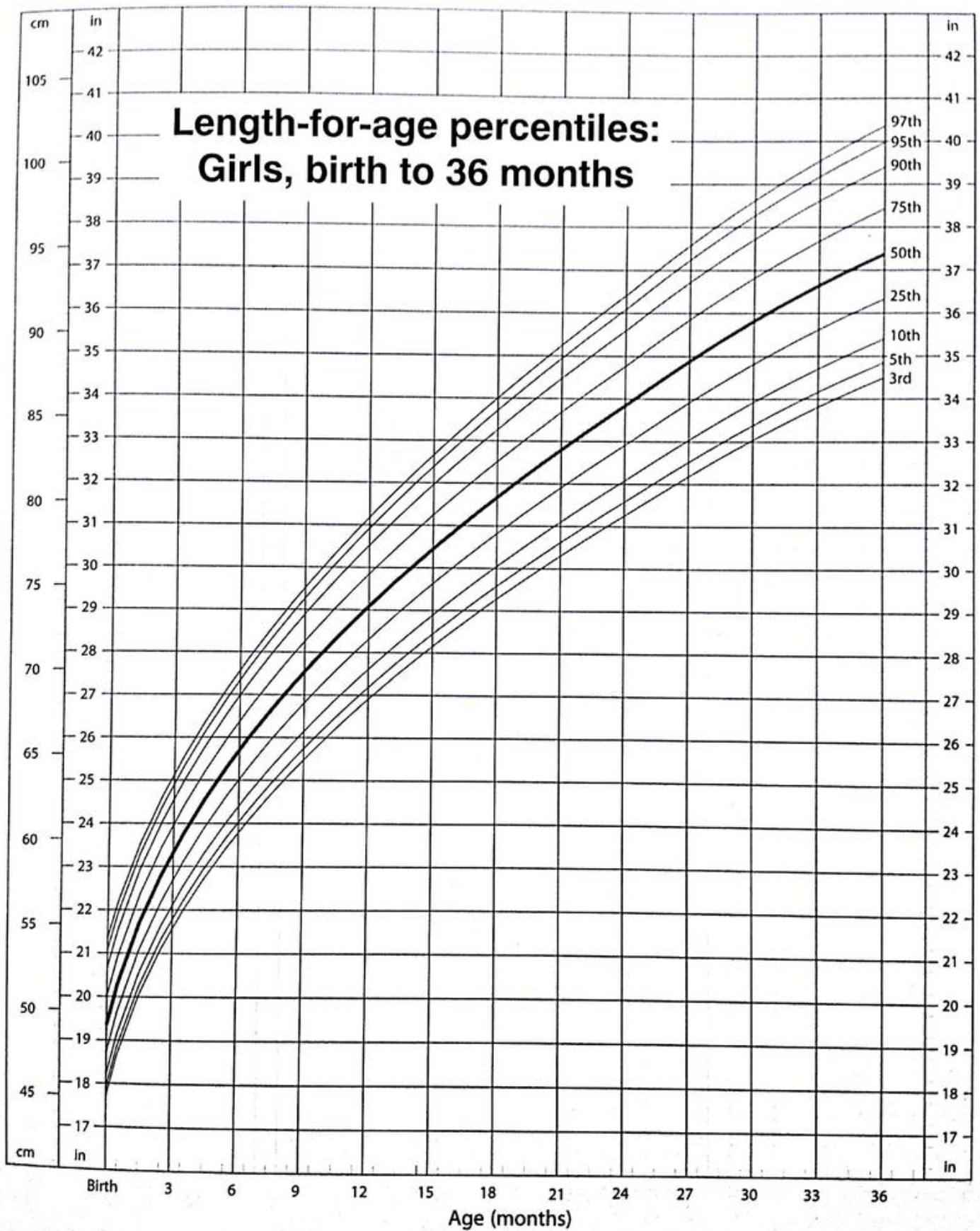
Weight-for-stature percentile: Boys, 2 to 20 years

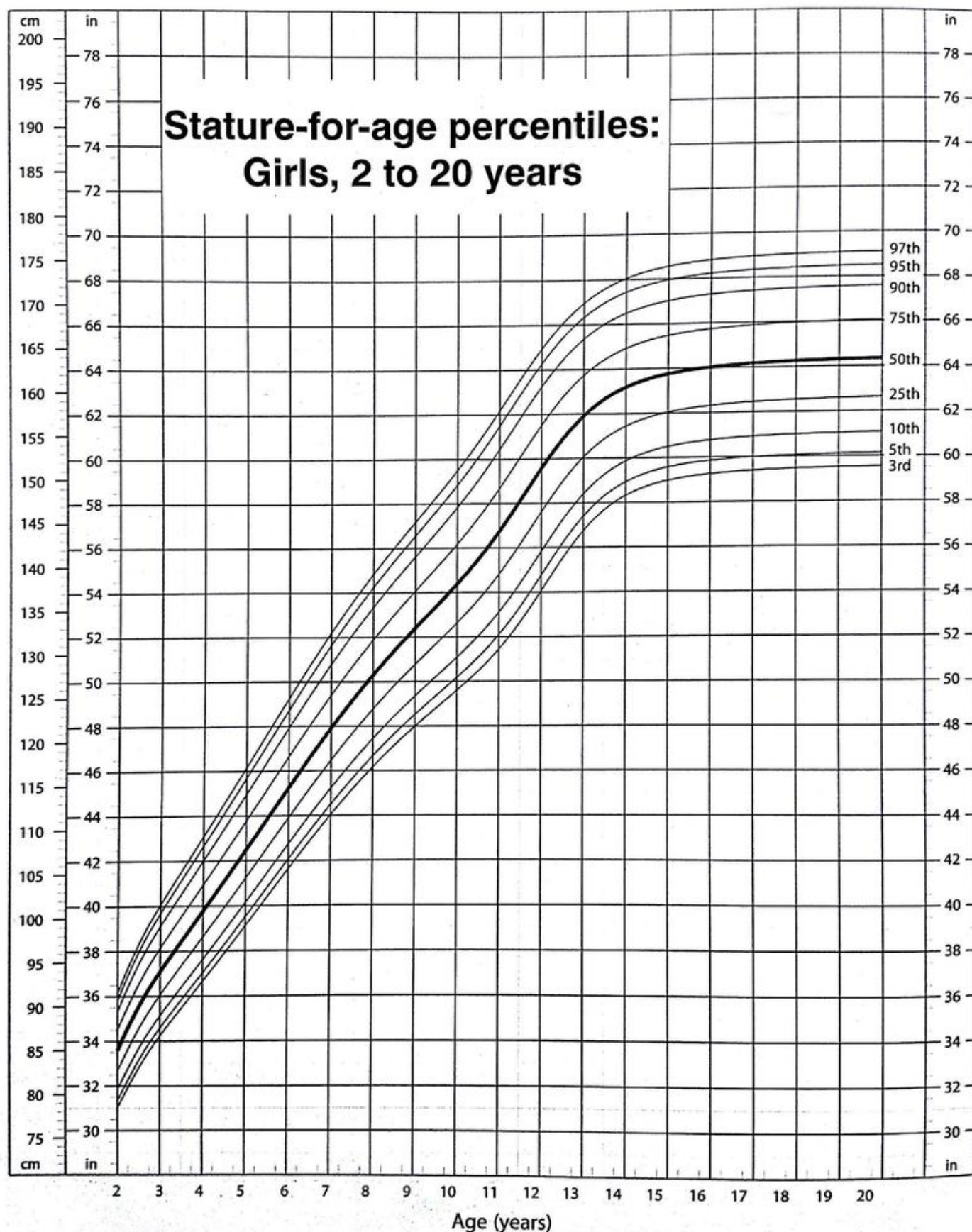


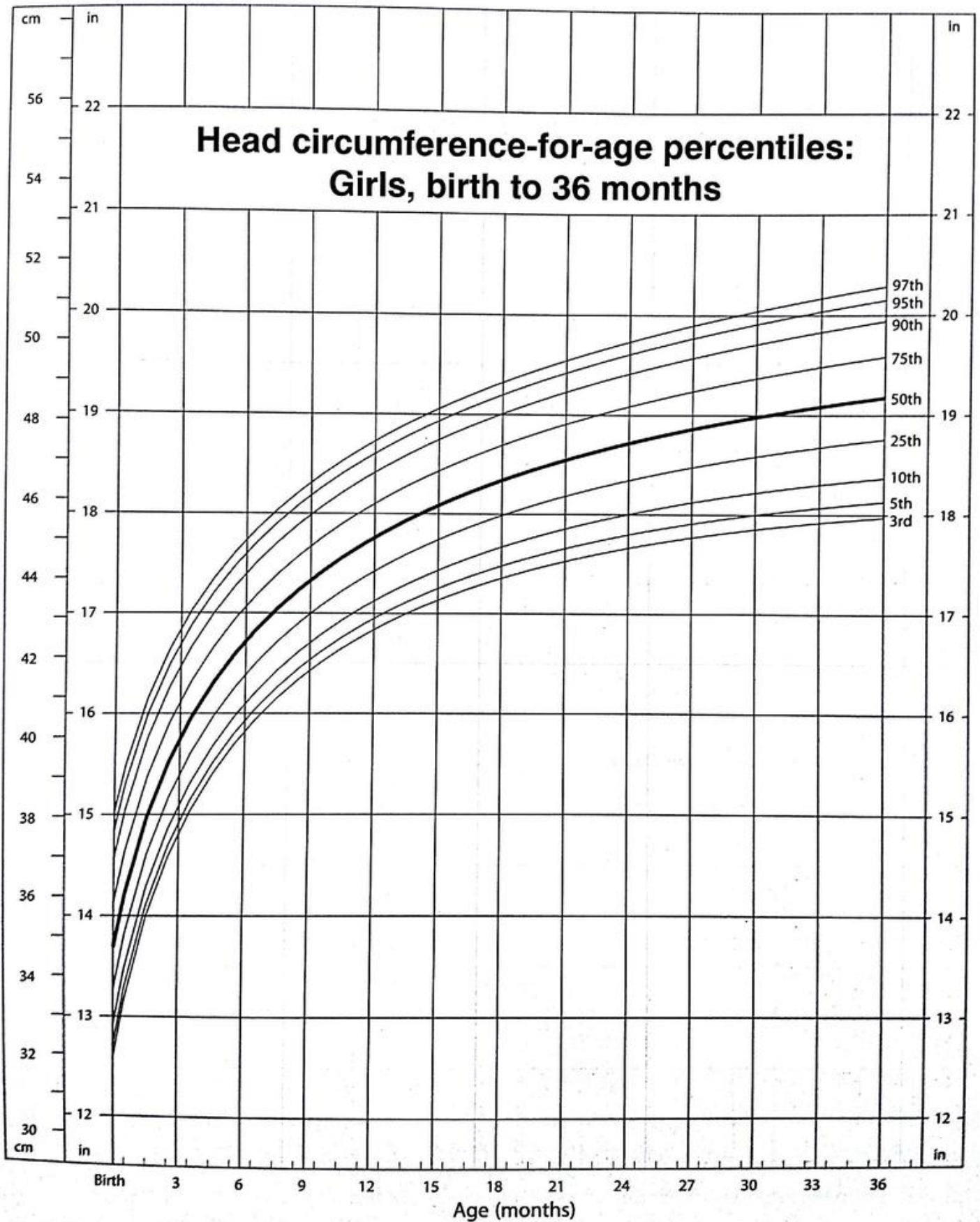


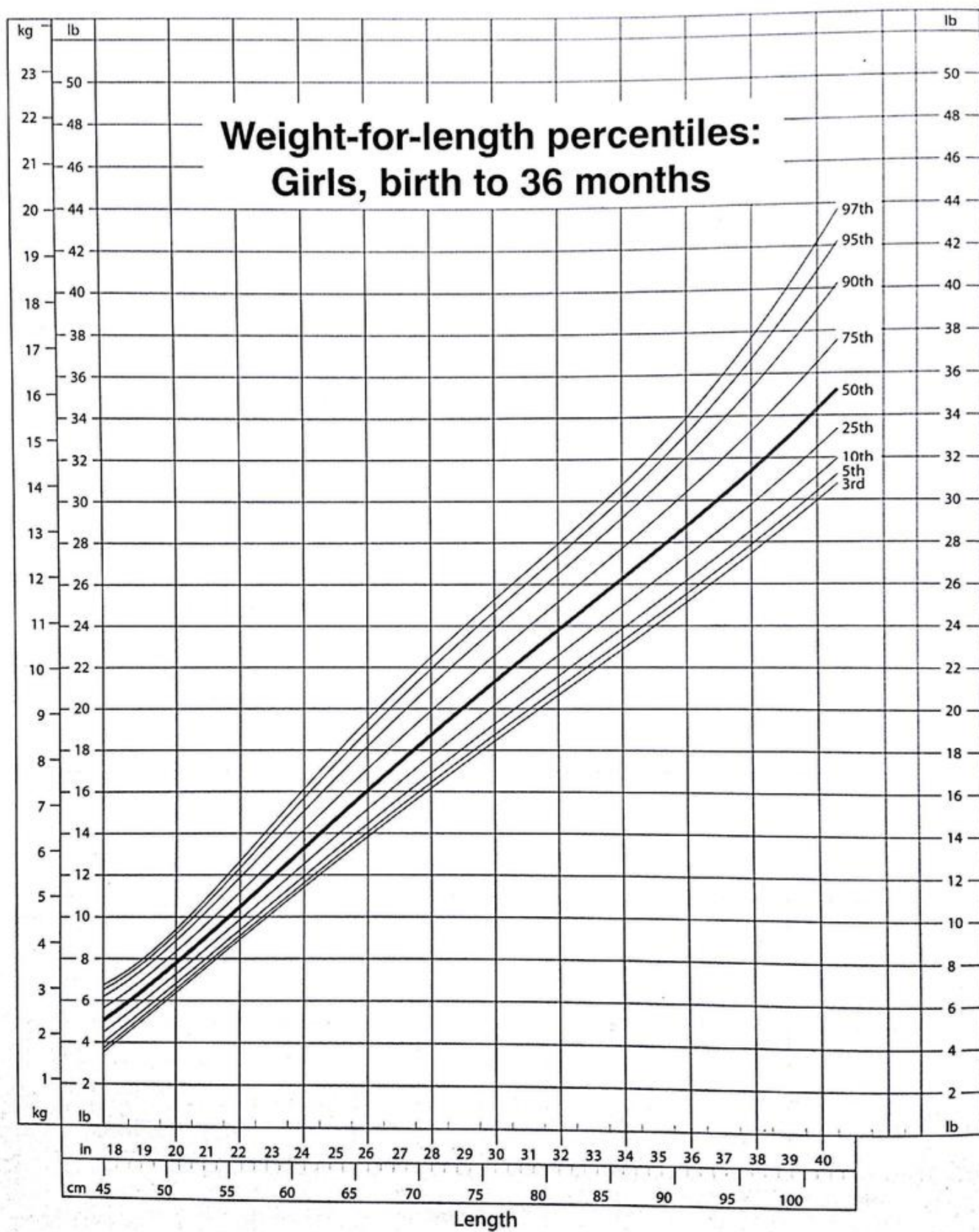




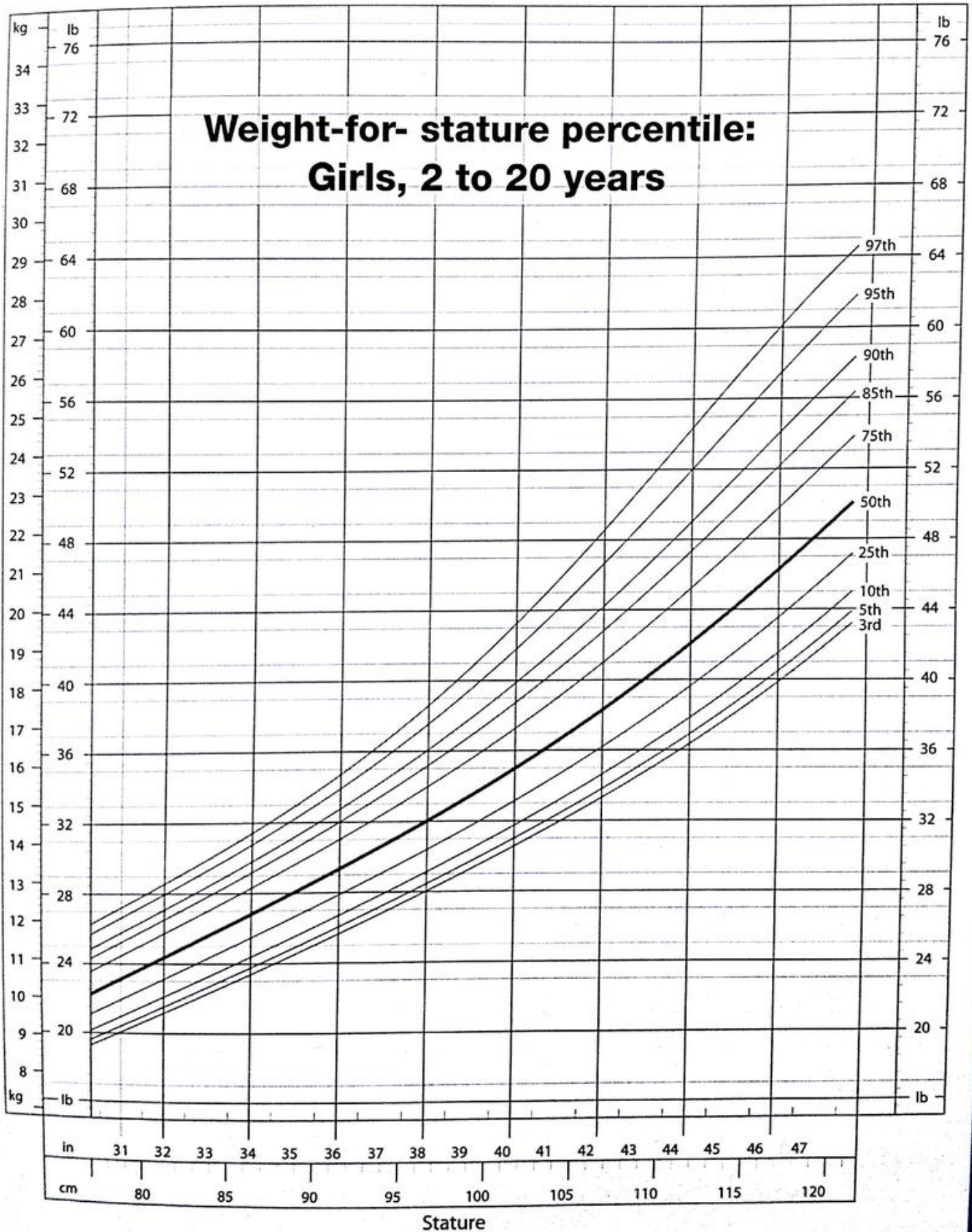


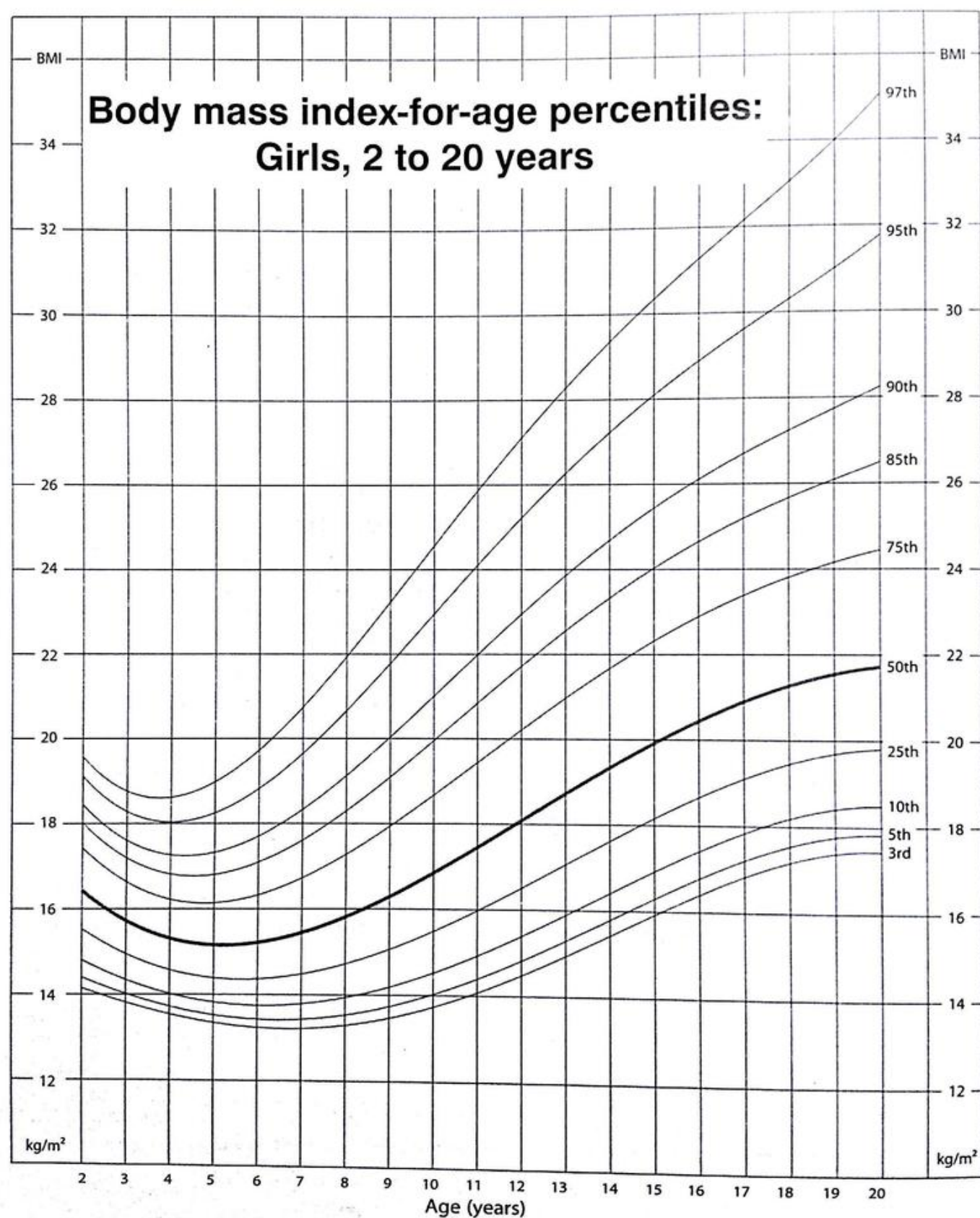






Weight-for-stature percentile: Girls, 2 to 20 years





INDEX

A

- abdominal striae 210
- ABO incompatibility 62, 314
- Abortive polio 222
- Absence seizure 238
- Acetylcholine 270
- acidosis 105, 109, 159, 206, 207, 314, 315
- acrodermatitis enteropathica 88
- Activated partial thromboplastin time 199, 202, 204
- Activated partial thromboplastin time (aPTT) 199
- Acute bronchiolitis 89
- acute glomerulonephritis 129
- Acute glomerulonephritis 206
- Acute glomerulonephritis (AGN) 206
- acute renal failure 307
- Acute renal failure 272
- Acute stroke 229
- Acute tubular necrosis 53
- Acute watery diarrhoea 104
- Acyclovir 39, 67, 177, 237
- ADA 33, 236
- adalimumab 144
- ADHD 253, 255, 256
- Adverse Events Following Immunization (AEFI) 26
- AFP 223
- AIDP 224
- AKI 53, 206, 212, 213, 214, 218
- Albendazole 282, 283, 284
- albumin 75, 161, 169, 208, 211, 283
- albuminuria 208, 210
- Alfa-1 antitrypsin 351
- algid malaria 156
- Allopurinol 193
- AMAN 224
- AMBU 276, 313
- aminocaproic acid 203
- Amoebiasis 279
- Amoebic colitis 279
- Amoebic liver Abscess 280
- Amphotericin B 161, 307
- AMSAN 224
- ANA 143, 169, 214
- Anaemia 179, 144, 181, 283
- Anal grip 293
- Ancylostoma duodenale 283
- Angular stomatitis 79
- Antenatal corticosteroid 61
- Anthelmintics 281, 282, 283
- Anti-D immunoglobulin 63, 199
- Anti dsDNA 214
- Anti Diphtheria Serum 43
- Anti-nuclear antibody 143, 169, 214
- Anti Rabies Vaccine 277
- Anti-thymocyte globulin (ATG) 195
- Anticoagulant 316
- Apnoea 40, 41, 51, 52, 59, 61, 86, 241, 275
- Apnoeic spells 50
- Appendicitis 110, 111, 113, 282
- Artemether 159
- Arterial blood gas 54, 57, 83, 105, 111, 167, 213, 288, 309
- Artesunate 159
- Arthralgia 38, 138, 147, 165
- Arthritis 31, 38, 81, 92, 132, 137, 141, 144, 155, 174, 267
- Ascariasis 281
- Ascariasis crisis 282
- Aseptic meningitis 38, 222
- ASO 119, 138, 207, 214, 324
- Aspiration pneumonia 89, 225, 237, 285, 285
- Aspirin 138, 140, 143, 203
- Asthma 86, 95

Asunra 186
 Ataxia 177, 262, 263
 Atlanto-occipital subluxation 250
 Atomoxetine 255
 Atonic seizure 238
 Atrial septal defect 122
 Atropine 271
 Attachment 16
 Autism 254
 Azacytidine 150
 Azotaemia 166 Atropine 271, 272, 278
 attachment 16, 17, 19
 azacytidine 187
 azotaemia 206, 209

B

B6 deficiency 65
 Bacteraemia 154
 Baily scale 13
 BCG 26, 33, 48, 67, 235
 Baclofen 227, 264
 Beclomethasone 98, 99
 Benign intracranial hypertension 312
 Beriberi 79
 Bifidus factor 16
 Biliary atresia 165, 168, 169, 171, 298
 Bilirubin 61, 111, 164, 166, 169, 172, 267, 315, 326
 Bilirubin induced neuronal deficit 62
 Birth Injuries 67
 Bitot's spot 80
 Black water fever 157
 Blalock-Taussig Shunt 128
 Blast cells 192, 193, 199
 Bleeding time 199, 202, 204
 Bleomycin 177
 Blood glucose monitoring 318
 Blood transfusion 156, 160, 167, 186, 193, 216, 272, 283
 BMI 8, 10, 85
 Body rocking 253
 Bone age 257, 258

Bone marrow aspiration 312
 Bone marrow transplantation 186, 193, 195
 Botulinum toxin 227
 Brachycephaly 249
 Bradycardia 51, 53, 59, 96, 275
 Brain stem herniation 312
 Breast feeding 15
 Breast milk jaundice 62
 Breath-holding attacks 180, 253
 Broken neck sign 271
 Bronchiolitis 93
 Bronchopneumonia 36, 41, 90
 Brudzinski signs 232, 235
 Brushfield spot 249
 Bruxism 253
 Budesonide 95
 Buffalo hump 210
 Bull neck 42
 BUN 211, 213, 214, 275

C

C3 16, 207, 211, 214
 C4 16
 Calcium gluconate 308
 Cancrum oris 161
 Caput medusa 171
 Caput succedaneum 67, 68
 Carbamazepine 239
 Carbamazepines 239
 Cardiomegaly 121, 123, 129, 130, 138, 140, 207, 246, 266
 Carditis 38, 43, 138, 140, 141, 143
 Caseation necrosis 33, 174, 175
 Cataract 27, 210, 249, 267
 CCF 129, 131, 140
 Cephalhaematoma 67, 68, 201
 Cerebelitis 39
 Cerebral abscess 127, 155, 232
 Cerebral infarction 232
 Cerebral malaria 157, 229, 238
 Cerebral palsy 50, 54, 232, 262

Ceruloplasmin 169, 172, 266
 Chemical pneumonitis 269
 Chemosis 175
 Chemotactic activities 16
 Chest indrawing 21, 22, 23, 59, 90, 92, 94, 287
 Chicken pox 27, 33, 147
 Child 1
 Chloroma 192
 Chloroquine 158, 159
 Cholera 27, 104, 106, 107,
 Cholera saline 106, 304, 308
 Chlorpromazine 140
 Chorionic villus sampling 187
 Choroid tubercle 235
 Christmas disease 200
 CKD 81, 83, 215, 257
 Cleft lip & palate 228
 Clobazam 231, 239
 Clonazepam 239, 264
 Clonic seizure 65, 238
 Clubbing 43, 125, 131, 168
 Coagulopathy 86, 127, 166, 169, 171, 200, 207,
 273
 Coeliac disease 250, 257
 Collapse 28, 31, 41, 43, 57, 82, 94, 102, 157,
 158
 Colostrum 15, 48
 Community IMCI 23
 Complementary feeding 17, 21, 72
 Congenital cataract 249
 Congenital diaphragmatic hernia 287
 Congenital heart diseases 89, 120
 Constitutional delay 257
 Constructional apraxia 168
 Convulsion 21, 23, 51, 61, 64, 79, 110, 157, 166,
 191, 207, 213, 229, 254, 264, 270, 296, 306
 Coombs tests 64
 Corneal ulceration 36, 80
 Corneal xerosis 36, 80
 Cough 21, 22, 30, 34, 36, 37, 41, 89, 93, 95,
 100, 118, 129, 176, 209, 225, 254, 269, 281,
 283, 320, 325
 CPK 272
 Cranial nerve palsy 43, 54, 80, 177, 232, 233,
 242, 263

Craniotabes 82
 Crigler-Najjar syndrome 62, 165
 Croup 100
 CRP 57, 60, 64, 94, 114, 133, 138, 139, 143,
 324
 Cryoprecipitate 203
 Cryopreserved RBC 186
 Cryptorchidism 295
 CSF 33, 60, 61, 65, 148, 176, 193, 225, 226,
 227, 230, 233, 236, 237, 242, 296, 311, 324
 Cutaneous larva migrans 283
 Cutis marmorata 246
 Cyanosis 22, 43, 46, 54, 57, 58, 59, 61, 90, 94,
 96, 100, 120, 121, 125, 127, 129, 201, 225,
 241, 272, 287, 318
 Cyclophosphamide 177
 Cyclosporine 195
 Cysternography 312
 Cystitis 219
 Cytarabine 177, 193
 Cytotoxic T cells 36

D

Dacarbazine 177
 Dance sign 291
 Daunorubicin 193
 DDAVP 204
 Decerebrate 235
 Deferasirox 186
 Dehydration 21, 51, 75, 104, 110, 128, 159, 171,
 213, 219, 279, 304, 325
 Dengue haemorrhagic fever 147, 148, 197
 Dengue shock syndrome 147, 149
 Dengue syndrome 147, 149
 Denver scale 13
 Deferiprone 186
 Desferrioxamine 186
 Desmopressin acetate 203
 Developmental delay 245
 Dexamethasone 95, 101, 156, 193, 235,
 Dialysis 214, 308
 Diaphragmatic hernia 57, 287, 313
 Diarrhoea 3, 15, 20, 21, 79, 104, 111, 116, 154,
 157, 167, 180, 209, 213, 269, 279, 303, 325

Diazepam 41, 215, 230, 232, 237, 264
 Diphtheria 42, 99, 118, 222
 Direct agglutination test 161
 DMSA scan 215, 220
 Dobutamine 54, 130, 241, 288
 Dog bite 277
 Domperidone 111
 Dopamine 54, 130, 241, 288
 Double bubble shadow 290
 Doughnut or target appearance 292
 Down syndrome 7, 116, 132, 248, 257
 Drowning 273
 Drug resistant TB 35
 DTPA 215, 220
 Duchenne Muscular Dystrophy 264
 Duodenal atresia 290
 Duodenoduodenostomy 291
 Dysentery 79, 105, 161
 Dysphagia 42, 174, 180, 225
 Dysuria 209, 219

E

Early Childhood Development 10
 EBV 118, 194, 197
 Echocardiography 127, 130, 133, 139, 187, 266
 Eisenmenger syndrome 121, 122
 Electromyogram 225, 266
 Electrophoresis 184, 187
 Elek test 43
 Electrolytes 54, 57, 65, 75, 83, 104, 111, 114, 145, 167, 193, 206, 211, 215, 230, 233, 275, 289, 303, 305
 Emergency sign 22
 Enamel hypoplasia 249
 Encephalitis 23, 36, 39, 236
 Encephalopathy 42, 53, 54, 166, 168, 169, 206, 207, 215, 229, 245, 262
 Encopresis 254
 Endemic iodine deficiency 246
 Entamoeba histolytica 279
 Enterobiasis 282
 Enterobius vermicularis 282
 Enthesitis related arthritis 142

Enuresis 254
 Eosinopenia 155
 Eosinophilia 93, 96, 176, 282
 EPI Schedule in Bangladesh 26
 Epicanthic fold 249
 Epididymo-orchitis 38
 Epigastric fullness 290
 Epilepsy 54, 238, 262
 Epiphyseal dysgenesis 247
 Epispadias 299
 Epistaxis 148, 160, 201, 203
 Erb's palsy 67
 Erythema marginatum 139
 Etanercept 144
 ETAT 4, 22
 Eltrombopag 200
 Etoposide 177, 193
 Eventration of diaphragm 287
 Exanthem subitum (HSV 6 & 7) 147
 Exchange transfusion 64, 314, 315
 Exclusive breast feeding 16, 23, 48, 64, 67, 80, 81
 Extreme LBW 49, 262

F

F-75 76, 77, 78, 327
 F-100 78, 327
 Familial (X-linked) hypophosphataemic rickets 82, 83, 84
 Familial short stature 257
 Fast breathing 21, 59, 89, 92, 94, 270, 287,
 Febrile convulsion 229
 Ferritin 143, 179, 184, 186, 187
 Fifth disease 147
 Flapping tremor 168
 Fluid replacement 304
 Fluticasone 98
 Foetor hepaticus 168
 Foetus 1, 49, 52, 57, 62, 63, 156, 187, 303
 Fragile X syndrome 238, 245
 Frankfort plane 9
 Frenulotomy 297
 Fresh water drowning 274
 Fulminant hepatic failure 166

G

G6PD 62, 181
 GABA 39
 Galactosaemia 62
 Gastroschisis 298
 GBS 177, 224
 G-CSF 61, 195
 GERD 50, 93
 Genetic short stature 258
 GFR 206, 212, 213
 Ghon complex 27, 28
 Giant cells 33, 175
 Giardiasis 79, 107, 113, 280
 Gingival hypertrophy 192
 Gonads 7
 Gower sign 264, 265
 Granisetron 111
 Granulocyte Colony Stimulating Factor 195
 Ground itch 283
 Growing pain 137
 Growth velocity 8, 257
 Growth 7, 8
 Growth hormone 258, 260
 Grunting 21, 22, 23, 57, 90
 Guillain-Barré Syndrome 105, 224
 Gynaecomastia 168

H

Haemarthrosis 200, 201, 203
 Haematemesis 148, 166, 168, 171, 197, 201
 Haematuria 80, 132, 133, 143, 148, 166, 197, 201, 206, 207, 209, 210, 211, 212
 Haemolytic disease of newborn 62, 314
 Haemophilia 200
 Haloperidol 140
 Hair on end 185
 Hair pulling 253
 HbBart 181
 HbC 182
 HbE 182
 HbS 182
 HBsAg 166, 172, 195, 211

Head banging 253
 Head Tilt-Chin Lift 241
 Helping Babies Breathe 4, 56
 Henoch-Schönlein purpura 208
 Hepatitis A 27, 165, 224
 Herniotomy 300
 Harpenden calipers 10
 Herpes simplex virus 118, 236
 Hirschsprung disease 292
 HIV 5, 20, 23, 32, 34, 67, 92, 131, 187, 194, 208, 238
 Hodgkin disease 175, 177
 Human recombinant erythropoietin 216
 Hurler syndrome 245
 Hydrocoele 300
 Hydrocephalus 110, 232, 296
 Hydronephrosis 215, 295
 Hydrops foetalis 63, 181
 Hydroxyurea 187
 Hyperbilirubinaemia 71, 298, 314
 Hyperkalaemia 206, 207, 212, 214, 215, 274, 275, 307
 Hypernatraemia 306
 Hypersplenism 169, 183, 184, 190
 Hypertension 49, 52, 86, 206, 209, 210, 211, 213, 214
 Hypokalaemia 75, 105, 110, 166, 167, 289, 307
 Hypomagnesaemia 65, 229, 240
 Hyponatraemia 65, 105, 110, 158, 167, 214, 233, 274, 289, 305
 Hypospadias 299
 Hypothermia 48, 50, 61, 75, 76, 275, 315
 Hypothyroidism 62, 72, 86, 116, 185
 Hypoxic ischaemic encephalopathy 53

I

Ibuprofen 124, 144, 203, 226
 ICSOL 242
 IgA nephropathy 207
 IGRA 33
 IMCI 20
 Immune mediated demyelinating neuropathy 224
 Immunization 26

Imperforate anus 294
 Incredible LBW 49
 Indomethacin 124
 Ineffective erythropoiesis 183
 Infant mortality rate 4
 Infantile body proportion 246, 247
 Infantile hypertrophic pyloric stenosis 289
 Infantometer 8
 Infective endocarditis 130
 Infliximab 144
 Inguinal hernia 301
 INH prophylaxis 67
 Intrauterine growth retardation 49
 Intravenous immunoglobulin (IVIG) 199, 225
 Intraventricular haemorrhage 50, 65
 Intussusception 291
 ITP 197
 IUGR 49
 IYCF 15

J

Janeway lesions 131
 Japanese B encephalitis 236, 237
 JIA 141
 Joulie solution 84

K

Kangaroo Mother Care 50, 61, 76
 Karyotyping 116, 250, 260
 Kasai operation 169, 298
 Keratomalacia 80
 Kernicterus 62, 64, 262
 Kernig's sign 231, 232, 233, 235
 Kerosene poisoning 269
 KLB 43
 Klinefelter's syndrome 245
 Koilonychia 180
 Koplik's spot 36
 Kramer's rule 63
 Kwashiorkor 74, 75

L

Lactoferrin 16
 Lactulose 117, 166, 167, 225, 227
 Language disability 232
 L-asparaginase 177, 193
 Laryngotracheobronchitis 100
 LBW 49
 LD bodies 161
 Leukopenia 37, 147, 149, 155, 161, 190, 194
 Leukoreduced packed RBC 186
 Leukotriene antagonists 98
 Levamisole 282, 283
 Liver abscess 154, 280
 Liver transplantation 167, 169, 172
 Lockjaw 40
 Lubchenco chart 49
 Lumbar puncture 311
 Lupus vulgaris 28
 Lymphadenopathy 143, 160, 174, 191, 198
 Lymphoma 175
 Lymphopenia 37

M

Macroglossia 249
 Maculo-papular 36
 Malabsorption syndrome 82, 281
 Malaria 156
 Malnutrition 72
 MAM 74
 Mantoux test 32, 34, 79, 236
 Marasmus 72
 Mercaptopurine 193, 194
 MCU 216, 220
 MDG 5
 MDI 97
 MDR-TB 35, 67
 Measles 4, 21, 27, 33, 36, 80, 89, 93, 147, 161, 197
 Mebendazole 79, 114, 282, 283
 Meconium 46, 52, 57, 59, 116, 246, 293, 294
 Megaloblastic anaemia 79
 Melaena 81, 148, 166, 168, 201

Meningocele 116
 Meningococcal 27, 147, 198, 232, 233, 235
 Mental retardation 54, 80, 232, 236, 245
 Metabolic acidosis 83, 105, 125, 158, 167, 193, 212, 214, 216, 278, 288, 309
 Metabolic alkalosis 289, 290, 309
 Metoclopramide 111
 Methotrexate 144, 177, 193
 Methylphenidate 255
 Methylprednisolone 227
 Metronidazole 41, 79, 107, 167, 280
 MFS 224
 Microcephaly 54, 249, 263
 Micro-ESR 60
 Mid upper arm circumference 10, 74
 Mid parental height 258
 Millennium Development Goals 4, 5
 Millitary TB 28, 33
 Miltefosine 161, 162
 MMR 27, 37, 38, 216
 Mobile blood transfusion 316
 Montelukast 98, 99
 Moro reflex 47, 53, 61, 69, 70, 263
 Morphine 128
 Mosaicism 248
 Multidrug-resistant Typhoid Fever 155
 Mumps 37
 Muscle spasm 40
 Myelography 312
 Myelomeningocele 116, 297
 Myoclonic seizure 65, 238
 Myositis 133
 Myotoxins 271

N

Na-marrhuate 172
 Na Stibogluconate 162, 208
 Nail biting 253
 Naproxen 144
 Nasal intonation of voice 223, 225
 Nasal regurgitation 223, 225
 Nebulization 92, 95, 97, 101, 308, 317
 Necator americanus 283
 Neck rigidity 111, 231, 235

Necrotizing enterocolitis 50, 53
 Neocyte 186
 Neomycin 167
 Neonatal convulsions 64
 Neonatal mortality rate 4
 Neostigmine 272
 Nephrotic syndrome 39, 308
 Nifedipine 208, 214
 Night-blindness 80
 Nipah 236
 Nitrofurantoin 221
 Noma 236
 Non Hodgkin lymphoma 177
 Non-disjunction 248
 Novy-Macneal-Nicolle 161
 NSAID 95, 144, 152, 171

O

Obesity 84
 Obidoxime 271
 Occipito-frontal circumference 9
 Oesophageal varices 169, 171, 172
 Oligoemia 127
 Omphalocele 298
 Oncovin 177
 Ondansetron 111
 Oophoritis 38
 Opisthotonus 40
 OPV 26, 27, 48
 Oral thrush 21, 105, 107, 118, 313
 Orchiopexy 295
 Orchitis 38
 Organophosphorus compound 269, 270
 ORS 106, 150, 304, 306, 308, 328
 Osler's nodes 131, 132
 Otitis media 36, 41, 107, 230, 249

P

P. ovale 156
 Pacitane 264
 Palatal palsy 43, 313
 Palmar erythema 168
 Palmar grasp 12, 47, 263

- Pancreatitis 38, 110, 113, 114, 282, 285
 Panda sign 237
 Papilloedema 233, 242
 Paraphimosis 300
 Parotid swelling 37, 192
 Patent ductus arteriosus 50, 123
 PCR 33, 148, 161, 162, 233, 236, 237, 266
 Peak flow meter 98, 317
 Pellagra 79
 PEM 34, 72
 Pencil shaped cells 184
 Penicillamine 169, 208, 267
 Peri ventricular leukomalacia 262
 Perinatal asphyxia 3, 52, 65, 245, 262, 313
 Perinatal period 1
 Peritoneal Dialysis 214, 308
 Persistent diarrhoea 105
 Pertussis 41
 Petechiae 60, 131, 148, 177, 191, 194, 197, 198, 202
 Peyer's patches 175
 Phenobarbitone 66, 82, 239, 264
 Phenylketonuria 245
 Phenytoin 82, 116, 239
 Phimosis 300
 Phlebotomus argentipes 160
 Phlyctenular conjunctivitis 28
 Phototherapy 49, 64, 315
 Phrynodema 80
 Physiological Jaundice 62
 Pica 180, 253
 Pincer grip 12
 PKDL 161, 162
 Planter grasp 47
 Pleocytosis 226, 237
 Pneumatocoele 90, 91, 270
 Pneumatosis intestinalis 60
 Pneumococcal conjugate vaccine 217, 235
 Pneumocystis jiroveci 194
 Pneumonia 89
 Pneumoperitoneum 60
 Pneumothorax 57, 90, 269, 270
 Podocytes 209
 Poliomyelitis 27, 222
 Polycythaemia 52, 125, 127, 314
 Polyneuritis 38
 Polyvalent antivenom 272
 Portal hypertension 168, 171, 267
 Porto-systemic anastomosis 171
 Positioning 16
 Post maturity 52
 Post term 52
 Posterior urethral valve 215, 295
 Pott's disease 30
 Pralidoxime 271
 Prelacteal feeding 16
 Pressure immobilization 272
 Primary complex 28, 34
 Primitive reflexes 47
 Priority sign 23
 Procarbazine 177
 Propranolol 128, 172
 Proptosis 192
 Protein creatinine ratio 211
 Prothrombin time 150, 160, 167, 169, 172, 199, 202, 204, 267
 Pseudohypertrophy of calves 264
 Pseudomembrane 42, 43
 Pseudo-paralysis 80
 Psoriatic arthritis 142
 Pulmonary hypertension 41, 52, 53, 57, 121, 122, 124, 129, 215
 Pulmonary oedema 156, 157, 158, 213, 214, 215, 274, 275
 Purified Vero Cell Rabies Vaccine 277
 Purified Chick Embryo Cell Vaccine 277
 Pyelonephritis 110, 113, 114, 213, 219, 220
 Pyloric stenosis 289
 Pyrantel pamoate 79, 282, 283
- ## R
- Rabies immunoglobulin 277
 Ramstedt pyloromyotomy 290
 Rapid diagnostic test 157, 158
 Reactive arthropathy 181
 Rectal prolapse 41, 105
 Red currant jelly 291
 Reed Sternberg cell 176
 Reiter's syndrome 281
 Renal transplantation 216, 217
 ReSoMal 76, 308, 328

Respiratory acidosis 309
 Respiratory alkalosis 309
 Respiratory Distress Syndrome 57
 Reticulocyte count 64, 157, 184
 Rh incompatibility 62, 63
 Riboflavin 79
 Rickets 51, 81, 257, 267
 Rifampicin 33, 35, 175, 235
 Risus sardonius 40
 rk39 161
 Robertsonian translocation 248
 Romiplastin 200
 Rooting reflex 47
 Rota virus 27, 104
 Roth's spots 131, 132
 Rubella 4, 27, 120, 147, 197, 254
 Rubeola 36

S

Salbutamol 22, 92, 95, 97, 98, 99, 308, 317
 Salmeterol 98
 Salt water drowning 274
 Schistocytes 184
 School phobia 253, 254
 Scurvy 80
 Seizure 40, 40, 59, 65, 82, 178, 229, 238, 239, 240, 258, 262, 269, 306
 Severe Acute Malnutrition 74
 Severe Malaria 158
 SGPT 111, 165, 166, 167, 169, 172, 187, 267, 275
 Shakir's tape 10
 Shield chest 259
 Silent chest 96
 Skin fold thickness 10
 Skin pinch 21, 104, 105, 106
 SLE 137, 144, 154, 174, 179, 208, 213, 312
 Slip through sign 265
 Snake bite 271
 Sodium L thyroxine 187
 Sodium polystyrene sulfonate resin 308
 Sodium valproate 86, 239
 Spasticity 227, 263, 264
 Spherocytosis 62, 165, 181
 Spider navies 168

Spinal shock 226
 Spironolactone 122, 169, 212
 Splenectomy 187, 199, 200
 Splinter haemorrhages 131, 132
 Squint 233, 262, 263
 SSPE 36, 262
 Staphylococcus aureus 59, 131, 133
 Status epilepticus 240
 Steeple sign 100
 Stepping reflex 47
 Sterility 38
 Stridor 21, 22, 42, 82, 92, 99, 100, 101, 102
 Stunting 126, 184
 Subaponeurotic (subgaleal) haemorrhage 67, 68
 Subconjunctival haemorrhage 41, 67, 148, 149, 194,
 Subcutaneous nodules 138, 138
 Subdural effusion 232
 Submersion 273, 274, 276
 Sucking reflex 47
 Suction pain 313
 Sulfasalazine 114, 144
 Surfactant 58
 Sydenham's chorea 138, 139
 Sympathomimetic amines 130
 Synapses 10, 11

T

Target cells 180, 184
 Target height 258
 Tear drop 184
 Temper tantrums 253, 254
 Testicular atrophy 38
 Tetanospasmin 39
 Tetanus 39
 Tetanus toxoids 27
 Tetralogy of Fallot 125
 Thalassaemia intermedia 182
 Thalassaemia major 182
 Thalassaemia minor or trait 182
 Thiamine 79
 Three-way stop cock 314
 Thrombocytosis 143, 180, 185
 Thumb sucking 253

Thyroiditis 38, 246
 Tics 254
 Tinidazole 280, 281
 Tongue depressor 313
 Tongue tie 297
 Tonic seizure 65, 238, 239
 TORCH 49, 65, 238, 245
 Total iron binding capacity (TIBC) 180, 184, 185
 Tranexamic acid 203
 Transient tachypnoea of newborn 58
 Transillumination test 300
 Transjugular Intrahepatic Portosystemic Stent Shunt (TIPSS) 172
 Transverse myelitis 226
 TRIAGE 4, 22
 Triple IT 193
 Trismus 40
 TSH 116, 187, 245, 247, 248
 Tubercular arthritis 137
 Tubercular meningitis 235
 Tuberculosis 27
 Tuberculous dactylitis 29
 Tunica vaginalis 300
 Turner syndrome 120, 259
 Typhoid 27, 30, 155, 161

U

Umbilical hernia 246, 247, 298
 Under-five mortality rate 4
 Undescended testis 295
 Urinary incontinence 299
 Urticaria 134, 175, 282

V

Ventricular septal defect 120
 Ventriculitis 155, 232
 Vermiform appendix 175
 Vibrio cholerae 104
 Vinblastine 177
 Vincristine 177, 193
 Visual impairment 232
 Vitamin A 4, 23, 36, 77, 78, 79, 80, 107
 Vivax 156, 157, 158, 159
 von Willebrand disease 203

W

Waddling gait 264
 Webbing of neck 259, 260
 Wet Lung 58
 Widal test 155
 Wilson disease 172, 266

X

XDR-TB 35
 Xerophthalmia 36, 37, 75, 78, 79, 80

Z

Zinc 23, 51, 77, 104, 105, 107, 169, 268, 328