CHAPTER 19

PAEDIATRIC CONDITIONS

ESSENTIAL NEWBORN CARE

SALIENT FEATURES

The components of essential newborn care include:
- Establishment of breathing at birth and neonatal resuscitation.
- Prevention of hypothermia.
- Prevention of infection.
- Early and exclusive breastfeeding.
- Early identification and appropriate referral of high-risk newborns.

Treatment

1. Establishment of breathing at birth

Most newborns cry immediately at birth and, therefore, need no assistance to establish breathing. If baby is preterm meconium-stained or some evidence of infection, not crying or breathing or muscle tone poor then proceed to initial steps of resuscitation as shown in Figure 2.4 (in Chapter 2 on CPR).

Note: Routine intrapartum oropharyngeal and nasopharyngeal suctioning of babies born through meconium-stained liquor is not recommended.

For term babies, use 100% oxygen when baby is cyanotic or when positive pressure ventilation is required. One may begin with less than 100% oxygen or room air. If so, supplementary oxygen should be available to use, if there is no appreciable improvement within 90 seconds after birth. If supplemental oxygen is not available, positive pressure ventilation should be continued with room air.

Medications

Naloxone not to be given by endotracheal route.

Babies who require resuscitation are at risk for deterioration after their vital signs have returned to normal. Once adequate ventilation and circulation have been established, the infant should be maintained in or transferred to an environment in which close monitoring and intensive care can be provided.

Discontinuing resuscitative efforts

Infants without signs of life (no heart beat and no respiratory effort) after 10 minutes of resuscitation show either a high mortality or severe neurodevelopmental disability. After 10 minutes of continuous and adequate resuscitative efforts, discontinuation of resuscitation may be justified, if there are no signs of life.

2. Hypothermia

(a) Identification of hypothermia. An axillary (or rectal) temperature <36.0°C is hypothermia. Such a baby would feel cold to touch on the abdomen and periphery.

(b) Identification of cold stress: Baby's peripheries are cold but abdomen is warm. This usually corresponds to axillary temperature of 36-36.4°C.

(c) Prevention of hypothermia.

(i) Dry the baby with warm dry linen at birth. Discard wet linen and wrap in dry linen.

(ii) Place baby after birth under a radiant warmer or 200 Watt bulb (placed at a distance of 45 cm above the baby). If neither is available, place the newborn infant on the mother's chest and wrap baby and mother together to prevent heat loss from the exposed skin surfaces of the baby.

(iii) Ensure that there are no open windows or fans turning in the delivery area where baby is being delivered or being observed.

- Place under radiant warmer
- Dry thoroughly
- Remove wet linen

Note: Suction mouth and then nose with mucous sucker.

Provide tactile stimulus and check for breathing effort. Check breathing and heart rate after 30 seconds. No breathing, heart rate <60 beats per minute (bpm) continue positive pressure ventilation (ppv); start chest compression and continue ppv; if heart rate <60 bpm, then give adrenaline 0.1-0.3 ml/kg of 1:10,000 solution IV or intratracheal (Fig. 2.4 in Chapter 2 on CPR)

(iv) Delay bathing of newborn to beyond 24 hours to prevent hypothermia. However, baby may be wiped with warm clean water to remove dried blood, vernix or secretions. Care must be taken to ensure that the room is warm and draught free when the baby is being cleaned or bathed. The baby should immediately be wrapped in dry linen after being wiped dry.

(v) After birth and for the first few days thereafter keep mother and baby in close proximity with baby being adequately clothed. In cold weather, the baby must have 2 layers of cotton vest with a woollen sweater, cap, socks and legs should be covered and baby should be wrapped in a blanket. In summer, cotton dress with a cotton diaper wrapped in a cotton cloth. Monitor temperature every half hourly for first 2 hours and then every 2 hourly.

3. Prevention of infection

(a) Always clean hands with soap and water and wear sterile gloves, if available, before conducting the birth of the baby and while examining babies during the first few days of life.
(b) A sterilized blade (if that is not available a new razor blade or a blade boiled for at least 20 minutes) must be used for cutting the cord at delivery.
(c) The cord tie used must be sterile or boiled for 20 minutes before being used for tying the cord after birth. Observe for oozing of blood, if blood oozes, place a second tie between the skin and first tie.
(d) The surface for conducting delivery and placing the baby after birth must be clean.
(e) Do not apply any medication/substance to the cord or eyes after birth. Leave stump uncovered and dry.
(f) Do not give prelacteal feeds.
(g) Give exclusive breastfeeding from birth.

4. Exclusive breastfeeding

Advise mothers to:

(a) Start breastfeeding within one hour of normal birth and as early as possible after caesarean section. Do not separate mother from the child.
(b) Not to give any prelacteal feeds such as honey, water, etc.
(c) Give breastfeeds to baby on demand as often as the child wants day and night, at least 8 times in 24 hours.
(d) Give the baby exclusive breastfeeding for at least first 6 months of life. However, there may be situations where it may not be possible to provide human milk, i.e. maternal death, severe maternal illness, and documented lactational inadequacy.
(e) Not to give water to the baby during period of exclusive breastfeeding.

5. Early identification of high-risk newborns

Babies born to mothers with eclampsia, antepartum haemorrhage, diabetes, etc. are considered as high-risk newborns and delivery should be conducted at a centre where all facilities for the care of the newborn are available. The following examination at birth or during the first few days would help detect high-risk babies who are in need of immediate referral to an appropriate health facility which has adequate newborn care.

(a) **Weigh baby.** Babies with birth weights <2000 g are at increased risk of morbidity and mortality and need careful assessment by a physician trained in child health.
(b) **Examine for major malformations.** Most major and life-threatening malformations such as neural tube defects, oesophageal and anal atresias, diaphragmatic hernia, etc. can be detected at birth by careful examination. Some important clues to an underlying malformation are non-passage of meconium at 24 hours of age or non-passage of urine at 48 hours after birth.
(c) **Sucking, activity and cry.** Newborn infants who have poor sucking, are less active than normal and have a weak cry are very ill and need immediate referral.

(d) **Respiratory distress.** Babies who have a respiratory rate of >60 bpm (counted for at least 1 minute and persisting on repeat count) or have severe subcostal retractions have respiratory distress and need immediate referral.

(e) **Identification of severe jaundice.** Yellow staining of the skin within 24 hours of age or when yellow staining of the skin includes the palms and soles at any age, this is severe jaundice and needs immediate referral.

6. Immunization

All newborns delivered at a health facility should be given BCG, one dose of oral polio vaccine and Heptatis B within 24 hours of birth (for details see section on Immunization).

LOW BIRTH WEIGHT BABIES

Nearly 75% neonatal deaths and 50% infant deaths occur among the low birth weight (LBW) babies. Even after recovery from neonatal complications, some LBW babies may remain more prone to malnutrition, recurrent infections and neurodevelopmental handicap.

SALIENT FEATURES

- Low birth weight (LBW) baby is the one who weighs less than 2500 g at birth.
- Low birth weight may result from either prematurity (gestational age <37 weeks) or intrauterine growth retardation (IUGR), which is also called small-for-date baby (SFD).

Treatment

Indications for hospitalization are:

Birth weight of less than 1800 g; gestational age of less than 34 weeks; neonate who is not able to take feeds from the breast or by cup (katori) and spoon (irrespective of birth weight and gestation); and a sick neonate (irrespective of birth weight and gestation).

1. Keep the LBW babies warm:

- Room temperature should be kept between 28-30°C. Following methods may be used:
  - Maternal-baby skin to skin contact (Kangaroo mother care). Place the naked baby between the mother's breasts. Wrap baby and mother with a shawl. Cover the baby's head with a cap.
  - Proper clothing—cap, woollen sweaters, socks and mittens.
  - Blankets.
  - Overhead radiant warmer.
  - Incubator.

  Nutrition—guidelines to provide fluids and nutrients to low birth weight babies are given in Table 19.1.

Tabel 19.1. Guidelines to provide fluids and nutrients to low birth weight (LWB) babies

Age	**Category of neonates**		
Birth weight gestation	**<1200 g <30 weeks**	**1200-1800 g 30-34 weeks**	**>1800 g >34 weeks**
Initial	Intravenous fluids (60 ml/kg/day)	Gavage (60 ml/kg/day)	Breastfeeding, if unsatisfactory, give katori/spoon feeds
After 1-3 days Triage, if not sick	Gavage feeds (15-30 ml/kg/d), increase by15-30 ml/kg/day to a maximum of 180 ml/kg/day of expressed breast milk	Katori/spoon maximum of 150-180 ml/kg/d	Breastfeed
Later (1-3 weeks)	Katori/spoon (150-180 ml/kg/day)	Breastfeed	Breastfeed
After some more time (4-6 weeks)	Breastfeed	Breastfeed	Breastfeed

Note: Ensure use of expressed breast milk. Start with small volumes and gradually build up. When the baby is on gavage or cup-spoon feed, it is important to put the baby on the breast before every feed.

2. Vitamin K 1.0 mg (0.5 mg for preterm) IM at birth.
3. Vitamin A 1000 IU orally daily—from 1 week age onwards till 6 months of age.
4. Vitamin D 400 IU orally daily—from 2 weeks age onwards till 6 months of age.
5. Iron 2-4 mg/kg/day orally daily—from 4 weeks age onwards till 6 months of age.
6. Vitamin E, calcium and phosphorus supplementation in very LBW (<2000 g, <32 week gestation).

Early detection of sickness by periodic evaluation. Referral to higher centre in the presence of any one or more of the following signs: Lethargy, refusal to feed, hypothermia, respiratory distress, grunt, apnoea, abnormal weight gain pattern, jaundice over soles and palms, abdominal distension, feed intolerance, cyanosis, pallor, sclerema, seizures and bleeding.

LBW babies can be discharged from hospital when they are feeding from breast or breast and cup, gaining weight for 3 consecutive days, no signs of illness, are able to maintain normal body temperature when roomed-in with mother and mother is confident of taking care of the baby.

For immunization of LBW babies see section on Immunization.

NEONATAL JAUNDICE

More than 50% of normal newborns and 80% of preterm infants have some jaundice. The jaundice can be physiological or pathological.

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- Jaundice is a common physical finding (manifesting as yellowness of the skin of the face when the serum bilirubin level exceeds 5 mg/dl) during first week of life.

- As the degree of jaundice increases, there is a cephalopedal progression of jaundice. Yellow colouration of trunk indicates serum bilirubin range between 10 and 12 mg/dl, whereas staining of palms and soles is ominous as it indicates a serum bilirubin of more than 15 mg/dl.
- More than 90% of all neonatal jaundice is physiological and does not need any specific therapy. It is recognized by its characteristic timetable: jaundice appears between 24 and 72 hours of age, its maximum intensity (peak serum bilirubin always below 15 mg/dl) is seen on the 4th to 5th day of life and usually disappears before 14 days of life.
- About 5% of newborn babies develop pathological jaundice. It should be considered a medical emergency as it may cause bilirubin encephalopathy or kernicterus when unconjugated bilirubin exceeds 20 mg/dl (term baby) or lower levels (preterm babies). Pathological jaundice is recognized by any of these features: Jaundice appearing within 24 hours, elevation of serum bilirubin levels requiring plasma transfusion or rise of bilirubin >0.5 mg/dl/hour and persistence of jaundice beyond 8 days in term baby and beyond two weeks of age in preterm baby or signs of underlying illness.
- If jaundice persists beyond 2 weeks or 21 days in preterm infants, the baby should be investigated for cholestatic (obstructive) jaundice. If baby's stool is pale and urine is dark, refer the baby to a specialized centre for further evaluation and management.

Treatment

There are two important modalities of treatment:

1. Phototherapy. Most preterm babies are placed under phototherapy, when their serum bilirubin approaches 10-12 mg/dl, and term babies are given phototherapy when their serum bilirubin approaches 15 mg/dl. During phototherapy, the naked infant (with covered eyes) is kept about 45 cm below the phototherapy unit comprising of blue and white tubes or halogen lamps. Non-breastfed babies should be provided additional fluids at the rate of 20 ml/kg/day. Many babies while undergoing phototherapy may pass greenish-yellow stools which by themselves are not harmful as long as baby is active. Assessment of severity of jaundice by looking at the skin is unreliable. Estimation of serum bilirubin is necessary to monitor response to therapy.

2. Exchange transfusion should be promptly performed, if any of the following exist:

(a) In babies with rhesus haemolytic disease of the newborn:

(i) Cord haemoglobin of 10 g/dl or less.
(ii) Cord bilirubin of 5 mg/dl or more.
(iii) Unconjugated serum bilirubin of more than 10 mg/dl within 24 hours or rate of rise of more than 0.5 mg/dl/hour.

(b) In babies with jaundice due to other causes:

(i) Unconjugated serum bilirubin of 20 mg/dl or more in term baby.

(ii) In preterm babies, serum bilirubin of more than 1.0 mg/100 g weight of the infant (i.e. 10 mg/dl for 1000 g and 15 mg/dl for 1500 g and so on).
(iii) In the presence of asphyxia, respiratory distress, sepsis, hypothermia, exchange is performed at about 2 mg/dl lower serum bilirubin level than is otherwise indicated.

MANAGEMENT OF COMMON CLINICAL PROBLEMS IN NEWBORNS

There are several phenomena after birth that are normal and mothers only need reassurance. These include:

Milia, Epstein pearls, Mongolian spots, capillary nevi, etc. There are a few developmental variants which may be present and be of concern to the mother. The mother needs to be reassured.

Red rashes on the skin may be seen on 2-3 days of life. These are normal.

Weight loss of 6-8% (10-12% in preterm infants) in the first few days of life is normal and most infants regain their birth weight by 10-14 days.

Regurgitation of feeds and vomiting. Unlike vomiting, non-projectile expulsion of stomach contents without force (regurgitation) is normal and simply needs advice regarding feeding technique.

Bowel disorders. No medication should be prescribed for passage of stools after each feed (exaggerated gastrocolic reflex) as this is normal in some babies. From 3rd to 14 days many exclusively breastfed babies pass loose stools (10-15 times/day) without illness/dehydration. These are transitional stools and require no medication.

Delayed passage of urine. Non-passage of urine by 48 hours after birth may suggest urinary tract anomalies. Such babies need to be investigated. Crying before passing urine is normal.

Jitteriness is abnormal only when it is excessive or persists even during feeding and then it may suggest hypoglycaemia or hypocalcaemia.

Dehydration fever. Transitory moderate fever (up to 38.5°C) usually during the second or third day of life in summer months in an active baby, who sucks well, is normal and responds to lowering the environmental temperature.

Excessive crying. Most baby cry when either they are hungry or are having discomfort such as due to full bladder before passing urine, wet napkin, nose block, etc. Excessive inconsolable crying or high-pitched crying is indicative of meningitis or any other painful inflammatory conditions.

Umbilical sepsis. If there is pus discharge not extending to periumbilical skin, apply 10% Gentian violet or Povidone Iodine locally twice a day. However, if there is periumbilical erythema or induration administer syrup erythromycin 40 mg/kg/day in 3-4 divided doses. If the newborn has any other high-risk factor, refer to a higher centre.

Umbilical granuloma. A red flesh-like nodule at the base of umbilical cord can be managed by cautery with Silver Nitrate or application of common salt for 3 to 4 days.

Engorgement of breasts in both sexes and vaginal bleeding after 4 days of birth is normal.

Tongue-tie. Rarely, requires surgical intervention.

See Neonatal Seizures section for its management.

IMMUNIZATION SCHEDULE

There are now a number of vaccines available for childhood immunization. However, there are those which are considered essential for all children because the infections which they protect against are important national causes of childhood morbidity and mortality (Tables 19.2 and 19.3).

General comments on vaccines

(a) **Simultaneous administration of multiple vaccines.** Both killed and live vaccines can be administered simultaneously without decreasing the efficacy of the individual vaccine. However, vaccines should be administered at different sites using separate needles for each component.

A gap of 1 month is recommended between 2 live vaccines, if not given together.

(b) **Injection safety issues.** Avoid giving injections, if skin is infected or compromised by a local reaction (skin lesion or weeping dermatitis). Prepare skin with a disinfectant. Always use a sterile syringe and needle for each injection and to reconstitute each unite of medication. After use, syringes and needles should be disposed off carefully as per guidelines.

Table 19.2. National immunization schedule (Universal Immunization Programme)

BCG	Birth or 6 weeks.
OPV	Birth, 6, 10, 14 weeks, 16-24 months.
Hepatitis B	Birth, 6, 10, 14 weeks
DPT	6, 10, 14 weeks, 16-24 months.
Measles	9 months.
MMR	15-18 months.
DT	5 years.
TT	10 and 16 years (if given for first time at this age, give 2 doses at 4 weeks Interval).

Tetanus prophylaxis in routine wound management

Doses of TT given in past	Clean, minor wound		All other wounds	
	TT	TIG*	TT	TIG*
Unknown, < 3 doses	Yes	No	Yes	Yes
≥ 3 doses	No**	No	No***	No

* TIG : Tetanus immunoglobulin (250 IU/IM); TT : Tetanus toxoid

** Yes, if more than 10 years since last dose.

*** Yes, if more than 5 years since last dose.

Table 19.3. IAP immunization time table

Age	Vaccines	Comments
Birth	BCG, OPV 0, Hep-B1	**Hepatitis-B:** Administer Hep-B vaccine to all newborns before hospital discharge.
6 weeks	DTwP1/DTaP1, IPV1, Hep-B2, Hib 1, rotavirus 1, PCV 1	**Polio:** All doses of IPV may be replaced with OPV, if former is unaffordable unavailable; Additional doses of OPV on all "Supplementary immunization activities" (SIAs); Two doses IPV instead of 3 for primary series if started at 8 weeks, and 8 weeks interval between in the doses. **Rotavirus:** 2 doses of RV-1 (monovalent) and 3 doses of RV-5 (pentavalent)
10 weeks	DTwP2/DTaP2, IPV2, Hib 2, Rotavirus 3, PCV 2	
14 weeks	DTwP3/DTaP3, IPV3, Hib 3, Rotavirus 3, PCV3	**Rotavirus:** Only 2 doses of RV1 are recommended at present.
6 months	OPV1, Hep-B3	**Hepatitis-B:** The final (third or fourth) dose in the Hep B vaccine series should be administered no earlier than age 24 weeks and at least 16 weeks after the first dose.
9 months	OPV2, Measles	
12 months	Hep-A1	**Hepatitis A:** For both killed and live hepatitis-A vaccines 2 doses are recommended.
15 months	MMR1, Varicella1,	**Varicella:** The risk of breakthrough varicella is lower, if given 15 months onwards.
	PCV booster	
16 to 18 months	DTwPB1/DTaPB1, IPV B1, Hib B1	The first booster (4th dose) may be administered as early as age 12 months, provided at least 6 months have elapsed since the third dose.
18 months	Hep-A2	**Hepatitis A:** For both killed and live hepatitis-A vaccines, 2 doses are recommended.
2 years	Typhoid1	**Typhoid:** Typhoid revaccination every 3 years, if Vi-polysaccharide vaccine is used.
4½ to 5 years	DTwPB2/DTaPB2,	**MMR:** The 2nd dose can be given at anytime 4-8 weeks after the 1st dose.
	OPV3, MMR2,	**Varicella:** The 2nd dose can be given at anytime 3 months after the 1st dose.
	Varicella2, Typhoid2	
10 to 12 years	Tdap/Td	**Tdap:** Preferred to Td, followed by Td every 10 years.
	HPV	**HPV:** Only for females, 3 doses at 0, 1-2 (depending on brands) and 6 months.

IAP recommended vaccines for high-risk* children (vaccines under special circumstances)

1. Influenza vaccine,2. Meningococcal Vaccine, 3. Japanese Encephalitis Vaccine, 4. Cholera Vaccine, 5. Rabies Vaccine, 6. Yellow Fever Vaccine, 7. Pneumococcal Polysaccharide Vaccine (PPSV 23).

High-risk category of children:

- Congenital or acquired immunodeficiency (including HIV infection)
- Chronic cardiac, pulmonary (including asthma if treated with prolonged high-dose oral corticosteroids), hematologic, renal (including nephrotic syndrome), liver disease and diabetes mellitus
- Children on long-term steroids, salicylates, immunosuppressive or radiation therapy
- Diabetes mellitus, cerebrospinal fluid leak, cochlear implant, malignancies
- Children with functional/anatomic asplenia/hyposplenia
- During disease outbreaks
- Laboratory personnel and healthcare workers
- Travellers

1. If the mother is known to be HBsAg negative, HB vaccine can be given along with DTP at 6, 10 and 14 weeks. If the mother's HBsAg status is not known, it is advisable to start vaccination soon after birth to prevent perinatal transmission of the disease. If the mother is HBsAg positive (and especially HBeAg positive), the baby should be given Hepatitis B immune globulin (HBIG) within 24 hours of birth, along with HB vaccine.
2. The only advantage of combination vaccines is convenience, however, should not be viewed as more effective than vaccines given separately. The manufacturer's instructions should be strictly followed whenever "mixing" vaccines in the same syringe prior to injections.

Immunization in special circumstances

1. **Immunization in preterm infants**: In general, all vaccines may be administered as per schedule according to the chronological age irrespective of birth weight or period of gestation. Very low birth weight/preterm babies can be given immunization, if they are stable otherwise.
2. **Children receiving corticosteroids**: Children receiving oral corticosteroids in high doses (Prednisolone 1-2 mg/kg/day) for more than 14 days should not receive live virus vaccines until the steroid has been discontinued for at least one month. Killed vaccines are safe but may not be completely effective in such situations. Patients on topical or inhaled steroids should not be denied their age appropriate vaccine.
3. **Children awaiting splenectomy:** Immunization with pneumococcal, Hib, and meningococcal vaccine should be initiated a few weeks prior to splenectomy.
4. **Vaccination in children with HIV infection:** Immune response may be suboptimal as it depends on the degree of immunodeficiency at that point of time. Re-administration of childhood immunization may be considered when their immune status has improved following anti-retroviral therapy.
5. **Lapsed immunization:** There is no need to restart a vaccine series regardless of the time that has elapsed between individuals doses. In case of unknown or uncertain immunization status, however, it is appropriate to start the schedule as for an unimmunized child.
6. **Minor illnesses**, e.g. fever, diarrhoea, respiratory infections and malnutrition should not be construed as contraindications to immunization.

Common vaccines, dose schedule, contraindications, and adverse effects (Table 19.4)

Table 19.4. Common vaccines, dose schedule, contraindications, and adverse effects

Vaccine	Diluent	Dose, route	Contraindication	Adverse effects
BCG (freeze-dried)	Normal Saline	0.1 ml intra-dermal left deltoid	Immuno deficiency	Axillary lymph adenitis
DTwP (whole cell vaccine) DTaP (acellular vaccine)	None (liquid form)	0.5 ml IM anterolateral aspect of thigh	Progressive neurological disease, Severe reaction to first dose	Fever, local pain & induration, incessant crying, rarely encephalopathy
OPV	None (liquid form)	2 drops orally	Immuno-deficiency, HIV disease	VAPP rarely
Hepatitis B10 mcg of purifed HBsAg	None (liquid form)	0.5 ml IM anterolateral aspect of thigh	None	Local pain, erythema
H. infu B 10 mcg of capsular polysaccharide	None (liquid form)	0.5ml IM Anterolateral aspect of thigh	None	Local pain, erythema, mild fever
Measles (lyophilized)	Sterile water	0.5 ml SC deltoid/thigh	None	Mild fever, mild rash after 7 days
MMR (Lyophilized)	Sterile water	0.5 ml SC deltoid/ thigh	Systemic hypersensitivity to neomycin	Mild fever, mild rash after 7 days
Varicella (Lyophilized)	Sterile water	0.5 ml SC Deltoid	-do-	Milder varicella type rash
Hepatitis A	None (Liquid form)	0.5 ml IM Thigh	None	Local pain, erythema
Typhoid Vi antigen vaccine 30 mcg of inactivated Vi capsular polysaccharide	None (Liquid form)	0.5 ml IM Deltoid	None	Mild local reaction
Meningococcal (A+ C) (Lyophilized) 50 mcg each serotype of Inactivated capsular polysaccharide	Sterile water	0.5 ml IM or SC deltoid/thigh	None	Mild fever; local reaction
Japanese encephalitis (Lyophilized)	Sterile water	1-3 years:0.5ml > 3 years: 1.0 ml SC deltoid	Hypersensitivity to first dose	Local reactions; allergies; rarely encephalitis
Pneumococcal 23 valent vaccine	None (Liquid form)	0.5 ml IM or SC anterolateral aspect of thigh/ deltoid	None	Local reaction

Note: All vaccines should be stored at +2 to+8°C except OPV which should be stored at -20°C or below.

References

1. Facility Based IMNCI (F-IMNCI) Participants Manual. WHO, UNICEF, and Ministry of Health & Family Welfare, Government of India, 2009.
2. American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care. Circulation 2010; 122: 18 Supplement 3.
3. Consensus Recommendations on Immunization and IAP Immunization Timetable 2012. Indian Academy Of Pediatrics Committee on Immunization (IAPCOI). Indian Pediatrics 2012; 49: 549-564.

FLUID AND ELECTROLYTES

Fluid and electrolyte therapy is divided into three phases:

1. Correction of pre-existing deficits. The losses, via renal or extra-renal route, should be estimated and corrected as soon as possible; for example, rehydration therapy for diarrhoeal dehydration.
2. Provision of maintenance requirements for normal metabolism.
3. Correction of ongoing losses. These may occur via the gastrointestinal tract through losses (as in diarrhoea, vomiting, etc.) or removal (suction, aspiration, etc.). Replacement of such losses should be similar in type and amount to the fluid being lost.

Out of these three phases, we shall discuss the maintenance requirements here. Correction of pre-existing deficits and correction of ongoing losses shall be discussed, wherever relevant (see section on Diarrhoea).

Maintenance requirements in children

A guideline for estimating daily fluid and electrolytes requirement in a normal child under normal conditions is: Water—100 ml/100 Kcal/day; sodium—1-3 mEq/100 Kcal/day; potassium—1-2 mEq/100 Kcal/day. Hence, the fluid requirement based on caloric requirement for different weight groups can be calculated as follows:

Weight	Fluid requirements
3-10 kg	100 ml/kg/day
10-20 kg	1000 + 50 ml/kg/day for each kg >10.
> 20 kg	1500 + 20 ml/kg/day for each kg >20.

Maintenance fluid requirement replaces water loss through skin (2/3 of losses), GIT, respiration, and urine. These losses are affected by ambient humidity, clothing, body temperature, respiratory rate, and age of the child. Situation specific adjustments are necessary when calculating maintenance fluids.

Refer to the section on newborn care for guidelines on fluid therapy in neonates and those weighing <3.0 kg.

The most commonly employed intravenous maintenance fluid employed in children is N/5 (0.18%) sodium chloride in 5% glucose + potassium chloride 20 mEq/liter. Commercially it is available as Isolyte P, Kidral, etc.

Maintenance requirements in newborns

Table 19.5 provides the normal fluid electrolyte requirements in newborn babies.

Table 19.5. Normal fluid requirements of newborns

Age (days)	Total fluids	Glucose/Dextrose (ml/kg/day)	Electrolyte
1	60	10% Dextrose in water	None
2	70-80	-do-	None
3	80-90	-do-	Sodium 2-3 mmol/kg/day
			Potassium 2 mmol/kg/day
4	90-100	-do-	-do-
5	100-110	-do-	-do-
6	110-120	-do-	-do-

- From day 3 onwards, fluid containing glucose-electrolyte mixture can be provided using commercially available paediatric maintenance intravenous solutions provided 5% weight loss has been documented.
- The fluid and electrolyte requirement from day 7-28 remains the same. However, in babies <1500 g, the fluid requirement after day 7 need to be increased by 10-20 ml/kg/day till a maximum of 150 ml/kg/day.

Conditions that increase fluid requirement

- Fever: For every 1ºC increase over 37.5ºC, the fluid requirement increases by 10 ml/kg/day.
- Phototherapy: This increases fluid requirement by 10-20 ml/kg/day.

Conditions that decrease fluid requirement

- Congestive cardiac failure: Fluid requirements are reduced to two-thirds of the normal need for that age.
- Renal failure: In cases of decreased urinary output, the fluid regimen is 400 ml/m^2/day for insensible water losses plus urinary output over the day. Potassium should be added with caution or omitted in suspected cases of acute renal failure.
  (see also Fluid and Electrolyte Imbalance in Chapter 2).

HYPONATRAEMIA

It is defined as serum sodium <135 mEq/L. This may be associated with increased or decreased extracellular water (ECF), evidenced by an acute increase or decrease in body weight respectively. Clinical symptoms appear when levels fall below 120 mEq/L. These include drowsiness, seizures and coma. Acute hyponatraemia is associated with hypotension, and circulatory failure.

Treatment

1. If fluid overload, renal failure, or SIADH is present, restrict fluid intake to two-thirds of the normal maintenance. If dehydration is present, expand ECF volume by giving isonatraemic fluids intravenously depending on the degree of dehydration.
2. Correction of asymptomatic hyponatraemia should be gradual (increase the Na^+ by 0.5 mEq/L/h) to a maximum change of about 12 mEq/L in the first 24 h. Rapid correction can cause coma.
3. Acute symptomatic hyponatraemia is treated with administration of 3% sodium chloride 1-2 ml/kg/h till symptoms resolve. Chronic hyponatraemia should be corrected over a period of 48 hours.
   The deficit is calculated as follows:
   Sodium deficit = [desired Na^+ - present Na^+] × weight × 0.6

HYPERNATRAEMIA

It is defined as serum sodium >145 mEq/L, consequent to:

1. Excessive administration of sodium (accidental salt administration in ORS), inadequate water intake or excessive water losses.
2. Symptoms are non-specific or relate to CNS such as altered sensorium weakness, irritability, focal neurologic deficits, and even coma or convulsions. The severity of symptoms is determined by the speed and magnitude of the change in serum sodium concentration.

Treatment

- Identify and treat the underlying cause.
- Replace water deficit as assessed by degree of dehydration over a period of 48 hours with a solution containing 40 mEq/L of sodium. The quantity of water needed to correct hypernatraemia can be calculated by using the following equation:

$$\text{Estimated water deficit} = \frac{(1\text{-}145)}{\text{Current sodium level}} \times 0.6 \times \text{Body weight}$$

  Over rapid correction may lead to cerebral oedema. (**Caution**: Sodium free solutions are never used except when hypernatraemia is acute, i.e. onset within few hours). Monitor serum sodium closely to ensure a gradual fall (and prevent rapid fall) in serum sodium.
- Serum sodium >180 mEq/L may require urgent dialysis.
  (see also Fluid and Electrolyte Imbalance in Chapter 2).

HYPOKALAEMIA

It is defined as serum potassium <3.5 mEq/L. Clinical symptoms include muscle weakness, hypotonia, respiratory difficulty, paralytic ileus, leg cramps. ECG changes include ST depression, T wave flattening/inversion, U waves and arrhythmias. Pulseless electrical activity or asystole may develop.

Treatment

- Identify and treat the underlying cause.
- Correct the deficit with potassium supplements @ 40 mEq/L of fluids. The amount of fluid is dictated by the hydration status of the child. Potassium chloride may be given orally (15 ml = 20 mEq). Intravenous correction with KCl (0.5-1 mEq/kg over 1 hour) is required when patient is unable to take orally, serum potassium is <2.5 mEq/L, has respiratory paralysis, or in the presence of arrhythmia.
- Correct the potassium deficit over a period of 24 hours.
- Potassium rich foods such as banana or fruit juice may be advised on long-term basis, especially in undernourished children.

HYPERKALAEMIA

It is defined as serum potassium >5 mEq/L. Symptoms include paraesthesias weakness, ascending paralysis, respiratory failure and tetany. ECG changes are characteristic including high peaked T waves, prolonged PR interval, widened QRS complex, heart blocks, and arrhythmias in that order. It is life-threatening and requires immediate therapy.

Treatment

1. Mild hyperkalaemia: Serum K^+ 5 to 6 mEq/L is managed by stopping the potassium intake and offending drugs such as potassium sparing diuretics, ACEI, NSAIDs, correction of acidosis and intravascular volume. Diuretics—inj. furosemide 40-80 mg IV and kayexalate 15-30 g in 50-100 ml of 20% Sorbitol orally or by retention enema.
2. Moderate hyperkalaemia (serum K^+ 6 to 7 mEq/L or peaked T waves) is managed by administering a glucose insulin infusion (0.5 g/kg glucose with 0.3 U regular insulin/g glucose, over 2 hours) and/or a sodium bicarbonate infusion (2 mEq/kg over 5-10 min), in addition to the measures already mentioned. Can be repeated 4-6 hourly.
3. Patients with severe hyperkalaemia (serum K^+ >7 mEq/L or ECG changes apart from tall T waves) should be urgently administered intravenous 10% calcium gluconate 0.5 ml/kg over 5-10 minutes. This immediately reverses the cardiac effects of hyperkalaemia. This should be followed up with the measures as for moderate hyperkalaemia. Intravenous Salbutamol (4 mcg/kg in 5 ml water) or nebulised salbutamol (2.5-5.0 mg) given over 15-20 minutes also acts rapidly to lower serum K^+. Dialysis has to be done in case the hyperkalaemia is refractory to therapy as in renal failure.
4. Monitoring of the therapy should be done with ECG and serum potassium levels after 1-2 h of initial intervention following which frequency can be reduced depending on the potassium levels and reversibility of the cause.

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ANAEMIA

A haemoglobin (Hb) level below 11 g/dl for children 6 months to 6 years old, and <12 mg/dl for children 6-14 years is considered as anaemia. Anaemia can result either from decreased RBC production, increased RBC destruction, or excessive blood loss. In some patients more than one mechanism may be operative.

1. **Anaemia due to decreased RBC production.** It may be due to:
   (a) Deficiency of one or more of haematopoietic nutrients, i.e. iron, folic acid, and vitamin B_{12}. Deficiency of other nutrients such as copper, protein, etc. is uncommon.
   (b) Bone marrow infiltration due to abnormal cells as in acute and chronic leukaemia, disseminated malignant diseases, myelofibrosis, etc.
   (c) Bone marrow aplasia—congenital and acquired aplastic anaemia (severe and moderately severe) and pure red cells aplasia such as Diamond-Blackfan syndrome, transient erythroblastopenia of childhood.
2. **Anaemia due to increased RBC destruction,** i.e. haemolytic anaemia. Commonest haemolytic anaemia seen in this part of the country is thalassaemia major. Others include sickle cell disease, hereditary spherocytosis, G6PD deficiency, haemolytic anaemia, malaria, etc.
3. **Anaemia due to excessive blood loss.** Usually in such cases, the site of bleeding is obvious, e.g. massive oesophageal variceal bleeding, rectal polyps, etc. In cases like ankylostomiasis, Meckel diverticulum, etc., there may be only occult bleed.

Clinical approach in a child with anaemia

Careful history and physical examination provide useful clues towards the likely cause of anaemia, thereby guiding the most appropriate laboratory tests required to avoid unnecessary expenses in diagnosis, e.g.

(a) Nutritional iron deficiency anaemia (IDA) is uncommon below 6 months of age in term born child with normal birth weight.
(b) Most thalassaemics are normal at birth and usually start becoming anaemic between 6-18 months of age.
(c) Constitutional aplastic anaemia (Fanconi pancytopenia) presents between 5-10 years, whereas congenital pure red cell aplasia can manifest in first few months.
(d) Megaloblastic anaemia occurs in infants and toddlers preschool children with prolonged exclusive breastfeeding by undernourished mothers.

(e) Presence of splenomegaly and hepatomegaly suggests the diagnosis of either haemolytic anaemia or leukaemia (usually there is associated lymphadenopathy) or anaemia of chronic infection/inflammation.
(f) Presence of petechial and/or purpuric spots is suggestive of concomitant thrombocytopenia and points towards the diagnosis of acute leukaemia, aplastic anaemia or megaloblastic anaemia.

Investigations

Initial investigations to be carried out in cases of anaemia—estimation of Hb%, TLC, DLC and platelet count, examination of peripheral blood smear for RBC size and shapes, anisopoikilocytosis, presence of immature cells and haemoparasites, reticulocyte count. Currently, most of the laboratories use electronic cell counters for haematological investigations which give additional useful information such as MCV, MCH, MCHC, etc.

The following important information can be gathered from the above investigations:

(a) Type of anaemia on the basis of cell size, such as microcytic (MCV <80fl), normocytic and macrocytic (MCV >90fl), and on the basis of Hb content, i.e. hypochromic or normochromic.
(b) Associated thrombocytopenia and/or neutropenia (bicytopenia or pancytopenia) is suggestive of aplastic anaemia, megaloblastic anaemia, or bone marrow infiltration due to leukaemia, etc.
(c) Increased, normal or decreased reticulocyte count is suggestive whether anaemia is due to decreased production or increased destruction of RBCs.

The following section describes the differential diagnosis of cases of anaemia according to preliminary investigations results:

1. Microcytic hypochromic anaemia

Two important causes are:

i. IDA—reticulocyte count is normal or mildly elevated.
ii. Thalassaemia major—reticulocyte count is usually 4-6%. Peripheral smear also shows target cells and numerous nucleated RBCs. Elevated foetal haemoglobin (HbF) on blood electrophoresis confirms the diagnosis. Lead poisoning and pyridoxine responsive anaemia, sideroblastic anaemia and copper deficiency are rare.

2. Macrocytic normochromic anaemia

i. Megaloblastic anaemia of B_{12} and folate deficiency is common and may have associated neutropenia and/or thrombocytopenia. Reticulocyte count is usually low. Bone marrow examination reveals megaloblastic changes.
ii. Other causes of macrocytic anaemia are liver diseases, hypothyroidism, thiamine deficiency and some inborn errors of metabolism.

3. Normocytic normochromic anaemia

This group comprises a large number of causes:

i. Congenital or acquired aplastic anaemia—usually have bicytopenia or pancytopenia and decreased reticulocyte count. Bone marrow aspiration or biopsy is confirmatory.
ii. Bone marrow infiltration such as leukaemia and other neoplasms, storage disorders, myelofibrosis, etc. Diagnosis is confirmed by bone marrow examination.
iii. Haemolytic anaemia—such as immune haemolysis, hereditary spherocytosis, G6PD deficiency, etc. Reticulocyte count is increased.
iv. Anaemia resulting from acute blood loss.

(see also Anaemia in Chapter 1 and Anaemia in Pregnancy in Chapter 15).

IRON DEFICIENCY ANAEMIA (IDA)

SALIENT FEATURES

Iron deficiency anaemia commonly occurs in children due to nutritional deficiency. However, IDA is uncommon in term breastfed children but prematurity, perinatal blood loss or cow milk feeding may lead to IDA in infancy. It is characterized by pallor, irritability, pica and absence of organomegaly and lymphadenopathy (10-15% may have mild splenomegaly).

Treatment

Nonpharmacological

After the period of exclusive breastfeeding (6 months), cereal based diet should be added. Encourage green leafy vegetables and fruits.

Pharmacological

Severe anaemia (Hb <6 g/dl)

Blood transfusion to all children with Hb ≤4g/dl and children with Hb 4-6 g/dl with any of the following: dehydration, shock, impaired consciousness, heart failure, fast breathing, very high parasitaemia (>10 of RBCs)

1. Give packed cell transfusion, usually 2-3 ml/kg at one time under close monitoring to severely anaemic children (Hb <4-5 g/dl).
2. Inj. Frusemide (1 mg/kg/dose) may be administered, if there is evidence of cardiovascular overload.

Mild (<11 g/dl) to moderate anaemia (6-9 g/dl)

Initiation of therapy. Oral ferrous salts (sulphate, gluconate, etc.) are the preferred therapeutic iron preparation.

Syr./Drops/Tab. Ferrous Sulphate/Ferrous gluconate/Ferrous fumarate 2-3 mg/kg/day of elemental iron in 2-3 divided doses to be given between meals for 8-12 weeks after normal Hb concentration for age is achieved.

Older children who can take tablets Iron Folic acid tablets and Tab Vitamin B_{12}

Usual Iron preparations have 35-50 mg elemental iron per 5 ml of syrup or per ml of drops. Elemental content of various ferrous salts is – Ferrous sulphate 20%, Ferrous gluconate 12%, Ferrous fumarate 33%, Colloidal iron 50%.

(**Caution**: Milk or milk products, tea or any other calcium preparation should particularly be avoided one hour before or after the drug).

Response to therapy. Decreased irritability and improved appetite is seen in 12-24 hours. Reticulocytosis is seen within 2-3 days and rise in Hb is noticeable by 5th-7th day. Rate of rise of Hb is 0.25-0.4 g/dl/day (daily or even weekly estimation of Hb% is not required). Usually normal Hb levels are obtained by about 8-12 weeks.

If the response is inadequate, check for the prescribed dose, compliance, presence of diarrhoea and/or malabsorption, infections (particularly urinary tract infection and tuberculosis), occult blood loss or β thalassaemia trait which may have been misdiagnosed as IDA.

Modification or step up therapy. Parenteral iron therapy is very rarely required, however, it is necessary, if there is interference to absorption of oral iron, chronic diarrhoea or malabsorption, occult bleeding from GIT when oral iron therapy may not maintain desired Hb. Parenteral iron therapy may also be used in severely anaemic child not likely to take oral therapy because of socioeconomic reasons.

When parentral iron is required, the total dose may be calculated:

Dose of iron required (mg) = wt (kg) × 2.5 × Hb deficit

Hb deficit is the difference of desired normal Hb and present Hb. To this dose, 10 mg/kg should be added for replenishing the stores. Inj. Iron Dextran or Iron Sorbitol Citric acid complex (50 mg/ml) deep gluteal IM injection (preferred) or infusion after a test dose. The total dose of iron may be given as a single dose IV or as multiple daily doses IM not exceeding 5 mg/kg/dose spread over several days, if the volume is too large.

Patient/parent education

- IDA occurs generally due to dietary deficiency of iron. Once the diet is modified, the patient should stick to that diet.
- Iron medicine should be taken between meals and never along with milk or tea.
- Intake of iron medicine usually causes harmless black discolouration of the teeth and stools. The teeth discolouration can be prevented by rinsing the mouth with water after doses.
- Increase in Hb levels with iron therapy will take approximately 5-7 days and about 12 weeks for desired normal Hb level to be achieved.

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PROTEIN ENERGY MALNUTRITION (PEM)

Nutritional marasmus and kwashiorkor are two extreme forms of malnutrition. Such extreme forms are rare; most cases suffer from mild and moderate nutritional deficit.

SALIENT FEATURES

- Milder forms may just present with failure to thrive, i.e. decreased rate of weight gain.
- Marasmus is characterized by gross wasting of muscle and subcutaneous tissues resulting in emaciation, marked stunting, and no oedema.
- Markedly retarded growth, psychomotor changes, and oedema of dependent parts are three essential clinical features of kwashiorkor.
- PEM is usually associated with:
  - (i) anaemia due to iron, protein, vitamin B_{12}, or folic acid deficiency,
  - (ii) xerophthalmia due to vitamin A deficiency, and
  - (iii) other micronutrient deficiencies including magnesium, copper, zinc, vitamins B, C, D and K.

Assessment of nutritional status

Undernutrition is classified by WHO into moderate and severe forms as shown in Table 19.6. Reference values for weight for height are provided in Table 19.7.

Table 19.6. WHO classification for severity of undernutrition

	Moderate undernutrition	Severe undernutrition
Symmetrical oedema	No	Yes[a]
Weight for height	SD score[b] -2 to -3	SD score ≤3
(measure of wasting)	(70-79% of expected[c])	(<70 % of expected)
Height for age	SD score[b] -2 to -3	SD score ≤3
(measure of stunting)	(85-89% of expectedc)	(<85 % of expected)

a. This includes kwashiorkar and marasmic kwashiorkar.

b. SD score = $\frac{\text{Observed value – expected value}}{\text{Standard deviation of reference population}}$

c. Median (50th percentile of NCHS standards).

Table 19.7. NCHS/WHO normalized reference values for weight-for-height/length

Boys' weight (kg)			Length (cm)	Girls' weight (kg)		
-3 SD	-2 SD	Median		Median	-2 SD	-3 SD
2.2	2.5	3.3	50	3.4	2.6	2.3
2.7	3.3	4.3	55	4.3	3.3	2.8
3.7	4.4	5.7	60	5.5	4.3	3.7
5.0	5.7	7.1	65	7.0	5.5	4.8
6.3	7.0	8.5	70	8.4	6.8	6.0

Boys' weight (kg)			Length (cm)	Girls' weight (kg)		
-3 SD	-2 SD	Median		Median	-2 SD	-3 SD
7.4	8.2	9.8	75	9.6	7.9	7.0
8.3	9.2	10.9	80	10.6	8.8	8.0
8.9	9.9	12.1	85	11.8	9.7	8.6
9.8	10.9	13.3	90	12.9	10.7	9.5
10.7	11.9	14.5	95	14.1	11.6	10.4
11.6	13.0	15.7	100	15.4	12.7	11.3
12.7	14.2	17.1	105	16.7	13.8	12.3
13.8	15.4	18.7	110	18.2	15.0	13.4

SD—standard deviation score (or z score).

Indian Academy of Paediatrics (IAP) takes a weight of more than 80% of expected for age as normal. Grades of malnutrition are: Grade I (71-80%), Grade II (61-70%,) Grade III (51-60%) and Grade IV (≤ 50%) weight of expected value for that age. Alphabet k is post-fixed in the presence of oedema.

Treatment

1. Mild to moderate undernutrition. Mild and moderately under-nourished children are best treated in their own home surroundings. Domiciliary treatment of malnourished children by their mother is economical, offers in-built advantage of practical health education, and is associated with minimal recurrence risk.
2. The parents should be advised to increase the food intake of the child by all available means. The child should receive adequate amount of calories and protein in the diet, which should be prepared from the locally available, inexpensive foods.
3. The child should be kept under surveillance by using a growth chart and effort should be made that he does not slip down to severe malnutrition.

Hospital management of severe malnutrition is given in (Table 19.8). Initial treatment involves managing complications. The aim is to treat complications and stabilize the child.

Severe malnutrition

Severely wasted children and those with oedema need hospitalization. Other indications for admission in an undernourished child are severe dehydration, severe diarrhoea, hypothermia, shock, systemic infection, severe anaemia, jaundice, bleeding, age less than one year, or persistent loss of appetite. Those with severe stunting alone may be managed in the community. Hospital management of severe malnutrition is summarized in Table 19.8.

There are 10 essential steps in two phases—an initial stabilization phase and a longer rehabilitation phase (Fig. 19.1). The focus of initial management is to prevent death while stabilizing the child.

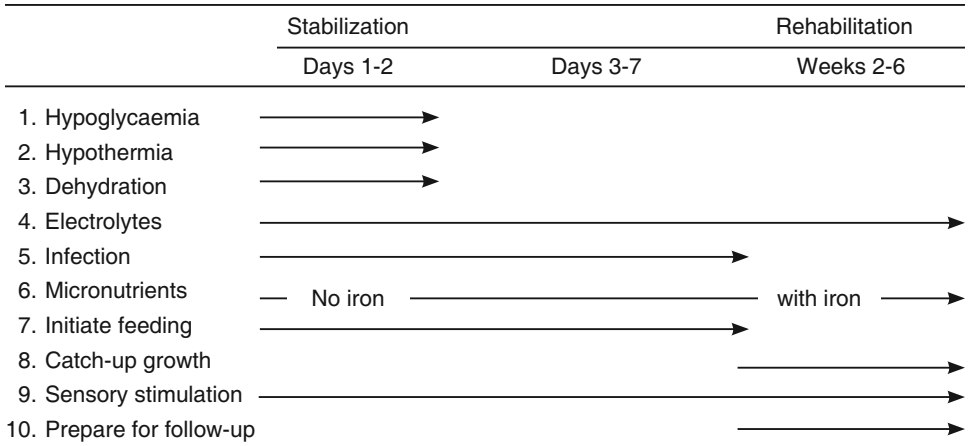

Fig. 19.1. Essential steps in an initial stabilization phase and a longer rehabilitation phase.

Important things NOT to do

- **Do not give IV fluids routinely**. IV fluids can easily cause fluid overload and heart failure. Only give IV fluids to children with signs of shock.
- **Do not give diuretics to treat oedema**. The oedema will go away with proper feeding. Giving diuretics will worsen child's electrolyte imbalance and may cause death.
- **Do not give high protein formula**. Almost all severely malnourished children have infections, impaired liver and intestinal function. Because of these problems, they are unable to tolerate the usual amount of dietary protein.
- **Do not give iron during the initial feeding phase**. Add iron only after the child has been on catch-up formula for 2 days (usually during week 2). Giving iron early in treatment has been associated with free radical generation and may interfere with the body's immune mechanisms against proliferating bacteria.

Table 19.8. Hospital management of severe malnutrition

Problem	Measurement
Hypothermia (rectal temperature <35.5ºC)	• Keep under a heat source, such as radiant warmer, room heater, hot air blower or 200 W bulb, and warm upto rectal temp. 37.0ºC within in 2-3 hours. If electric gadgets are not available, cover the child well. • Warm up with Kangaroo technique (placing the naked child on mothers' bare chest and covering them both together with cloth and blanket). Monitor rectal temperature half hourly. • Investigate and treat for infection and hypoglycaemia. Check for hypoglycemia, whenever, hypothermia is found. Prevent hypothermia
Hypoglycaemia (blood sugar <54 mg/dl)	• 10% glucose, 5-10 ml/kg IV immediately followed by IV infusion of a dextrose containing solution.

Problem	Measurement
	• If IV dose cannot be given immediately, give the nasogastric dose first. Give appropriate antibiotics and start feeding as soon as possible. Give 2-hourly feeds, day and night, at least for the first day. • If the initial blood glucose was low, repeat the measurement (using finger prick or heel prick blood) and estimate blood sugar after 30 minutes. If the axiliary temperature falls <35°C or if there is deterioration in the level of consciousness anytime, repeat the blood sugar measurement
Dehydration (as assessed by WHO classification)	• Whenever possible, rehydrate a dehydrated child with severe malnutrition orally or through a nasogastric tube. In addition to ORS start potassium supplements to prevent hypokalemia (syrup potassium chloride-15 ml of the syrup provides 20 mEq of potassium (See hypokalaemia) • ORS 5 ml/kg body weight every 30 minutes for the first 2 hours; then 5-10 ml/kg alternate hours for up to 10 hours. The amount offered in this range should be based on the child's willingness to drink and the amount of ongoing losses in the stool. Starter formula is given in alternate hours during this period until the child is rehydrated. Monitor every 30 min for the first 2 h and then hourly. Check respiratory rate, pulse rate, urine output and frequency of stools and vomiting. • If the child has already received IV fluids for shock and is switching to ORS, omit the first 2-hour treatment and start with the amount for the next period of up to 10 hours. • Stop ORS immediately on signs of overhydration (increasing respiratory rate by 5/min and pulse rate by 15/min), and reassess after 1 h.
Severe dehydration: weak pulse, oliguria	• The only indication for IV infusion in a severely malnourished child is circulatory collapse caused by severe dehydration or septic shock. • Severe dehydration: Administer (N/2) saline with 5% dextrose at slower infusion rates of 15 ml/kg over the first hour with continuous monitoring (pulse rate, pulse volume, respiratory rate, capillary refill time, urine output). • Monitor pulse and respiratory rates every 5-10 min. If there is improvement (pulse slows; faster capillary refill) at the end of the first hour of IV fluid infusion, consider diagnosis of severe dehydration with shock. Repeat rehydrating fluid at the same rate over the next hour and then switch to ORS at 5-10 ml/kg/hour, either orally or by nasogastric tube. If there is no improvement or worsening after the first hour of the fluid bolus, consider septic shock and treat accordingly (Fig. 19.2). **Caution:** • Do not use 5% dextrose alone • Add potassium to the IV fluids at the rate of 1.5 ml per 100 ml after the patient passes urine. 1 ml of potassium chloride provides 2 mmol of potassium. Do not increase to more than 40 mEq/litre. • Monitor frequently and look for features of over hydration and cardiac decompensation. • Increasing respiratory rate (> 5 per minute) and increasing pulse rate (> 15 per minute), increasing oedema and periorbital puffiness indicates overhydration which may be dangerous and may lead to heart failure.
Septic shock (clinical features similar to severe dehydration)	• See Fig. 19.2 Give blood/plasma transfusion 10 ml/kg over 3 hours. • Start antibiotics; as given in Infections. • Fluid management is similar to that of severe dehydration.
Dyselectrolytaemia	• Give supplemental potassium at 3-4 mEq/kg/day for at least 2 weeks. Potassium can be given as syrup potassium chloride; the most common preparation available has 20 mEq/15 ml.

Problem	Measurement
	• On day 1, give 50% magnesium sulphate IM once (0.3 ml/kg up to a maximum of 2 ml). Thereafter, give extra magnesium (0.4–0.6 mEq/kg daily) orally. If oral commercial preparation is not available give injection magnesium sulphate (50% which has 2 mEq/ml) orally as magnesium supplements mixed with feeds for 2 weeks. • Prepare food without adding salt to avoid sodium overload.
Infections	• Assume all children with severe malnutrition admitted in a hospital have an infection and give broad-spectrum antibiotics. If specific infections are detected such as dysentery, malaria, pneumonia, worm infestations, tuberculosis, treat as per STG of that particular condition. (Table 19.9). • Hypoglycaemia and hypothermia are often signs of severe infection.
Congestive heart failure (tachycardia, cardiomegaly)	• Restrict fluid intake. • Give Inj Frusemide 1 mg/kg stat.
Severe anaemia (haemoglobin<4 g/dl)	• Give whole blood or packed cell transfusion, if Hb is < 4g/dl or Hb is 4-6 g/dl and child has respiratory distress. Give 10 ml/kg slowly over 4-6 hours and give Inj. Frusemide 1mg/kg at the start of the transfusion. Do not repeat blood transfusion within 4 days.
Vitamin A deficiency	• Give a single dose of vitamin A orally to all children: <6 months: 50,000 IU; 6 months - 1 year: 1,00,000 IU; >1 year: 2,00,000 IU; Children < 8 kg irrespective of age should receive 1.00,000 IU orally. • Give half of the above dose, if injectable (intramuscular) vitamin A needs to be given. Give same dose, on Day 0,1 and 14 if there is clinical evidence of vitamin A deficiency.
Vitamin K deficiency or bleeding tendency	Inj Vitamin K 2.5 mg IM single dose.
Zinc	• 2 mg/kg/day for at least 2 weeks • Give 0.2 ml/kg of 50% solution of magnesium sulphate IV single dose.
Folic acid deficiency	• Give folic acid 5 mg on day 1 followed by 1 mg/day for at least 2 weeks.
Copper	• 0.3 mg/kg/day (if separate preparation not available use commercial preparation).

Table 19.9. Selection and dose of antibiotics

Status	Antibiotic
All admitted cases	• Inj. Ampicillin 50 mg/kg/dose 6 hourly and Inj. Gentamicin 7.5 mg/kg once a day for 7 days • Add Inj. Cloxacillin 50 mg/kg/dose 6 hourly, if staphylococcal infection is suspected • Revise therapy based on sensitivity report
For septic shock or worsening/ no improvement in initial hours	• IV Cefotaxime 50 mg/kg/dose 6 hourly or Inj. Cerftriaxone 50 mg/kg/dose 12 hourly plus Inj. Amikacin 15 mg/kg/once a day
Meningitis	• IV Cefotaxime 50 mg/kg/dose 6 hourly or Inj. Ceftriaxone 50 mg/kg/dose 12 hourly plus Inj. Amikacin 15 mg/kg/once a day
Dysentery	• Inj. Ceftriaxone 100 mg/kg once a day for 5 days

Note: Duration of antibiotic therapy depends on the diagnosis i.e. suspicion of clinical sepsis: at least 7 days; Culture positive sepsis: 10-14 days; Meningitis: at least 14-21 days; Deep seated infections like arthritis and osteomyelitis: at least 4 weeks

Treat other associated conditions

Malaria, tuberculosis (see respective section), suspect HIV, if child has also other problems like persistent diarrhoea, oral thrush, pneumonia, parotid swelling or generalized lymphadenopathy. Investigate and follow HIV guidelines.

Persistent diarrhoea: Diarrhoea is common in severe malnutrition but with cautious refeeding, it should subside during the first week. In the rehabilitation phase, the poorly formed loose stools are not a cause for concern, provided the child's weight gain is satisfactory. If the child has persistent diarrhoea, screen for non-intestinal

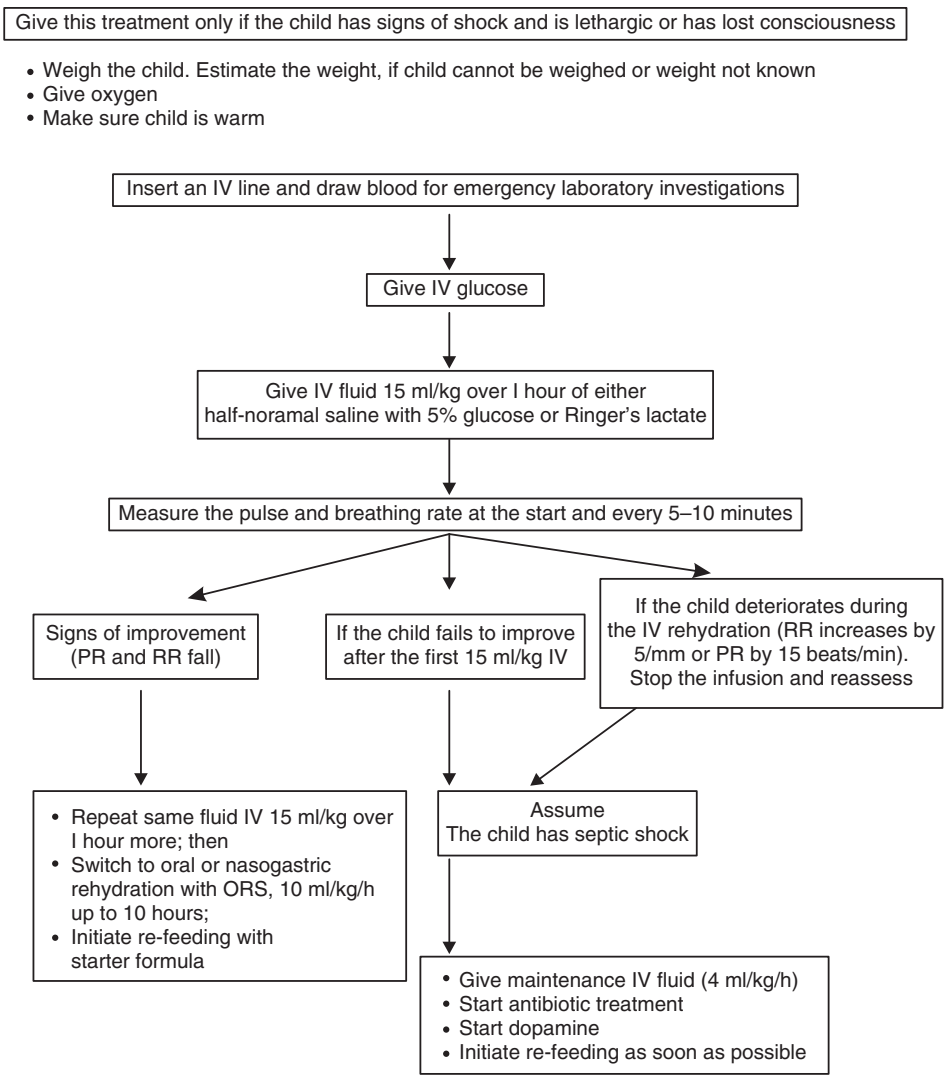

Fig. 19.2. Management of shock in a child with severe acute malnutrition.

infections and treat appropriately. Continue breastfeeding and try to give feeds with low lactose initially and subsequently change to lactose free options, if diarrhoea persists.

Criteria for failure to respond to treatment: (i) fail to regain appetite by day 4, (ii) loose oedema by day 4, or (iii) fail to gain weight at least 5 g/kg of body weight per day by day 10 of therapy. Children who fail to respond to treatment should be screened for faulty feeding, inadequate feeding, persistent diarrhoea, malabsorption, giardiasis, shigellosis, amoebiasis, otitis media, pneumonia, UTI, fungal infections, scabies, tuberculosis, helminthiasis, malaria, and HIV/AIDS. If the search proves futile, one should also look for any underlying immunological disease, inborn errors of metabolism and malignancies.

Initiation of cure. First seven days aim–start nutrition.

Starting point. Once complications are taken care of and child is ready to tolerate feeds (Table 19.10).

Table 19.10. Initiation of cure

Start feeding	• Initiate feeds as early as possible. • If oral feeding is not possible, give nasogastric feeding. • Start with a lower volume of feed at frequent intervals; no. of feeds varying from 12 feeds on first and second day and 6 to 8 feeds on days 3-7. Ensure night feeds. • If tolerated, milk-based diets are most suitable (80 kcal/kg/d) and protein (0.7 g/kg/d). The caloric intake should not exceed 100 kcal/kg/d on the first day. Increased gradually over one week to 150 kcal/kg/day of energy and 2-3 g/kg/d of proteins. Total amount of fluids should be 130 ml/kg/d. • Sugar and oil can be added to provide extra calories.
Lactose intolerance (stool pH, 5.5 on two separate occasions)	• Reduce the total lactose load in the diet by diluting the milk for 3 or 4 days or substituting a part of milk feeds by formulae based on lactose-free milk protein (calcium caseinate), sugar and oil, soyabean, meat or vegetable protein mixtures.
Other nutrients	• Supplement the diet with minerals and trace elements as follows: Potassium chloride (1.2-2.4 g/L of feed), magnesium chloride (300-600 mg/L of feed), zinc acetate (20 mg per day), copper acetate (2 mg/L of feed), selenium (6-10 mcg/kg/day) and folic acid (1 mg per day). • Do not give iron at this stage. Add iron only after a week of therapy. • Vitamins of B complex group are not useful in initial therapy.

Signs of improvement

During these seven days, a child with kwashiorkor will lose weight and a marasmic child gains little or nothing because the tissue gains are masked by excess body water loss.

Rehabilitative phase (2-6 weeks)

Aim: Restore normal weight for height.

Starting point: Child has started showing signs of recovery of appetite and change of expressions.

Intensive feeding (to recover lost weight)	• Replace the initial milk diet with home diet as soon as possible. • Provide therapeutic diet as follows: fluids 150 ml/kg/day, energy 175-200 kcal/kg/day, protein 2-4 g/kg/day. • The diet prescribed for the child should be such, which the family can afford to provide for the baby within its limited income, can be easily cooked at home, does not perish easily, is culturally acceptable and easily available in the local market.
Treat concurrent nutritional deficiencies	• Start oral Iron 3 mg/kg/d elemental iron once a day. Start other vitamins including vitamins B, C, D, E at double the RDA. • Continue potassium, magnesium, zinc, copper, selenium and folic acid supplementation. • Provide vitamin D 400 IU oral once daily for 4 weeks.

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3. Facility Based IMNCI (F-IMNCI) Participants Manual. WHO, UNICEF, and Ministry of Health & Family Welfare, Government of India, 2009.

NUTRITIONAL RICKETS

Rickets is defective mineralization of growing skeleton caused by deficiency of vitamin D characterized by skeletal deformities like genu valgum/genu varum, broadening of wrists, susceptibility to fractures, weakness, hypotonia and disturbances in growth. Most often it is nutritional (lack of exposure to sunlight and inadequate dietary intake) and occurs between 2 months to 2 years of age. Radiological picture shows that epiphyseal growth plate is increased in thickness, cupped with hazy metaphyseal borders. Serum calcium is generally normal or low, phosphate is low or normal and alkaline phosphatase is raised in nutritional rickets.

Treatment

Nonpharmacological

- Encourage the child to play outdoors/increase exposure to sunlight.
- Enhance dietary sources of vitamin D—dairy products, egg and fish liver oil.

Pharmacological

1. Vitamin D 600,000 IU Stat oral or IM (if patient is sick due to intercurrent infection). Repeat X-ray wrist after 4 weeks. If the response is positive, i.e. healing line of rickets is seen on X-ray, continue oral vitamin D 400 IU/day. If no response to therapy after 4 weeks refer to a higher centre for evaluation of non-nutritional rickets.
2. Calcium supplementation (elemental calcium) 1-3 years 700 mg/day; 4-8 years 1000 mg/day; 9-18 years 1300 mg/day

Patient education

- Discourage early cessation of breastfeeding
- Consumption of dairy products which are rich in vitamin D should be emphasized
- Exposure to sunlight is beneficial for a child with rickets.
- No special type of oil is required for massage.
- Most of the deformities improve in the due course of time.

Reference

1. Rickets and Hypervitaminois D. In: Nelson's Textbook of Paediatrics. Behrman RE, Kliegman RM, Jenson HB (eds), 19th Edition, WB Saunders Co, 2011; pp. 200-209.

PICA

Pica involves repeated and chronic ingestion of non-nutrient substances including mud, plaster, paint, earth, clay, etc. Most of the time, it is self-limiting and represents manifestations of family disorganization, poor supervision, and affectional neglect.

Treatment

- Pica below two years does not need any intervention.
- Children with pica are at increased risk of lead poisoning, iron deficiency, bezoars, and parasitic infections. They should be investigated for these problems and if present, treated suitably.
- Education, guidance and counselling of the family.
- The child has to be kept occupied in other tasks and provided with the environmental stimulation.

Reference

1. Rumination, Pica, and Elimination (Enuresis, Encopresis) Disorders. In: Nelson's Textbook of Paediatrics. Behrman RE, Kliegman RM, Jenson HB (eds), 19th Edition, WB Saunders Co, 2011; pp. 70-75.

BREATH HOLDING SPELLS

Paroxysmal self-limiting events occurring in up to 5% of healthy children and are rare prior to 6 months of age, peak at about 2 years of age and abate by 5 years of age.

SALIENT FEATURES

- Child starts crying (precipitated by an upsetting event, such as anger, fear, or injury) and then holds breath in expiration followed by a colour change (blue or pale).
- Spell may resolve spontaneously or the child may lose consciousness and may have convulsions. Normal breathing and alertness is resumed within a minute.

Treatment

Reassurance. Explain that attacks are harmless and always abort by itself.

Immediate measures

- Prevent injury during the episode. Help the child to floor and have him lie flat.
- If loss of consciousness occurs, place on the side to protect against aspiration.
- Maintain patent oral airway but do not start CPR.
- Do not shake the baby, splash water or put anything in the mouth.

Long-term measures

There are NO prophylactic medications. Treat iron deficiency, if associated.

Refer to a higher centre

- If the child is less than 3 months or unconsciousness lasts for more than 1 minute.
- If attacks are too frequent or seizure disorder or cyanotic spell is suspected.

Parent education

- Avoid precipitating factors such as exhaustion, hunger, or injury. Do not give toys or tasks beyond the child's abilities and try to distract.
- Avoid excessive rules and restrictions. Try to remove unnecessary frustrations.

References

1. Breath Holding Spell. In: Essence of Office Practice. Stockman JA, Lohr JA (eds), WB Saunders, Philadelphia, 2001; pp. 53.
2. Breath Holding Spell. In: Current Paediatric Diagnosis and Treatment. Hay WW, Hayward AR, Levin MJ et al (eds), 15th Edition, Lange Medical Books, New York, 2001; pp. 80.
3. Breath Holding Spells, Paediatric Neurol, 14, 1996; 91.

PRIMARY NOCTURNAL ENURESIS

Most common cause in primary enuresis is inappropriate toilet training. Other causes could be genetic, sleep disorder, reduced ADH at night. Psychological causes may be found in secondary. 3% children have organic pathology, such as obstructive uropathy or UTI.

SALIENT FEATURES

- Involuntary discharge of urine after the age at which bladder control should have been established (5 years).
- In primary nocturnal enuresis, child has never been dry at night while in secondary, child has been continent for at least 6 months before the child begins to wet again.

Treatment

Nonpharmacological (effective in 30% cases)

- Rule out organic causes. Restrict fluid intake in the evening.
- Bladder exercises:
  (i) Hold urine as long as possible during the day.
  (ii) Practice repeated starting and stopping the stream at the toilet bowl.
- Practice getting up from bed and going to the bathroom at bedtime before sleep.

Pharmacological

Indicated only in children > 6 years where sufficient trial of nonpharmacological management has failed with following:

- Tab. Imipramine: 6-8 year (25 mg), 9-12 year (50 mg), >12 year (75 mg) once a day at bedtime. Success rate 30-60%, relapse rate 90%.
  Tab. Desmopressin 0.1-0.5 mg at bedtime.
  Or
  Desmopressin acetate (nasal spray, 10 mcg per spray): Start with 10 mcg given at bedtime daily and increase gradually by 10 mcg/per week to a maximum of 40 mcg per day. If effective, it should be used for 3-6 months. Success rate is 40-60%, relapse rate is 90%.
  (**Caution:** Not effectively absorbed in rhinorrhoea. If not used properly may cause hyponatraemia)

Refer the patient to a higher centre, if organic cause is suspected or when diagnosis is in doubt.

Parent education

- Reassure the parents that condition is self-limiting.
- Ask the parents to maintain a diary record of dry nights; reward the child for such nights. Avoid punitive measures.

References

1. Current Paediatric Diagnosis and Treatment. Hay WW, Hayward AR, Levin MJ, et al (eds), 15th Edition, Lange Medical Books, New York, 2001; pp. 175-176.
2. Nocturnal Enuresis. In: Evidence Based Paediatrics and Child Health. Meyer VA, Elliott EJ, Davis RL, et al (eds), BMJ Books, London, 2000; pp. 313-317.
3. Enuresis. In: Essence of Office Practice. Stockman JA, Lohr JA (eds), WB Saunders, Philadelphia, 2001; pp. 127.

WHEEZY CHILD

Wheezing is a clinical symptom present in asthma and other illnesses including bronchiolitis and other viral infection, foreign body inhalation, tuberculosis, pneumonia, cystic fibrosis, immune deficiency, bronchomalacia, hypersensitivity pneumonia and conditions compressing airways. Most commonly in the first 5 years of life, children due to recurrent viral infection. After first 5 years of age, wheezing is usually due to

asthma. Sometimes children with pneumonia present with wheeze. The differential diagnosis of wheezing in a child is detailed in Table 19.11. Wheezing in asthma is recurrent, gets worse in night and after exercise, seasonal and may be associated with other allergic illnesses like atopic dermatitis, allergic rhinitis, etc. (for details see section on Bronchial Asthma in Chapter 1). Absence of family history and personal history of atopy with gradual decrease in frequency of episodes is seen in many transient wheezers who grow out of their wheezing episodes. Clinical features suggestive of other cause of wheezing are: neonatal onset, associated with difficulty in feeding, choking or vomiting, localized findings in chest or abnormality in cardiovascular system.

The different presentations of wheezing in children under 5 based on clinical features and course of illness are detailed in Table 19.11.

Table 19.11. Differential presentations of wheezing in children under 5 based on clinical features and course of illness

Diagnosis	In favour
Bronchiolitis	• First episode of wheeze in a child aged < 2 years • Wheeze episode at time of seasonal bronchiolitis • Hyperinflation of the chest • Prolonged expiration • Reduced air entry (if very severe, airway obstruction) • Poor/no response to bronchodilators
Episodic viral wheeze	• Wheeze recurrently with viral infection. • Free of symptoms in between the episodes • Do not wheeze due to any other trigger.
Multiple trigger wheeze	• Recurrent wheezing, in addition, to viral infections wheeze due to various other triggers like exercise, smoke, dust, etc. • Asymptomatic in between the viral episodes.
Atypical wheeze	• Wheeze has neonatal onset, is associated with difficulty in feeding, choking or vomiting, localized findings in chest or abnormality in cardiovascular system. • Suggesting an underlying cause like cystic fibrosis, congenital heart disease, aspiration syndromes, immunodeficiency, localised pathology like congenital lesions or foreign body.

Treatment

Children with atypical features must be investigated and given specific treatment for underlying cause.

Acute wheeze

Mild acute first or recurrent wheeze does not require any specific treatment. Children who are feeding well and do not have respiratory distress can be sent home on symptomatic treatment for fever and nasal block. However, parents must be explained red flag signs so that they can bring the child immediately to hospital in case respiratory distress becomes severe and child is unable to feed.

Severe wheeze

1. Severe bronchiolitis

Child should be admitted to emergency.

Nonpharmacological: Child should be nursed in a comfortable position may be in mother's lap. Monitoring should be frequent.

Pharmacological:

- Oxygen: A child in severe respiratory distress or SpO_2 less than 92% requires oxygen in non-threatening way. Blow by method may be better than mast or hood, if these make the child irritable.
- Intravenous fluids: Most of these children with severe distress cannot feed. Child should be kept well hydrated with intravenous fluids and under/over hydration should be avoided.

There is an unpredictable response to bronchodilators in young wheezers. However, a trial of bronchodilators is given to children admitted with severe disease.

Nebulized Adrenaline (0.1 ml to 0.5 ml/kg max 5 ml) is preferred in bronchiolitis. If there is response, it may be repeated on as and when basis.

Frequency of nebulisation reduced and oxygen is withdrawn when child starts improving. There is no role of antibiotics and chest physiotherapy. No cough syrups or sedatives should be given.

2. Acute severe wheeze in recurrent wheeze

It is treated the same way as bronchiolitis, except salbutamol nebulisation or MDI (100 ug/puff) with spacer may be used as bronchodilator in recurrent wheezer.

Generally 3 doses of Salbutamol one every 20 minutes, (0.15 mg/kg/dose Salbutamol add normal saline to make it 3 ml every dose). One dose of nebulisation is equivalent to 4-5 doses given by MDI with spacer. Very occasionally steroids may be required to treat very severe acute episode, particularly in a multi-trigger wheezer. Systemic steroids are preferred over inhaled in such situation. Tab. Prednisolone 1 mg/kg/day (or in equivalent dose any other steroid) may be used for a short course of 3-5 days.

Prophylaxis in recurrent wheezing

Nonpharmacological: Protect from environmental triggers like dust, smoke, perfumes, deodorants, repellents, etc. Parents should be advised to follow these instructions irrespective of severity of disease.

Pharmacological: If episodes are mild and infrequent, no prophylaxis is required. Each episode is treated as discussed above. However, prophylaxis to prevent recurrence may be needed, if episodes are frequent (more than or once a month) and severe.

Prophylaxis in severe and frequent multi-trigger wheeze (MTW)

Inhaled corticosteroids (MDI with spacer or nebulised) like Budesonide nebulisation with 0.5 mg twice daily for 3 months. If child shows decrease in severity and frequency

of episodes, treatment is stopped. If there is recurrence after stopping, intermittent corticosteroid inhaled corticosteroids (ICS), a decision to give long-term ICS may be taken.

A multi-trigger wheezer with severe recurrent episodes and a family history of atopy or asthma may be labelled as asthma and treated accordingly.

Prophylaxis in severe and frequent episodic viral wheeze (EVW)

Intermittent Montelukast (satchet) 4 mg/day, given for a week or so beginning with the onset of episode may be useful but may be less effective than ICS. Trial of ICS may be given as in MTW and followed up in the same way with decision for long term depending on the response.

ACUTE BRONCHIOLITIS

Acute bronchiolitis is an acute respiratory tract infection caused commonly by viral pathogens. The commonest aetiological agent being *Respiratory syncytial* virus. Bronchiolitis commonly occurs in infants below 6 months of age. Peak occurrence during winter and early spring.

SALIENT FEATURES

- Cold for 2-4 days followed by cough, wheeze and rapid respiration. With increasing severity of illness there may be lower chest indrawing, difficulty in feeding, excessive crying due to hypoxaemia, cyanosis and respiratory failure. There may be history of viral upper respiratory infections in other family members in the recent past.
- Mild disease is characterized by rapid respiration, no chest indrawing, no problem in feeding, no clinical evidence of hypoxaemia and oxygen saturation is more than 95% (optional).
- Severe disease is characterized by chest indrawing, difficulty in feeding, clinical evidence of hypoxaemia, lethargy, convulsion, oxygen saturation <95% (optional).
- Normal or minimal increase in total leucocyte counts with relative lymphocytosis. X-ray chest may show hyperinflation and small atelectasis.

Treatment

Nonpharmacological

- For associated nasal block, normal saline drops in both nostrils as and when required, especially before feeds, and use of home remedies (ginger, honey, tulsi) for control of cough and plenty of liquids orally.
- For hospitalized patients, elevation at 30-40 degrees and neck slightly extended.
- To be nursed in comfortable environment.

Pharmacological

Treatment of mild disease (ambulatory treatment at home)

No antibiotics.

Syr. Paracetamol 10-15 mg/kg 4-6 hourly for fever (for details see section on Fever in Chapter 1).

If patient shows overall improvement with no evidence of chest indrawing, cyanosis, difficulty in feeding continue treatment as above. If there is partial improvement patient should be called again after 2 days or earlier if patient deteriorates for reassessment.

Hospitalize immediately, if any of the following develop:

Chest indrawing, poor feeding, cyanosis, altered sensorium and convulsions and managed as severe disease.

If there is no improvement or deterioration at any time during the illness, the patient should be managed as severe disease.

Treatment of the severe disease (needs hospitalization for management)

1. Oxygen administration by oxygen hood or nasal catheter and intravenous fluids, if child is not able to feed.
2. Adrenaline inhalation (injectable form) 0.3 mg/kg by nebulizer after dissolving the solution in 3 ml saline; can be repeated every 4-6 hourly as required.
   (No role of antibiotics, steroids, ribavirine inhalation in uncomplicated patients).
3. If adrenaline not available, Salbutamol inhalation (0.15 mg/kg dissolved in 3 ml soln) may be tried and continued, if response observed.
4. Syr. Paracetamol 10-15 mg/kg/dose may be given 4-6 hourly.
   Do not use sedatives.

Monitor improvement in respiratory rate, lower chest indrawing, difficulty in feeding, excessive crying, cyanosis and oxygen saturation, if available, every 4-6 hours till there is significant improvement. If child does not improve/deteriorate, look for underlying heart disease, i.e. myocarditis/congenital heart disease and get an X-ray chest and look for massive collapse of lung/infection/pneumothorax, etc. and manage accordingly.

Patient education

- Mother should be educated about the signs of pneumonia, i.e. rapid respiratory rate, chest indrawing, difficulty in feeding.
- Mother should be educated about identification of danger signals in a child suffering from pneumonia and report immediately to the health care facility.

References

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4. Ventilated Respiratory Syncytial Virus Bronchiolitis. A Randomized Placebo Controlled Trial. Am J Respir Crit Care Med, 1999; 160, 829-34.
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PNEUMONIA

Pneumonia is commonly caused by infectious agents, e.g. viruses, bacteria and mycoplasma. Viruses alone or combined with bacteria are responsible for majority of the cases. In developing countries bacterial pneumonia (*Streptococcus pneumoniae*, *H. influenzae*) may be more common.

SALIENT FEATURES

- Fever, cough with rapid breathing, lower chest indrawing, crepitations/wheezing, difficulty in feeding and cyanosis.
- On the basis of clinical features, pneumonia can be classified as mild to very severe disease.
  No pneumonia—no fast breathing and no indicators of severe or very severe pneumonia.
  Pneumonia—fast breathing, e.g. age below 2 months >60 RR/min; 2-12 months > 50 RR/min; 12-60 months >40 RR/min and no indicators of severe or very severe pneumonia; definite cracles on auscultation.
  Severe pneumonia—lower chest indrawing or nasal flaring and no signs of very severe pneumonia.
  Very severe pneumonia—central cyanosis or not able to breastfeed or drink or convulsions or lethargy or unconsciousness or severe respiratory distress (e.g. head nodding).

Treatment

Nonpharmacological

- Nasal block to be treated with saline nasal drops as and when required, especially before feeds.
- Ginger, honey, tulsi with warm beverages can be used as home remedies for cough.
- Patients with respiratory distress to be nursed in semi-reclined posture at angle of about 30º.
- Young infants should be nursed in comfortable position preferably in mother's lap.
- Breastfeeding and small frequent feeds to be continued in children who do not have severe or very severe pneumonia.

Pharmacological

Fever to be treated as in section on fever. Treatment is initiated according to the severity.

1. Pneumonia

Patients with age more than 2 months and with absence of features of severe/very severe pneumonia can be treated at home.

Tab./Syr. Amoxycillin 20-40 mg/kg/day in 3 divided doses for 5-7 days.

Or

Tab./Syr. Cephalexin 20-40 mg/kg/day in 3 divided doses for 5-7 days.

2. Severe pneumonia and very severe pneumonia or age <2 months treated as inpatients

1. Oxygen inhalation to maintain $SaO_2 \geq 92\%$. Continue with oxygen until the signs of hypoxia (such as severe lower chest wall in-drawing or breathing rate of ≥ 70/ min) are no longer present.
2. Give supportive care:
   - o Ensure that the child receives daily maintenance fluids appropriate to child's age. Encourage breastfeeding and oral fluids, once the distress settles and the child is able to feed.
   - o If the child has fever (≥38.5ºC) which appears to be causing distress, give oral Paracetamol (15 mg/kg/dose).
   - o If wheeze is present, give a rapid-acting bronchodilator (as described in the next section).
   - o Remove any thick secretions in the nose/throat, which the child cannot clear, by gentle suction.
3. Inj. Cefotaxime 100 mg/kg/day in 3 divided doses for 7-10 days.

   Or

   Inj. Cefuroxime 100 mg/kg/day in 2 divided dose for 7-10 days.

   Or

   Inj. Ampicillin 100 mg/kg/day in 3 divided doses Plus

   Inj. Gentamicin 7.5 mg/kg/day in 2-3 divided doses for 7-10 days.

3. Severe pneumonia and very severe pneumonia with age >2 months treated as inpatients

Admit the child in hospital.

Obtain a radiograph of the chest, if facilities are available for the same. Radiography in very severe pneumonia is required at admission to assess the extent of disease and to rule out presence of puemothorax or effusion. In case of severe distress, stabilize and oxygenate the child before sending for radiograph.

1 and 2 as above

3. Inj. Ampicillin 50 mg/kg IM/IV every 6 hours plus Inj. Gentamicin 7.5 mg/ kg IM/IV once a day. If the child responds well, discharge after 5 days to continue treatment at home with oral Amoxicillin 15 mg/kg per dose 3 times a day plus IM Gentamicin once daily for a further 5 days.

Or

Inj. Chloramphenicol 25 mg/kg IM or IV every 8 hours until the child has improved. Then continue the same drug orally in the same dose for 3 times a day for a total course of 10 days.

If the child does not improve by 48 hours to any one of these treatments, reassess for complications and switch to Inj. Ceftriaxone 80 mg/kg IM or IV once daily for 10 days.

High-risk patients, i.e. postmeasles, with congenital heart disease and severe malnutrition, etc. may be given Amoxycillin + Clavulanic acid, or Cefotaxime/ Cefuroxime as initial therapy.

Children who deteriorate rapidly, develop empyema/pneumothorax or have skin lesions suggestive of staphylococcal infection—should be treated with Inj. Cloxacillin 200 mg/kg/day in 3-4 divided doses + Inj. Gentamicin 7.5 mg/kg/day in 2-3 divided doses. When the child improves, continue Cloxacillin orally 4 times a day for a total course of 3 weeks at least. Children with complicated pneumonia (Empyema) need longer therapy for 4-6 weeks.

Follow-up and monitoring

Children with mild pneumonia are reassessed at 48 hours or earlier, if child deteriorates, look for complications or other diagnoses. If child shows improvement, treatment is continued as above. If deteriorates, patient is hospitalized and treated as severe/very severe pneumonia. Children who are hospitalized (severe and very severe pneumonia) are monitored more frequently. Children with severe/very severe pneumonia (age >2 months) on deterioration can be treated with cefotaxime/cefuroxime in the doses given in (2). If possible, obtain a repeat chest X-ray. Consider transfer to a higher facility in case of poor response or deterioration despite second-line therapy.

Patient/parent education

- Explain the signs of pneumonia, i.e. rapid respiratory rate, chest indrawing, difficulty in feeding, etc.
- Explain the danger signals in a child suffering from pneumonia.

References

1. Facility Based IMNCI (F-IMNCI) Participants Manual. WHO, UNICEF, and Ministry of Health & Family Welfare, Government of India, 2009.
2. Diagnosis and Management of Pneumonia in Children. Paediatric Inf Dis J 2000; 19: 924-28.

THRUSH (ORAL CANDIDIASIS)

Oral candidiasis may be seen as early as 7-10 days of age (peak 4th week of life) uncommon after 12 months of age, when it is secondary to broad-spectrum antibiotic treatment. Chronic /recurrent oral candidiasis is seen in hypoparathyroidism, Addison's disease, autoimmune disorders, immunodeficiency, AIDS, myelosuppressive therapy and severe malnutrition.

SALIENT FEATURES

- Thick white patches on an erythematous base in the oral mucosa may spread to involve the lips, buccal mucosa, tongue and palate.
- Asymptomatic or may cause pain in the mouth, discomfort, anorexia and decreased feeding. Rarely may cause aspiration pneumonia.
- Diagnosis is confirmed by the fact that on removing the plaques, punctate areas of bleeding are seen on the undersurface.

Treatment

Nonpharmacological

Correction of faulty sterilization technique of bottle; best to avoid bottle feeding.

Pharmacological

Nystatin (100,000 units/ml) oral suspension 1 ml applied to each side of mouth every 6 hours.

Or

Clotrimazole 1% cream, gel or lotion, oral application 3-4 times/day after feeding for 5-7days (or 1-2 days beyond recovery).

Or

Miconazole gel 25 mg 4 times a day for 5-7 days.

Or

Gentian violet 1% aqueous solution 1-2 times a day, for 5-7 days (can stain tissues and clothes).

In resistant/chronic cases (patients with major underlying disease)

Tab. Fluconazole 3-6 mg/kg once daily for 5-7 days.

Or

Tab. Ketoconazole 3-6 mg/kg once daily for 5-7 days.

Warning

Resistant/recurrent/chronic thrush in a child with no obvious predisposing factor/ source of infection look for underlying endocrinopathy/immune disorder, AIDS and malnutrition.

Patient/Parent education

- Emphasize on bottle hygiene, care/hygiene of the nipple and treatment of vaginal candidiasis in expectant mother.

References

1. Treatment of Oropharyngeal Candidiasis in Neonates. Review and Appraisal. Paediatric Inf Dis J 1997; 16(9), 885-894.
2. Mycotic Infection. In: Text Book of Paediatrics. Martin Wesse, Stephne C. Aronoff (edd), pp. 933-934.

CONSTIPATION

Constipation is defined as the passage of hard stools that are difficult to pass irrespective of frequency. However, passage of stool less than twice a week is considered as constipation. Genuine hard stools may result from an inadequate milk intake, hunger stools, use of over-strength artificial feeds and low roughage diet. True constipation may be due to imperforate anus, meconium plug, low intestinal obstruction, neonatal small colon syndrome, Hirschsprung's disease, cystic fibrosis or hypothyroidism but most of the time it is idiopathic.

SALIENT FEATURES

- Fretfulness, poor appetite, intermittent abdominal pain, distension. Retentive posturing occurs with urge to defaecate, relieved after going to the toilet, overflow soilage may appear.
- There may be history of recurrent UTI. Weight gain may be impaired.
- On examination, there is faecal soiling of under wear and persistent faecal odour. Abdomen is often distended and tympanic to percussion. Faecal masses palpable above pubis and in left colon, rarely entire colon is filled with firm mass; on rectal examination, hard stools are palpable in ampulla.

Treatment

If a surgical cause is suspected, patient should be investigated and treated accordingly. The main objective of medical management is to dislodge faecal mass, overcome withholding behaviour and promote regular bowel habits.

Nonpharmacological

- Dietary modification: Ensure adequate fluid intake in diet. In infants, breast milk should continue as it is less likely to be constipating than cow's milk, can add extra sugar in cow's milk, if child is not breastfed.
- Add fibre by cereals (wheat bran, oat, corn), pulses, vegetables, salads and fruits and isabgol.
- Behavioural modification.
  - Toilet training to achieve regular evacuation. Child is instructed to use bathroom after breakfast or dinner, to take advantage of meal stimulated increase in colonic motility.
  - Maintain calendar to record stooling.
  - Positive reinforcement (reward/appreciation) for successful toileting (no punishment for failure).

  Follow up with regular contact with child and parent for 2-3 years.

Pharmacological

1. Agarol or Lactulose in infants 2.5-10 ml/day; children 40-90 ml/day in 3-4 divided doses.

Or

Mineral oil (Liquid paraffin) 5-15 ml/kg/day.

Or

Milk of Magnesia 0.5-3 ml/kg/day. Dose is titrated to produce at least one stool/day.

Medical management has to be with different group of laxatives added serially to maximal doses and maintained for a considerable length of time (3-6 months) and then tapered gradually. Commonest cause of failure is short-term treatment and suboptimal doses.

2. Enemas may be used in severe cases where sufficient trial of medical therapy has failed.

   Hypertonic Phosphate (5-6 ml/kg) or Glycerine saline (1 ml/kg). Pure saline enemas are less effective and plain tap water/soap water enemas are not used in children. Suppositories of Glycerine/Bisacodyl may also be used. To empty the bowel of faecoliths, enemas may be required daily or on alternate days for initial few days.

   In severe cases with faecal soiling, in the initial stages: bowel cleaning/disimpaction may be required with enemas 1-2/day or suppositories 1-2/day.

In very severe cases with multiple faecoliths, failed medical treatment, mental retardation, etc., surgical disimpaction may be done.

Patient/parent education

- The parents should be empowered to titrate the medication against the child's stools.
- Importance of dietary modifications should be explained.
- Treatment should not be abandoned early after recovery.
- Bowel training should have only positive reinforcements. Negative reinforcement should be avoided at all costs.

References

1. Diarrhoea and Constipation. Harrison's Principles of Internal Medicine. Kasper DL, Braunwald E, Fauci AS et al (eds), 18th Edition, McGraw Hill Company Inc., New York, 2012; pp 308-319.
2. Major Symptoms and Signs of Digestive Tract Disorders. In: Nelson's Textbook of Paediatrics. Behrman RE, Kliegman RM, Jenson HB (eds), 19th Edition, WB Saunders Co, 2011; pp 1240-1249.
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(See also Constipation in Chapter 6)

RECURRENT ABDOMINAL PAIN OF CHILDHOOD (RAP)

Three or more bouts of abdominal pain occurring over a period of not less than three months and severe enough to interfere with child's normal activities. It is most common in the age group of 5-15 years and in 90% cases, it is functional.

SALIENT FEATURES

- Paroxysmal—child appears well in between the episodes or sometimes dull continuous ache may be present.
- Mostly periumbilical, epigastric or suprapubic.
- Episodes last for generally less than one hour.
- Not related temporally to activity, meals, and stress or bowel habits.
- Rarely awakened from sleep.
- Normal physical examination and growth.

Warning signs pointing towards organic pain

- Well localized pain away from midline (Apley's law—farther the pain from midline, more likely to be organic).
- Repeated vomiting.
- Pain awakening the patient from sleep.
- Radiation to shoulder, back, scapula, lower extremities.
- Age less than 6 years.
- Associated fever, arthralgias, rash, rectal bleeding.
- Consistent sleepiness following pain attacks.
- Intermittent faecal incontinence.
- Weight loss or growth deceleration.
- Recurrent isolated episodes of pain that come suddenly and last for several minutes to few days.

In case of any warning sign, patients should be investigated accordingly, otherwise treat as functional. However, basic investigations, e.g. urine, stool, Mantoux and ultrasound examination might be done. Upper gastrointestinal endoscopy is generally not required.

Treatment

Nonpharmacological

- Treat organic cause, if found.
- Environmental intervention to avoid painful stress; change in parent reaction to avoid secondary gain. Common psychogenic factors responsible for RAP are complaint modelling (parents with abdominal pain), school phobia, learning problems, anxious overachiever, ridicule by peers, teacher incompatibility, attention seeking (attention withdrawal after an illness, over busy parents, single child, sibling rivalry, eating

time conflict, forceful toilet training), family psychopathology (parental conflict, single parent).
- Visit to doctor and placebos often help.
- Child is asked to maintain pain chart (help in assessment of improvement as well as aetiology).
- If required, help from a psychologist may be taken.

Pharmacological

- Nothing more than placebo is required.
- Constipation, if present may be treated.

Patient/parent education

- Explain the outline of the work up and treatment for the child before starting treatment. Doing so after negative work up makes family feel that the physician is making excuses. Explain that cause of RAP in most children is nonorganic.
- Discovery of cause may lessen the family's concern but may not alleviate the symptoms. There is no way to be certain that abdominal pain is because of identified disease entity. Pain may continue and its persistence does not mean serious organic disease.

References

1. Recurrent Abdominal Pain. In: Pain in Infant, Children and Adolescents. Neil L. Schhechter, Leonard A, Rappaport, Alan M. Leichtnr (eds), pp. 561-569.
2. Recurrent Abdominal Pain in School Children. Paediatric Clinics of North America, Vol. 31. No. 5, 1984; 969-991.
3. Functional Abdominal Pain (Non-Organic Chronic Abdominal Pain). In: Nelson's Textbook of Paediatrics. Behrman RE, Kliegman RM, Jenson HB (eds), 19th Edition, WB Saunders Co, 2011; pp. 1346-1349.

ACUTE DIARRHOEA

Acute diarrhoea is defined as passage of 3 loose stools per day for a duration of less than 7 days, and increased fluidity or volume of stools. It is caused commonly by *rotavirus*, *E. coli*, *V. cholerae*, *Giardia* or parenteral infections and invasive diarrhoea by *Shigella*, *Salmonella* and *E. histolytica*.

SALIENT FEATURES

- Clinical features of diarrhoea are frequent stools, vomiting, fever and dehydration.
- Dehydration is categorized into some dehydration and severe dehydration (Table 19.12). Investigations in acute diarrhoea which may be if indications exist (Table 19.13).

- Dysentery is diarrhoea presenting with loose frequent stools containing visible blood. It is usually associated with fever, abdominal cramps and rectal pain. Most episodes in children are due to *Shigella* but can be caused by *Salmonella*, *E. coli, C. jejuni* and infrequently by *E.histolytica*.

Table 19.12. Assessment and classification of dehydration

Classification	Signs and symptoms	Treatment
Severe dehydration	Two or more of the following signs: • Lethargy/unconsciousness • Sunken eyes • Unable to drink or drinks poorly • Skin pinch goes back very slowly (> 2 seconds)	• Give fluids for severe dehydration (Plan C)
Some dehydration	Two or more of the following signs:· • Restlessness, irritability • Sunken eyes· • Drinks eagerly, thirsty· • Skin pinch goes back slowly	• Give fluids for some dehydration (Plan B) • After rehydration, advise mother on home care • Follow up in 5 days, if not improving
No dehydration	Not enough signs to classify as some or severe dehydration	• Give fluids, zinc supplements and food and advise to continue ORS at home (Plan A)· • Advise mother when to return immediately. • Follow up in 5 days, if not improving.

Table 19.13. Investigations in acute diarrhoea

Investigations	Indications
Stool microscopy	Dehydration or high fever, diarrhoea persisting beyond 7 days, Blood persisting in stool after 48 hour of treatment
Blood urea, S. electrolytes (SE) and arterial blood gas (ABG)	All 3 investigations in moderate to severe dehydration, SE in persistent vomiting or signs of dyselectrolytaemia; ABG in respiratory distress with no chest signs and sepsis (correct it only if pH <7.25).
Infection screening by TLC, DLC, band cell count, ESR and CRP	Fever persisting >72 hours, PEM > grade III or age <3 months.
Blood culture	Suspected sepsis, before starting antibiotics.
Chest X-ray, CSF and others	As and when required
Stool culture	**No role**

Treatment

Nonpharmacological

- Maintain hydration by home available fluids (HAF) in place of or along with ORS and water. These are rice, kanji, butter milk, dal soup, coconut water or weak tea, etc. Soft drinks, sweetened fruit drinks and tea are unsuitable and could be potentially dangerous.
- Maintain nutrition: Continue breastfeeding. Continue normal light diet, e.g. khichri, dalia, banana or mashed dal, etc. Do not dilute or stop milk as there is not much role of lactose intolerance or milk protein allergy. Give extra food during recovery.
- Teach the mother to recognize danger signs and return immediately.

Pharmacological

1. Low osmolarity oral rehydration solution (ORS) in some dehydration.

- 75 ml/kg in 4 hours under observation.
- After 4 hours, if dehydration is corrected, or if child was not dehydrated at presentation, send home with instructions to give ORS in 2:1 dilution as accepted by the child. Asked to report back, if vomiting persists or urine is not passed for >8 hours. As a rough guideline 10 ml/kg of ORS may be added for each large stool.
- If dehydration is not corrected after 4 hours, same amount of ORS may be repeated in next 4 hours and if dehydration is corrected, send home.
- If dehydration does not improve in 8 hours or if it worsens abandon, oral rehydration therapy (ORT) and give IV fluids.
- Zinc ORS is not superior to supplementation of zinc separately, in malnourished children with diarrhoea.

Principles of Oral Rehydration Therapy (ORT)

- Give in small sips.
- Vomiting is not a contraindication unless persistent.
- Contraindicated in altered sensorium or paralytic ileus.
- Stop as soon as diarrhoea stops.

2. In severe dehydration (without severe acute malnutrition)

Rapid IV rehydration immediately with close monitoring, followed by oral rehydration once the child starts to improve sufficiently. If the child can drink, give ORS (5 ml/kg/hr) by mouth while the drip is set up.

For management of severe dehydration with severe acute malnutrition see section PEM.

Note: Ringer's lactate solution is the preferred IV solution. If it is not available, normal saline can be used. 5% dextrose solution is not effective and should not be used. In addition, all patients should start to receive ORS solution at the rate of 5 ml/kg/h when they can drink.

Give 100 ml/kg Ringer's lactate solution (or if not available, normal saline), divided as follows:

Age	First give 30 ml/kg in	Then give 70 ml/kg in
Infants (under 12 months)	1 hour*	5 hours
Children (12 months up to 5 years)	30 minutes*	2½ hours

* Repeat once if radial pulse is still very weak or not detectable.

- Reassess the child every 15-30 minutes. If hydration status is not improving, give the IV drip more rapidly.
  - o Also give ORS (about 5 ml/kg/h) as soon as the child can drink: usually after 3-4 h (infants) or 1-2 h (children).
  - o If IV treatment not possible, give ORS 20 ml/kg/h for 6 h (120 ml/kg) by nasogastric (NG) tube.
- Assess an infant after 3 h and a child after 6 h. Classify dehydration again. Then choose the appropriate plan (A, B, or C) to continue treatment.
- Give oral antibiotic for cholera, if child 2 years or older.
- If possible, observe the child for at least 6 h after rehydration to be sure that the mother can maintain hydration by giving the child ORS solution by mouth.

If child presents in Shock—push 20 ml/kg of Ringer's lactate or normal saline over 15 minutes and repeat twice more, if shock persists, use central venous pressure monitoring for further management if shock present after pushing 60 ml/kg. (For details see section on Shock in Chapter 2).

3. Tablet Zinc Sulphate (up to 6 months 10 mg; > 6 months 20 mg for 14 days

Specific therapy, if indicated

Frank blood and mucus in the stool or >10 pus cells/HPF

Syr. Nalidixic acid 55 mg/kg/day in 3 divided doses for 5 days

Or

Syr. Ciprofloxacin 15-20 mg/kg/day in 2 divided doses (*Shigella* strains are largely resistant to ampicillin and cotrimoxazole) for 5 days.

Indications for admission are: Children with severe malnutrition and dysentery and children who are toxic, lethargic, have abdominal distension and tenderness or convulsions.

Inj. Ceftriaxone 100 mg/kg IM/IV once daily for 5 days may be used.

Ensure a good diet as dysentery has a marked adverse effect on nutritional status.

Giardiasis (only if trophozoites are seen on stool microscopy)

Syr. Metronidazole 15 mg/kg/day in 3 divided doses for 5 days

Or

Syr. Tinidazole 50 mg/kg/day single dose (maximum 2 g) with food

Amoebic dysentery

Young children should not be routinely treated for amoebiasis, as it is an infrequent cause of bloody diarrhoea in children. Amoebiasis should be considered only if two

different antibiotics usually effective for *Shigella* have been given sequentially without showing signs of clinical improvement, or if a microscopic examination of fresh stool done in a reliable laboratory shows trophozoites of *E. histolytica* containing RBCs.

Amoebic dysentery should be treated with metronidazole or tinizadole as above for 5-10 days.

Cholera (suspect in any child with severe watery diarrhoea)

Mainstay of treatment is fluid therapy and following antibiotic may be used to prevent spread:

Syr. Doxycycline 5 mg/kg (max 200 mg) in single dose.

Or

Syr. Cotrimoxazole (TMP) 8 mg/kg/day in 2 divided doses for 5 days.

Or

Syr. Erythromycin 30 mg/kg/day for 3 days.

Parenteral infections to be treated by appropriate antibiotics. There is not much role of antiemetics in a child with vomiting. Rule out meningitis, URI and dyselectrolytaemia and give ORS in sips. If vomiting persists give intravenous fluids. However, occasionally 1 or 2 doses of Metoclopramide (0.5 mg/kg) or Domperidone (0.5 mg/kg) may be tried before giving intravenous fluids. ***Binding agents, e.g. Kaolin pectin, etc. are not useful.***

Following drugs are contraindicated

1. Antimotility agents, e.g. loperamide, diphenoxylate, etc.
2. Antisecretory agents, e.g. salicylates, etc.

   Not enough evidence on either safety and efficacy of Racedotril and Probiotics.

Monitoring

Keep record of vitals, e.g. pulse, BP, capillary filling time (CFT), respiratory rate (1 hourly) and temperature (6 hourly). Monitor for improvement or worsening of signs of dehydration. Record urine output and stool frequency and consistency.

Modifications or step up treatment

- Admit, if PEM grade III or age <3 months (as higher chances of complications, e.g. shock, hypoglycaemia, etc.), anxious mother, associated severe systemic infections, e.g. septicaemia, meningitis or pneumonia.
- Investigate for lactose intolerance, incipient infections, e.g. urinary tract infection (UTI) or rare gut organisms, if diarrhoea persists for >7 days.
- Exclude parenchymal renal failure, if child has not passed urine after hydration. Give a fluid challenge (20 ml/kg of normal saline) followed by frusemide injection (1-2 mg/kg). If urine is still not passed, then parenchymal renal failure considered and managed accordingly.

Patient/parent education

- Give information on natural course of diarrhoea to avoid dissatisfaction and that ORS is the mainstay of treatment as it prevents dehydration; purge rate and consistency usually improves by 3-7 days.
- Explain that most of the complications in diarrhoea are because of dehydration and thus ORS is the mainstay of therapy.
- Explain preparation of ORS and method of administration.
- In case of dysentery, diarrhoea takes 2-3 days to cease after disappearance of blood.
- Nutritional advice as mentioned earlier in nonpharmacological section.
- Education about food and water hygiene.

References

1. IAP Guidelines on Management of Acute Diarrhoea. 2006.
2. Major Symptoms and Signs of Digestive Tract Disorders. In: Nelson's Textbook of Paediatrics. Behrman RE, Kliegman RM, Jenson HB (eds), 19th Edition, WB Saunders Co, 2011; pp. 1240-1248.
3. Facility Based IMNCI (F-IMNCI) Participants Manual. WHO, UNICEF, and Ministry of Health & Family Welfare, Government of India, 2009.

ACUTE VIRAL HEPATITIS

Acute viral hepatitis is a systemic infection affecting liver and is caused by a number of viruses like Hepatitis A, B, C, D, E viruses, etc. Commonest causes for infective hepatitis among children are Hepatitis A and E. Both of these are spread by faeco-oral route. Hepatitis B and C are more common in children requiring blood product for certain chronic illnesses.

SALIENT FEATURES

- The illness may vary from asymptomatic infection, anicteric hepatitis to icterus, and even hepatic coma.
- Prodrome constituted by fever, malaise, nausea, emesis, anorexia and abdominal discomfort may precede the appearance of jaundice. It may go unnoticed or may be severe mimicking malaria or typhoid fever.
- LFTs may be done only if the course of disease is unusual or when obstructive jaundice is suspected.

Treatment

Nonpharmacological

- Rest if the patient feels exhausted or fatigued (forced rest does not help and does not shorten the time to recovery).

- Regular small frequent meals with high caloric content. High carbohydrate diets are acceptable but should be hygienic. Traditionally sugarcane juice is used as home therapy though it has no established benefit.
- Maintain adequate hydration in case of vomiting and avoid fatty meals.

Pharmacological

There is no specific treatment for simple acute viral hepatitis. Uncomplicated cases can be treated at home.

- If patient has frequent vomiting Syr./Tab. Metoclopramide 0.1 mg/kg/dose can be given as and when required but not to be repeated before 6 hours.
- Usually fever abates after jaundice appears. Occasionally, if the situation requires, paracetamol may be used sparingly (see section on Fever in Chapter 1).

Persistent high grade fever suggests alternative diagnosis. Hospitalization required only in clinically severe illness, e.g. alteration in sleep pattern, altered behaviour, abnormal movements, persistent vomiting, dehydration, decreased urinary output, bleeding from any site or any other complication.

Patient education

- Continue breastfeeding or other regular feeding.
- Observe carefully for any danger signs listed above.
- Usually a self-limiting disease and fever subsides after the jaundice is evident clinically. Most patients start recovering in 7-14 days time. Total duration of illness is 3 weeks.
- Hepatitis A and B are two different diseases. Getting your child vaccinated with hepatitis B vaccine will not protect you against Hepatitis A (see section on Immunization for details).
- Hepatitis A spreads through contaminated food and water and close person to person contact.
- Raw or insufficiently cooked food (fruits, vegetables, salads) or cooked food handled by an infected individual can be the source of hepatitis A infection.

References

1. Viral Hepatitis. In: Nelson's Textbook of Paediatrics. Behrman RE, Kliegman RM, Jenson HB (eds), 19th Edition, WB Saunders Co, 2011; pp. 1393-1404.
2. Acute Viral Hepatitis. In: Harrison's Principles of Internal Medicine. Fauci, Kasper, Braunwald, et al (eds), 18th Edition, McGraw Hill Company Inc: New York, 2012; pp. 2537-2866.
(See also Jaundice and Acute Viral Hepatitis in Adults in Chapter 1).

CHICKENPOX OR VARICELLA

Varicella is the primary infection caused by Varicella-zoster virus. It is highly infectious and is transmitted by droplet infection. The incubation period is about 14 days.

SALIENT FEATURES

- Begins as crops of small red papules over the trunk appearing within 1 day of fever and systemic symptoms which quickly develop into clear, often oval vesicles on an erythematous base. Contents become cloudy in about 24 hours and than scab. Many such crops may appear for 3-4 days.
- Bacterial superinfection, thrombocytopenia, arthritis, hepatitis, encephalitis or meningitis can complicate the disease.
- The disease is severe in adolescents and adults as well as immune compromised individual. Reactivation disease results in herpes zoster or shingles (for details see Skin section in Chapter 14).

Treatment

Nonpharmacological

- Itching is bothersome and scratching effect may be minimized by making the patient wear mittens, daily change of clothes and good personal hygiene may decrease the risk of secondary infection.

Pharmacological symptomatic therapy

1. For management of fever (see section on Fever), Aspirin and other salicylates are contraindicated due to risk of Reye's syndrome and should not be used.
2. Local anti-pruritic agents like Calamine lotion may alleviate itching. If itching is not relieved with above, Tab. Pheniramine 25 mg 2 times a day.

   In children: Syr. 0.5 mg/kg/day every 8 hours

   Or

   Tab. Cetirizine 10 mg once a day

   In children (2-6 years): 5 mg; (>6 years) 10 mg once a day.
3. In case of immuno-compromised children on long-term treatment with steroids, those on anti-cancer drugs or other immunosuppressive therapy, HIV positive patients, children older than 12 years of age, those with chronic cutaneous or pulmonary disorders who are at increased risk of severe disease, oral acyclovir if started within few hours (<24 h) of the onset of rash may decrease the duration, magnitude of fever as well as the number of skin lesions.

   Tab. Acyclovir 20 mg/kg/ day is given 6 hourly for 5 days.

   In case the patient is severely immuno-compromised, viral encephalitis or severe disease in adults, Inj. Acyclovir should be started as soon as possible in all cases at the dose of 10 mg/kg 8 hourly IV for 7 days.

   Acyclovir not recommended routinely for a healthy child.

Assessment of response to therapy

Most cases will stop having fever after the initial 3-4 days when new crops of vesicle stop appearing. The vesicles normally heal by scabbing in about a week's time. Persistence of fever may suggest secondary infection.

The disease can be complicated by: secondary bacterial infection of skin lesion, thrombocytopenia, pneumonia—particularly in adolescents and adults, Reye's syndrome, postinfectious encephalitis and if any of these develop, should be treated appropriately.

Patient/Parent education

- The disease commonly is self-limiting in healthy children. Child should be excluded from day care or school till after 6th day of the rash or till scabs are formed.
- Do not use over-the-counter fever medicines as they may contain aspirin or other salicylates.
- An expensive but potent vaccine is available for protection against the disease and can be recommended only for those at risk of severe form of the disease but is immunocompetent.
- Post-exposure prophylaxis with VZIG (specific immunoglobulins) is recommended for the contacts that are severely immunocompromised or pregnant (particularly in the first trimester).

References

1. Cutaneous Manifestations of Systemic Infections. In: Text Book of Paediatric Infectious Diseases. Feigin RD, Cherry JD (eds), 4th Edition, WB Saunders Co. Philadelphia, 1998; pp. 713-737.
2. American Academy of Paediatrics. In: Report of the Committee on Infectious Diseases, 25th Edition, Elk Grove Village, Illinois, US, 2000.
3. Varicella-Zoster Virus. In: Nelson's Textbook of Paediatrics. Behrman RE, Kliegman RM, Jenson HB (eds), 19th Edition, WB Saunders Co, 2011; pp. 1104-1110.
4. Viral Infections. In: Textbook of Dermatology. Champion RH et al (eds), 6th Edition, Blackwell Science Ltd., pp. 1015.
5. Varicella and Herpes Zoster. In: Dermatology in General Medicine. Fitzpatrick TB et al (eds), 5th Edition, the McGraw Hill Company Inc., New York, pp. 2427.

MEASLES

Measles is an acute viral disease of childhood, associated with high rates of morbidity and mortality. It directly or indirectly contributes to 7% of the under five deaths in the developing world.

SALIENT FEATURES

- Fever, cough, coryza, conjunctivitis, an erythematous maculopapular rash appearing on the 4th day of the illness, and a pathognomonic enanthem (Koplik spots) characterize it.

- Rash starts from behind the ears, along the hairline, involve the face and then the trunk and the limbs.
- Fever usually subsides after the appearance of the rash unless there is some complications such as otitis media, bronchopneumonia, laryngotracheobronchitis (croup), and diarrhoea. Acute encephalitis, which frequently results in permanent brain damage, occurs in approximately 1 in every 1000 cases.
- Another cause of persistence of fever could be flaring up of Koch's.

Treatment

Nonpharmacological

- The patient should be isolated from other susceptible individuals particularly unimmunized children for at least four days after the appearance of the rash.
- Bed rest is usually required and cold sponging may be required for febrile patients.
- Small frequent feeds and plenty of oral fluids should be continued.

Pharmacological

No specific antiviral treatment is available.

1. Fever is managed with oral Paracetamol (see the section on Fever in Chapter 1).
2. If there is persistent coryza or nasal itching which is disturbing the child, oral Syr. Promethazine 1 mg/kg/day in 3-4 divided doses can be used.

Treatment of other co-existing problems

1. Inj. Vitamin A 100,000 IU is given intramuscularly for 2 consecutive days or else high dose oil based preparations containing 50,000 units per ml may be given. A third dose may be given 4 weeks later particularly if there are manifesting signs of vitamin A deficiency.
2. Treat appropriately secondary bacterial infection like bronchopneumonia and/or gastrointestinal infection.

Patient/parent education

- The disease leads to marked anorexia and also often precipitates protein energy malnutrition (PEM) and other deficiencies. Regular frequent feeds must continue. Extra meal should be added to provide for increased requirement during convalescence.
- The disease usually lasts 10-12 days and the maximum risk of infectivity is 5 days prior to and 4 days after the appearance of rash. The rash usually heals by desquamation and often leaves some hyperpigmented stains on the body which disappears over weeks subsequently.
- The parents must report to the hospital in case the child develops any of the following warning signs:

  - Stiff neck, facial twitching or convulsions (seizures), extreme drowsiness, loss of consciousness or altered behaviour.
  - Rapid and or laboured breathing, difficulty in feeding, cyanosis.
  - Significant dehydration as evident by sunken eyes or fontanelles, loss of skin turgor, dryness of tongue or lack of tears, etc.
  - Blood in stools.
- Vaccination against measles is recommended at 7- 9 months of life and a subsequent booster with measles or MMR is mandated at 15 months of age, particularly, if the primary immunization was done at less than 9 months of age. There is no role of giving measles vaccination to a child who has already suffered from the disease.
- In case any other susceptible (unimmunized child below 5 year) has been in contact with the patient of measles then it may be worthwhile to immunize this individual. Measles vaccine is useful, if used early as it can prevent or decrease the severity of the disease in the secondary contacts (see section on Immunization for details).

References

1. Measles Virus. In: Text Book of Paediatric Infectious Diseases. Feigin and Cherry (eds.), 4th Edition, WB Saunders Co. Philadelphia, 1998; pp. 2054-2074.
2. American Academy of Paediatrics. In: Report of the Committee on Infectious Diseases, 25th Edition, Elk Grove Village, Illinois, US.
3. Measles. In: Nelson's Textbook of Paediatrics. Behrman RE, Kliegman RM, Jenson HB (eds), 19th Edition, WB Saunders Co, 2011; pp. 1069-1075.

MUMPS

Mumps is a disease caused by a virus that can infect many parts of the body, especially the parotid salivary glands.

SALIENT FEATURES

- The parotid glands become increasingly swollen and painful over a period of one to three days. There is often a fever of up to 103°F (39.4°C), with headache and loss of appetite.
- Mumps can also involve the brain, pancreas and other organs. The involvement of these organs signifies a severe disease and there is usually a recrudescence of high fever in such situations in addition to organ specific symptoms.
- Meningoencephalitis is the commonest complication (250/100 000 cases). Other complications are orchitis, epididymitis, oophoritis, pancreatitis, thyroiditis, myocarditis, deafness, optic neuritis and arthritis.

Treatment

Nonpharmacological

- Child should be encouraged to drink plenty of fluids. Water, decaffeinated soft drinks and tea are better tolerated than acidic fruit juices (like orange juice, grape fruit juice or lemonade) that make parotid pain worse.

- Either warm or cold packs, whichever feels better, may be used to sooth the swollen parotid glands.

Pharmacological

- Most cases are treated symptomatically on OPD basis.
- Fever when troublesome may be brought down using non-aspirin fever medications such as Paracetamol (10-15 mg/kg/day SOS or every 4-6 hours). These medicines will also help relieve pain in the swollen parotid glands.
  (**Caution:** Aspirin is contraindicated in children with viral illnesses due to risk of Reye's syndrome).
- Being a viral illness, antibiotics have no role. There is no specific therapy available.
- Patients with abdominal pain, testicular swellings or signs of raised intracranial tension need to be admitted in the hospital.

Patient/parent education

- Parents should be explained warning signs, e.g.
  - In boys, parents are told to watch for high fever, with pain and swelling of the testicles.
  - Watch for abdominal pain that can mean involvement of the pancreas in either sex, or involvement of the ovaries in girls.
  - Severe headache, stiff neck, convulsions (seizures), extreme drowsiness, etc. suggest CNS involvement and need for admission to a tertiary level centre.
  - Recurrence of high grade fever (above 101°F/38.3°C) often heralds onset of the above complication and can be used as an early referral sign.
- Children usually recover from mumps in about 10-12 days. First attack of mumps almost always gives lifelong protection against another, therefore, such children do not benefit from any immunization later.
- Mumps can be prevented by a vaccine which can be given alone, or as part of the mumps-measles-rubella (MMR) vaccine given at the age of 15 months. Mumps vaccine is effective in 75 to 95% of immunized persons (for details see section on Immunization).

References

1. Text Book of Paediatric Infectious Diseases, WB Saunders Co. Philadelphia.
2. American Academy of Paediatrics. In: Report of the Committee on Infectious Diseases, 25th Edition, Elk Grove Village, Illinois, US, 2000.
3. Mumps. In: Nelson's Textbook of Paediatrics. Behrman RE, Kliegman RM, Jenson HB (eds), 19th Edition, WB Saunders Co, 2011; pp. 1078-1081.

ACUTE FLACCID PARALYSIS (AFP)

A case of AFP is defined as any child aged <15 years, with acute onset of flaccid paralysis without any obvious cause (e.g. severe trauma or electrolyte imbalance like hypokalaemia). AFP is a notifiable disease and all cases must be reported immediately

to Nodal Officer and District Surveillance Officer, NPSP Unit, Directorate of Family Welfare. India has shifted to the virological system of case classification, i.e. within 90 days of paralysis onset, all cases should undergo final classification as confirmed polio, non-polio AFP or compatible with poliomyelitis. India has been declared polio free for last 2 years.

SALIENT FEATURES

- The paralysis is of acute onset (<4 weeks) and the affected limb(s) are flaccid (floppy or limp). If the AFP is due to polio, then sensation is never affected. Other important differentials to be considered in cases with AFP are detailed in Table 19.14. This includes possible illness due to Guillian-Barré syndrome, transverse myelitis, traumatic neuritis, viral infections caused by other enteroviruses, toxins and tumours. Isolated facial paralysis is not included.
- Pseudoparalysis due to pain in congenital syphilis, osteomyelitis, abscess, scurvy, unrecognized trauma leading to contusions, slipped epiphysis or fractures, etc. can also mimic AFP.

Table 19.14. Important differential diagnosis of AFP (adapted from Field Guide, MOHFW, GOI)

Signs and symptoms	Polio	GBS	Transverse myelitis	Traumatic or injection neuritis
Age	Most cases occur under 3 years of age	Usually above 2 years of age	Mostly above 4 years of age	No age limit
Progression of paralysis	24-48 h onset to full paralysis	Hours to days	Hours to 4 days	Hours to 4 days
Fever onset	High always present at onset of flaccid paralysis disappears the following day	Not common	Rare	Commonly present before, during and after paralysis
Flaccidity	Acute, asymmetrical, Proximal	Acute, symmetrical, Distal	Acute lower limbs symmetrical	Acute, asymmetrical Limb
Muscle tone	Diminished	Diminished	Diminished in lower limbs	Diminished in affected limb
Deep tendon reflexes	Decreased or absent	Absent	Absent in lower extremities, later hyper-reflexia	Decreased or absent
Sensation	Severe myalgia but no sensory deficit	Cramps, tingling hypoanaesthesia of palms and soles	Anaesthesia of the lower limbs with sensory loss	Pain in gluteal region

Contd....

Signs and symptoms	Polio	GBS	Transverse myelitis	Traumatic or injection neuritis
Cranial nerve	Only in bulbar or bulbospinal cases. Loss of gag reflex most common	Often present affecting VII, IX, X, XI, XII	Absent	Absent
Respiratory insufficiency	Only when bulbar and bulbospinal involving respiratory muscles	In severe cases	Sometimes	Absent
CSF WBCs proteins	High WBCs. Normal or slightly increased	<10 High	Normal Normal or slightly elevated	Normal Normal
Bladder dysfunction	Absent	Transient	Present	Never
Nerve conduction velocity in 3rd week	Abnormal, anterior horn cell disease	Abnormal, demyelination	Normal of abnormal has no diagnostic value	Abnormal in sciatic nerve
EMG 3rd week	Abnormal	Normal	Normal	Normal
Sequelae at 3 months and up to a year	Severe asymmetrical atrophy, skeletal deformities may develop later	Symmetrical atrophy of distal muscles, diplegia, atrophy after years	Flaccid	Moderate atrophy only in affected lower limb

An AFP case is "confirmed" as polio only by the isolation of wild poliovirus from any stool specimen.
An AFP case is classified as "non-polio AFP" if wild poliovirus is not isolated from adequate stool* specimens. If stool specimens are inadequate, final classification of the AFP case as either nonpolio AFP or compatible with polio will depend on the results of 60 days follow-up examination. If the 60 days follow-up examination shows no residual weakness, the case is classified as non-polio AFP. The final classification of the case as "compatible" or discarded as "non-polio AFP" is determined by the National Expert Review Committee (ERC) which meets every month in New Delhi to review all such cases.
* Adequate stool: Two specimens collected within 14 days of paralysis onset and at least 24 hours apart; each specimen must be of adequate volume (8-10 grams) and arrive at a WHO-accredited laboratory in good condition (i.e., no desiccation, no leakage, with adequate documentation and evidence that the cold chain was maintained.)

Treatment for acute POLIO like illness

All cases should be treated as below except patients with isolated single lower limb involvement and reporting after 4 days of onset of paralysis and currently not progressing for more than 48 hours.

Nonpharmacological

- Complete bed rest and correct positioning of the affected limbs in the optimal position as follows:

Hip—slight flexion, knee—5° flexion, foot—90° with support against the soles. Both legs should be supported from the lateral sides with pillows or rolled towels or salt/sand packs to prevent rotation. When pain subsides, passive movements of the joints for about 10 minutes, 2-3 times a day.

- Warm water fomentation using hot packs with soaked towels wrapped around the affected parts for about 10 minutes, 2-3 times a day help in relieving pain.
- If transient urinary retention occurs, alternate hot and cold compresses over the suprapubic region.
  (**Caution:** No massage or intramuscular injections as it may further precipitate paralysis. Watch for progression, particularly for the involvement of the respiratory muscles.)

Pharmacological

There is no specific drug therapy for polio. For fever and pain, use paracetamol or ibuprofen (see section on Fever in Chapter 1). Referral to a tertiary care centre with a ventilatory support facility, if there is progression of paralysis, respiratory distress, bulbar involvement, paralysis of upper limbs which is <3 days old (there is higher risk of diaphragmatic involvement in such cases), marked drowsiness or any other complication.

Patient/parent education

- No dietary restrictions, however, continue breastfeeding or other regular feeding.
- Paralysis progresses usually for about 4-7 days after onset. Recovery may start thereafter over days to weeks with little recovery of strength after 6 months of illness. A regular physiotherapy facilitates recovery of muscles.
  Note: Post-polio residual paralysis should be referred for rehabilitative services to an appropriate centre.

References

1. Surveillance of Acute Flaccid Paralysis. Field Guide, 3rd Edition, Child Health Division, Department of Family Welfare, Ministry of Health and Family Welfare, 2005.
2. Enteroviruses. In: Nelson's Textbook of Paediatrics. Behrman RE, Kliegman RM, Jenson HB (eds), 19th Edition, WB Saunders Co, 2011; pp 1088-1094.

PERTUSSIS (WHOOPING COUGH)

This results from *Bordetella pertussis* infection leads to this respiratory disorder which can have long-term poor effects on health.

SALIENT FEATURES

- Beginning as a mild upper respiratory tract infection (catarrhal stage), can progress to severe paroxysms of cough, often with a characteristic whoop, followed by vomiting.

- The child runs out of breath with bulging eyes, flushed face, lacrimation, salivation, protrusion of tongue and distension of the neck veins, etc. Such episodes are exhausting and precipitated by yawning, sneezing, eating or even suggestion.

Treatment

Pharmacological

1. Syr./Tab. Erythromycin, 40-50 mg/kg/day in 4 divided doses orally for 14 days initiated early in the coryzal phase of the disease, i.e. first 14 days of the illness may shorten the course of whooping cough, which otherwise may last for weeks or months. Later once the paroxysms start, no antimicrobial have any benefit except for eradication of any secondary pulmonary infection.
2. In patients with severe coughing paroxysms, salbutamol 1-2 mg/kg/day in 3-4 divided doses for a week or so may be tried.
3. Severe cases particularly those <6 months of age and those with respiratory distress need to be admitted for intravenous fluids and oxygen therapy.

Supportive therapy

- Oxygen therapy is required in severe cases with respiratory distress.
- Hydration should be maintained with intravenous or oral fluids in adequate amounts (cough suppressants are usually not helpful).

Patient/parent education

- Explain the need to continue feeding during the prolonged period of cough, adequate hydration and nutrition to prevent onset of malnutrition.
- Antibiotic therapy must be continued for at least 14 days to prevent relapse of the disease, even if they may not be providing any relief in the symptoms.
- All contacts below 7 years of age must be given erythromycin for 14 days.
- Contact the doctor immediately, if the patient develops listlessness, apnoea or seizures. This is particularly more common in infants below 6 months.
- Immunization against pertussis is available in our country as triple antigen (DPT) and 3 primary doses are routinely advised for all infants followed by a booster after 1.5 years and 4.5 years after the primary immunization. The primary immunization is expected to reduce the disease burden by two-thirds.

References

1. American Academy of Paediatrics. In: Report of the Committee on Infectious Diseases, 25th Edition, Elk Grove Village, Illinois, US.
2. Pertussis (Bordetella pertussis and B. parapertussis). In: Nelson's Textbook of Paediatrics. Behrman RE, Kliegman RM, Jenson HB (eds), 19th Edition, WB Saunders Co, 2011; pp. 944-948.

CARDIAC FAILURE

Cardiac failure is defined as a state in which the heart cannot deliver an adequate cardiac output to meet the metabolic needs of the body. Clinical presentation is dependent on age and degree of cardiac reserve. Common causes according to age of presentation are:

- Neonate—severe anaemia, heart block, congenital heart disease, e.g. hypoplastic left heart, coarctation, left to right shunt and large mixing cardiac defects.
- Infant—left to right shunt, supraventricular tachycardia.
- Children—rheumatic fever, myocarditis, cardiomyopathy, acute hypertension e.g., acute glomerulonephritis.

SALIENT FEATURES

- Exertional dyspnoea, poor weight gain, feeding difficulties, breathes too fast and better when upright, persistent cough and wheezing, excessive perspiration and irritability, puffiness of face and pedal oedema.
- Tachypnoea, tachycardia, small volume pulse, peripheral cyanosis, pedal/facial/sacral oedema, hepatomegaly, raised JVP (appreciated well in older children), gallop rhythm, cardiomegaly and failure to thrive.

Treatment

Identify and treat the underlying cause.

Nonpharmacological

Restricted activity and bed rest with upright posture depending on cardiac reserve.

In severe CHF, dietary modifications in infants by increasing calories per feed. Breastfeed supplementation, nasogastric feed to avoid the exertion of active feeding.

No added salt in diet and fluid restriction. Monitor weight and fluid balance (input/output) charting.

Cold sponging in case of fever.

Pharmacological

Treat anaemia with iron and/or packed cells as and when indicated. Algorithm for treatment is shown in Fig. 19.3.

1. Elixir/Tab. Digoxin (Elixir 0.25 mg/5 ml, Tab. 0.25 mg)
   Method of digitalization. 0.5 × digitalization dose initially, 0.25 × digitalizing dose 8 and 16 hours later.
   Digitalizing dose. Newborn = IV, IM: 0.010-0.030 mg/kg divided or orally: 0.040 mg/kg divided in fractions.
   Infants = IV, IM 0.030-0.040 mg/kg or orally 0.050 mg/kg in fractions.
   Children = IV, IM, PO: 0.010-0.015 mg/kg in fractions.

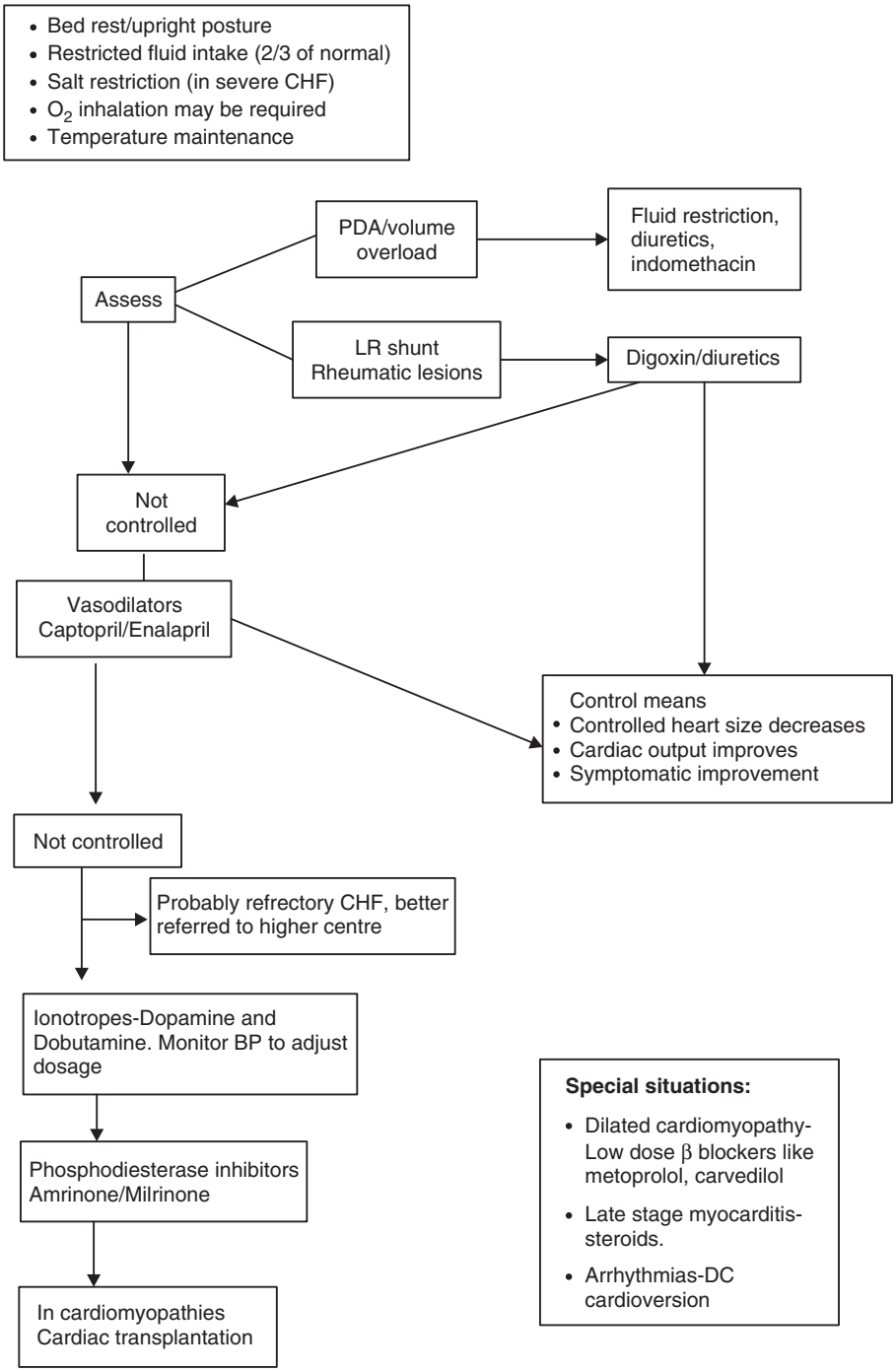


Fig. 19.3. Algorithm for treatment of congestive heart failure.

For maintenance. Begin maintenance dosage 24 hours after 1st fraction of digitalizing dose. Newborn = PO: 0.005-0.010 mg/kg/24 hours, divided every 12 hours. In infants and children, orally 0.002-0.005 mg/kg/24 hours divided every 12 hours.

(**Caution:** Avoid hypokalaemia during therapy with digoxin)

2. Tab. Frusemide 0.5-2 mg/kg every 12 hourly (may need K supplement).
   Or
   Tab. Chlorothiazide 20-50 mg/kg/day in 2 divided doses.
   Or
   Tab. Spironolactone 1-3 mg/kg/day in 2 divided doses.
3. In cases with regurgitant cardiac lesions like severe MR where reduction in after load is required
   Tab. Captopril 0.25 test dose build up doses from 1.5 mg/kg/day to 3 mg mg/kg/day in 3 divided doses.
   Or
   Tab. Enalapril 0.08-0.5 mg/kg/dose 12-24 hourly (maximum 1 mg/kg/day).
4. Patients with hypotension and low cardiac output should be referred to a higher centre) for
   Inj. Dopamine infusion (40 mg/ml) 2-20 mcg/kg/min prepared in normal saline or 5% dextrose. Hypovolaemia should be corrected before infusion is started and BP is monitored during the infusion.
   Or
   Inj. Dobutamine infusion (250 mg/5 ml) 2-20 mcg/kg/min. Both the drugs can be used simultaneously to have added response because of different mechanism of actions.
   Or
   Inj. Milrenone 0.5 mcg/kg/min infusion.

Refer for surgery in case of severe mitral regurgitation due to chordal rupture leading to refractory CHF.

Patient/parent education

- Decreased salt intake should be emphasized.
- Sufficient rest and adequate sleep must be emphasized. Strict bed rest is necessary only in severe cases.
- Semi-upright position during sleep may make the patient more comfortable.

References

1. Heart Failure. In: Nelson's Textbook of Paediatrics. Behrman RE, Kliegman RM, Jenson HB (eds), 19th Edition, WB Saunders Co, 2011; pp 1638.
2. Consensus Guidelines on Pediatric Acute Rheumatic Fever and Rheumatic Heart Disease. Working Group on Pediatric Acute Rheumatic Fever and Cardiology Chapter of Indian Academy of Pediatrics. Indian pediatrics 2008; 45: 565-573.

(See also Congestive Heart Failure in Chapter 3).

DIABETES MELLITUS (DM)

Most of the cases of DM in children are of insulin dependent diabetes mellitus (Type 1) and have hyperglycaemia with glucosuria.

SALIENT FEATURES

- While some cases present with classical symptoms of polyphagia, polydipsia, polyuria and weight loss, many children at the onset present in the state of diabetic ketoacidosis (DKA).
- A minority of cases, while asymptomatic are detected to have glucosuria and hyperglycaemia.
- Diagnosis of DM is made by demonstration of hyperglycaemia (random plasma glucose more than 200 mg/dl). Table 19.15 shows the cut off levels of plasma glucose used for diagnosis of DM, while doing oral glucose tolerance test (GTT)—after glucose dose of 1.75 g/kg of ideal body weight (maximum 75 g).
- Patients during DKA have moderate to severe dehydration with plasma glucose levels usually more than 300 mg/dl, metabolic acidosis, ketonuria and various electrolyte disturbances.

Table 19.15. Diagnostic criteria for impaired glucose tolerance and diabetes mellitus

Impaired glucose tolerance (IGT)	Diabetes mellitus (DM)
Fasting glucose 110-125 mg/dl	*Symptoms of DM plus random plasma glucose ≥200 mg/dl
2 h plasma glucose during the	Or
OGTT <200 mg/dl but ≤ 140 mg/dl	Fasting plasma glucose ≥126 mg/dl
	Or
	2 h plasma glucose during the OGTT[#]
	≥200 mg/dl

* Symptoms include polyuria, polydipsia and unexplained weight loss with glycosuria and ketonuria

[#] OGTT—Oral glucose tolerance test

Treatment

Nonpharmacological

Diet. Regularity of eating pattern is very important so that diet and insulin dosing is synchronized.

- General nutritional guidelines are followed.
- Calorie mixture should have 55% carbohydrates, 30% fat and 15% proteins.
- Avoid carbohydrate with refined sugars to prevent metabolic swings. Carbonated drinks should be of sugar free variety.

- Fats derived from animal sources to be reduced and should be replaced by fats of vegetable origin.
- Calorie intake should be split as 20% breakfast, 20% lunch, 30% dinner and 10% each for 3 snacks at mid morning, mid afternoon and evening.

Physical activity and fitness. Usual exercises advised to diabetic children and adolescents include vigorous walking, jogging, swimming, tennis, etc. Though, diabetics can undertake any exercise, but unusual exercise may require modification in insulin dosing. For the schedule day of unusual exercise, insulin dose may be reduced by 10-15%.

Pharmacological

Initial therapy. Treatment is initiated in the hospital with fast acting (regular) insulin.

At the onset of DM (or after recovery from DKA), the dose of insulin is 0.5-1.0 unit/kg/day.

Inj. Regular insulin 0.1-0.25 units/kg subcutaneous injections are given 6-8 hourly before meals.

Simultaneous blood glucose level monitoring is done. One to two days therapy is required to find out total daily insulin requirement. Once the patient stabilizes on 6 hourly insulin injections, the patient is switched over to "2 daily injections" schedule.

In "2 daily injections" schedule, the insulin is administered as follows:

- Combinations of intermediate acting (usually lente) insulin and fast acting (regular) insulin in the ratio of 2-3:1. Two-thirds of total daily-dose is injected before breakfast and one-third before dinner. Each injection has combination of both types of insulin, e.g. total dose of insulin is 30 units—20 units (14 units lente and 6 units regular) are injected before breakfast and 10 units (6 units lente and 4 units regular) are injected before dinner.
- Blood glucose levels are monitored before each meal and the dose of insulin adjusted accordingly. Blood glucose levels should ideally be 80 mg/dl fasting and 140 mg/dl after meals (acceptable range between 80-240 mg/dl). Early morning 3 AM blood glucose level should be more than 70 mg/dl.

Modification in the insulin doses

Modification in the insulin doses will be required depending upon the blood glucose levels (Table 19.16).

- Any increase or decrease in insulin dose is by 10-15%. Generally not more than 6 units.
- After initial stabilization, newly diagnosed cases may have gradual decline in insulin requirement even up to 0.5 units/kg/day. This may persist for several weeks to several months.
- Decrease total dose of insulin by 10% at the time of discharge from hospital as the increased activity at home will decrease the insulin requirement.

Table 19.16. Modification in insulin doses

Time and blood glucose	Type and time of insulin modified
1. High fasting blood glucose	Evening lente insulin is increased by 10%
2. High noon blood glucose	Morning regular insulin is increased by 10%
3. High pre-dinner blood glucose	Morning lente insulin is increased by 10%
4. High pre-bedtime blood glucose	Evening regular insulin is increased by 10%
5. Low fasting blood glucose	Evening lente insulin is decreased by 10%
6. Low noon blood glucose	Morning regular insulin is decreased by 10%
7. Low pre-dinner blood glucose	Morning lente insulin is decreased by 10%
8. Low pre-bedtime blood glucose	Evening regular insulin is decreased by 10%

Assessment of diabetic control or response to therapy

- Blood glucose estimation should be done before each meal and at bedtime in the first few weeks after diagnosis. After stabilization, it can be reduced to twice a week.
- Periodically blood glucose estimation at 3-4 AM is required to detect early morning hypoglycaemia.
- Urine for sugar is also monitored initially 3-4 times daily before meals. This can be done less frequently after initial few weeks, preferably on the days when blood sugar is not done.
- Urine for ketones once daily should be done.
- Glycosylated haemoglobin (HbA_{1C}) estimation-once every 3 months. - HbA_{1C} goals are: 0-6 years < 8.5% (but > 7.5%); 6-12 years < 8%; 13-19 years < 7.5%.
- Serum lipids-cholesterol, HDL, LDL, VLDL, triglycerides and urine for protein should be done once every year. Serum cholesterol should be less than 200 mg/dl, LDL less than 130 mg/dl and triglycerides less than 140 mg/dl.
- Thyroid function tests should be done once every year to detect concomitant hypothyroidism.

(For management of hypoglycaemia and diabetic ketoacidosis see also Chapter 11 on Hormonal Disorders).

Patient/parent education

Patient/parents should be taught self-diabetic care which should include:

- Technique of measuring insulin in the syringe.
- Importance of drawing insulin always in the same sequence (usually regular insulin first) so that same type of insulin is left over in the dead space of the syringe.
- Explain technique of subcutaneous injections and importance of rotating the injection sites—arms, thighs (upper and lower), buttocks and abdomen.
- Monitoring urinary sugar—by the double void method (void 30 minutes before the test void).

- Blood sugar monitoring, maintaining the records of treatment and sugar levels.
- Adherence to diet.
- Regular exercise.
- Recognizing the symptoms of hypoglycaemia and its home management.
  (See also Diabetes Mellitus in Chapter 11).

References

1. Diabetes Mellitus. In: Nelson's Textbook of Paediatrics. Behrman RE, Kliegman RM, Jenson HB (eds), 19th Edition, WB Saunders Co, 2011; pp 1968-1977.
2. International Guidelines for Paediatric and Adolescent Diabetes (ISPAD) Consensus Guidelines, 2000.
3. Standards of Medical Care in Diabetes 2006. American Diabetes Association: Clinical Practice Recommendations. Diabetes Care 2006; 29: Suppl 1:54-42

HYPOTHYROIDISM

Hypothyroidism is characterized by decrease in the function of the thyroid glands. Most cases in children are due to congenital hypothyroidism causes such as aplasia, hypoplasia or ectopia of thyroid gland. Common causes of acquired hypothyroidism are iodine deficiency, lymphocytic thyroiditis and following irradiation of cervical region for malignant disorders. Diagnostic studies and treatment are same as that for congenital hypothyroidism.

SALIENT FEATURES

- Congenital hypothyroidism is difficult to diagnose in neonatal period as the symptoms and signs may not be fully developed. However, prolongation of physiological jaundice and feeding difficulty in the form of sluggishness and choking during feeding occur. Infants cry less, sleep more and have constipation, abdominal protuberance and umbilical hernia. Infants with these features should be screened by thyroid function tests to avoid delay in diagnosis. Gradually, the features of physical and mental retardation become more obvious which can be severe.
- The diagnosis is based on demonstration of low serum T4. Serum T3 levels may be normal and are not useful for diagnosis. In primary hypothyroidism, TSH is elevated. Radionuclide scans are not essential for diagnosis but help to delineate the exact aetiology.

Treatment

Pharmacological

Initiation of therapy. L-thyroxine (Tab. 50 and 100 mcg).

Initial dose in neonatal period is 10-15 mcg/kg/day (usually 37.5-50 mcg per day), given as a single daily dose half an hour before food. The tablet can be crushed and mixed in expressed breast milk or any other liquid for small infants.

Treatment is required life long and the requirement keeps changing with increasing age. In later part of infancy, dose decreases to 5-6 mcg/kg/day then to 3-4 mcg/kg/day in children and the adult dose is 2 mcg/kg/day.

Assessment of response. Early response is evident in initial few weeks and consists of symptomatic improvement in alertness, relief of constipation, improvement in appetite and feeding. Increased linear growth and osseous maturation is seen over next few months.

- The child should be followed clinically every month for 6 months, 3 monthly till 2 years and thereafter once to twice every year. Recurrence of symptoms such as lethargy, constipation and weight gain suggest under treatment and diarrhoea, palpitations, increased appetite and weight loss suggest overdosing.
- Periodic check on thyroid function tests is needed (6 monthly or so). Serum T4 level should be maintained in upper normal range and TSH levels suppressed to normal.
- After a few months of starting therapy, sometimes features suggestive of raised intracranial tension such as headache and vomiting may appear. The patient should be immediately admitted and treated.

Patient/parent education

1. Patient should be told about the need for life long administration of the drug.
2. Regular follow-up at the interval described above is important for proper monitoring and dose titration.
3. Clinical symptoms of under or overdosage, including the danger signs of pseudotumour cerebri should be explained.
   (See also Hypothyroidism in Chapter 11).

Reference

1. Hypothyroidism. In: Nelson's Textbook of Paediatrics. Behrman RE, Kliegman RM, Jenson HB (eds), 19th Edition, WB Saunders Co, 2011; pp 1895-1903.

URINARY TRACT INFECTION (UTI)

Urinary tract infection (UTI) is a common bacterial infection in infants and children. One per cent boys and 3-5% girls below 14 years develop UTI. Risk of UTI is higher in children with congenital urinary tract anomalies, chronic diarrhoea and malnutrition.

SALIENT FEATURES

- Symptoms are nonspecific. In neonates, it presents as a part of septicaemia, in infants and young children with fever, diarrhoea, vomiting, pain and poor weight gain.
- Older children may have burning, urgency, frequency, flank pain, turbid urine and recent onset enuresis. Diagnosis is confirmed by growth of significant number of organisms of a single species in the urine (Table 19.17).

Table 19.17. Interpretation of urine culture

Method of collection	Colony count	Probability of infection
Suprapubic aspiration	Urinary pathogen in any number	99%
Urethral catheterization	$>50 \times 10^3$ CFU/ml	95%
Midstream clean catch	$>10^5$ CFU/ml	90-95%

CFU: colony forming units.

Definitions

Significant bacteriuria: Colony count of $>10^5$/ml of a single species in a midstream clean catch sample.

Asymptomatic bacteriuria: Presence of significant bacteriuria on two or more specimens in a child with no symptoms.

Recurrent UTI: Second attack of UTI.

Complicated UTI: Presence of fever >38.5°C, toxicity, persistent vomiting, dehydration and renal angle tenderness.

Simple UTI: UTI with low grade fever, dysuria, frequency, urgency but none of the above symptoms.

Treatment

Nonpharmacological

Maintain adequate hydration and encourage liberal fluid intake to alleviate dysuria (**Note**: Alkalinization of urine is not necessary).

Pharmacological

Therapy should be started after obtaining urine culture. Patient's age, degree of toxicity, state of hydration, ability to retain oral intake and the likelihood of compliance with medication help in deciding therapy.

Complicated UTI and/or age less than 3 months

1. Inj. Ampicillin 100 mg/kg/day IV in 3 divided doses for 10 to 14 days.
2. Inj. Gentamicin 5-6 mg/kg/day in 2 divided doses for 10 to 14 days.
   Or
   Inj. Cefotaxime 100-150 mg/kg/day IV in 3 divided doses for 10 to 14 days.
   Or
   Inj. Ceftriaxone 75-100 mg/kg/day IV in 1-2 divided doses for 10 to 14 days.

If age more than 3 months only Inj. Gentamicin can be given.

Uncomplicated UTI and age >3 months

Syr. Amoxycillin 30-50 mg/kg/day in 3 divided doses for 7 to 10 days.

Or

Syr. Cotrimoxazole (Trimethoprim) 6-10 mg/kg/day in 2 divided doses for 7-10 days.

Or

Syr. Cephalexin 50-70 mg/kg/day in 3 divided doses for 7-10 days.

(**Caution**: Quinolones should be avoided as firstline medication; their use should be guided by results of culture and sensitivity test)

Nalidixic acid or Nitrofurantoin should NOT be used to treat UTI in young infants since they do not achieve therapeutic concentration in renal parenchyma and bloodstream.

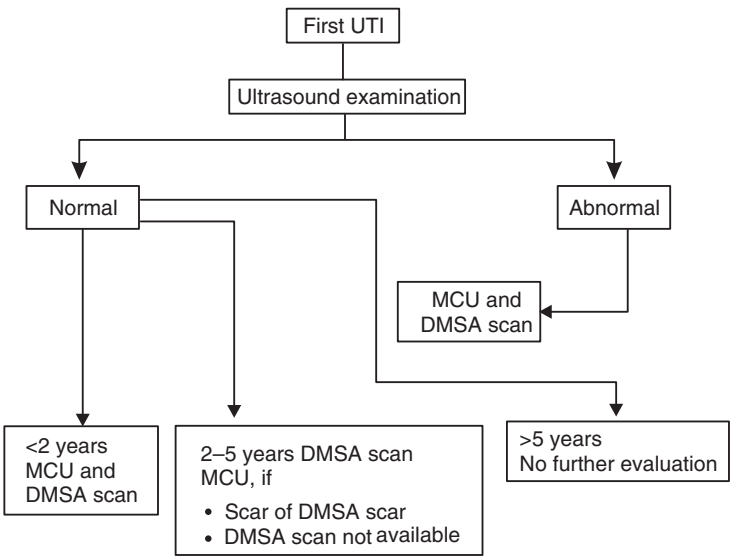
Monitoring

An abdominal ultrasound examination and repeat urine culture are necessary in patients who fail to show clinical response (reduction of fever and toxicity) within 48 hours of initial treatment.

Workup of a case of first UTI is shown in Fig. 19.4. Child with more than one episode should be worked-up for cause of recurrent UTI. Each episode is treated as mentioned above but child should be investigated in detail with ultrasound, MCU and DMSA scan and prophylaxis for recurrence as in Tables 19.18 and 19.19.

Table 19.18. Antimicrobials for prophylaxis of UTI

Drug	Dose (mg/kg/day)	Remarks
Cotrimoxazole	1-2 (trimethoprim)	Avoid in infants <3 months age and G-6PD deficiency
Nitrofurantoin	1-2	Gastrointestinal upset; avoid in infants <3 months age, G-6 PD deficiency and renal insufficiency
Cephalexin	10	Drug of choice in first 3-6 months of life



MCU - Micturating cystourethrogram
DMSA - Dimercaptosuccinic acid radionuclide scan.

Fig. 19.4. Workup of cases of first UTI.

Table 19.19. Indications and duration for antimicrobial prophylaxis

Findings	Age	Duration
First UTI		
Reflux and renal scar present	All	Till 5 years of age*
No reflux but renal scar	All	Six months and re-evaluate**
No reflux, no renal scar	< 2 years	Six months and re-evaluate**
	> 2 years	No prophylaxis
Recurrent UTI	All	Six months
(without reflux or scar)		

* Child >5 years of age at initial evaluation prophylaxis for 12-18 months, re-evaluate

**DRCG/MCU to look for vesicoureteric reflux (VUR), which might have been missed on initial evaluation. Prophylaxis is stopped, if VUR is not detected.

Antibiotic prophylaxis in recurrent UTI

Long-term, low-dose antibacterial prophylaxis is used to prevent recurrent febrile UTI.

Note: Grade IV (bilateral) and Grade V—prophylaxis given up to 1 year, then surgery is indicated.

Reference

1. Consensus Statement on Management of Urinary Tract Infections. Indian Paediatric Nephrology Group, Indian Academy of Paediatircs. Indian Paediatrics 2001; 38: 1106-1115.
(See also Urinary Tract Infection in Chapter 10).

ACUTE GLOMERULONEPHRITIS (POST-STREPTOCOCCAL)

It follows streptococcal infection of throat or skin by 1-2 weeks. Complications like congestive heart failure or encephalopathy may occur in a few patients. Diagnosis is clinical with urine showing RBCs, WBCs and mild proteinuria. Serum C3 levels are low. Serum ASLO titres are elevated in most patients of post-streptococcal glomerulonephritis (PSGN) (up to 90%). Disease is self-limiting and generally resolves in one month; however, microscopic urinary changes may persist up to one year.

SALIENT FEATURES

- Sudden onset of gross haematuria, proteinuria, oedema, hypertension, oliguria and other features of renal insufficiency.

Treatment

Child should be admitted for monitoring and treatment, if complications occur.

Nonpharmacological

- Routine activity need not be restricted unless features of acute renal failure or severe hypertension occur.
- Diet is restricted like in acute renal failure.

Pharmacological

There is no specific treatment.

Treatment of hypertension:

- Inj. Frusemide (40 mg) 1-2 mg/kg/day in 2 divided doses till oliguria lasts.
- Cap. Nifedipine 0.25 mg/kg SOS.
- Inj. Procaine penicillin 4 lac units once daily, if evidence of sore throat or skin infection.

Monitoring and follow-up with:

- Regular weight record, strict intake-output chart, blood pressure recording should be done regularly.
- Refer to a higher centre, if hypertension, haematuria or renal failure is not manageable.

Patient/parent education

- Parents should be explained the natural course. More than 95% recover within 2-4 weeks. Only a few patients may end up with chronic renal insufficiency.

Reference

1. Glomerulonephritis associated with Infection. In: Nelson's Textbook of Paediatrics. Behrman RE, Kliegman RM, Jenson HB (eds), 19th Edition, WB Saunders Co, 2011; pp. 1703-1786.

NEPHROTIC SYNDROME (NS)

Nephrotic syndrome is an important chronic disorder in children. It can be primary (idiopathic) or secondary (SLE, Henoch-Schonlein purpura, amyloidosis, etc). About 90% children with idiopathic nephrotic syndrome have 'minimal lesion' on renal histology and respond promptly to corticosteroids, and are classified as 'steroid sensitive'. Approximately three-fourth patients have one or more relapses. Steroid toxicity and frequent serious infection complicate such cases.

SALIENT FEATURES

- Heavy proteinuria, hypoalbuminaemia (S. albumin <2.5 g/dl), hyperlipidaemia (S. cholesterol >200 mg/dl) and oedema. Dipstick or heat coagulation of urine shows 3+/4+ proteinuria. Spot protein/creatinine ratio > 2 mg/mg or urine albumin excretion > 40 mg/m^2/h (on a timed sample). 24 h urine protein measurement is seldom necessary. Estimation of blood levels of antistreptolysin O and C3 in patients with gross or persistent microscopic haematuria.

- Investigations which help in diagnosis and management are urine analysis, blood counts, S. cholesterol, S. proteins, blood urea, S. creatinine, urine culture, X-ray chest, Mantoux, HBsAg.

Treatment

Treatment of steroid sensitive nephrotic syndrome without hypertension, haematuria and azotaemia is shown in Figure 19.5.

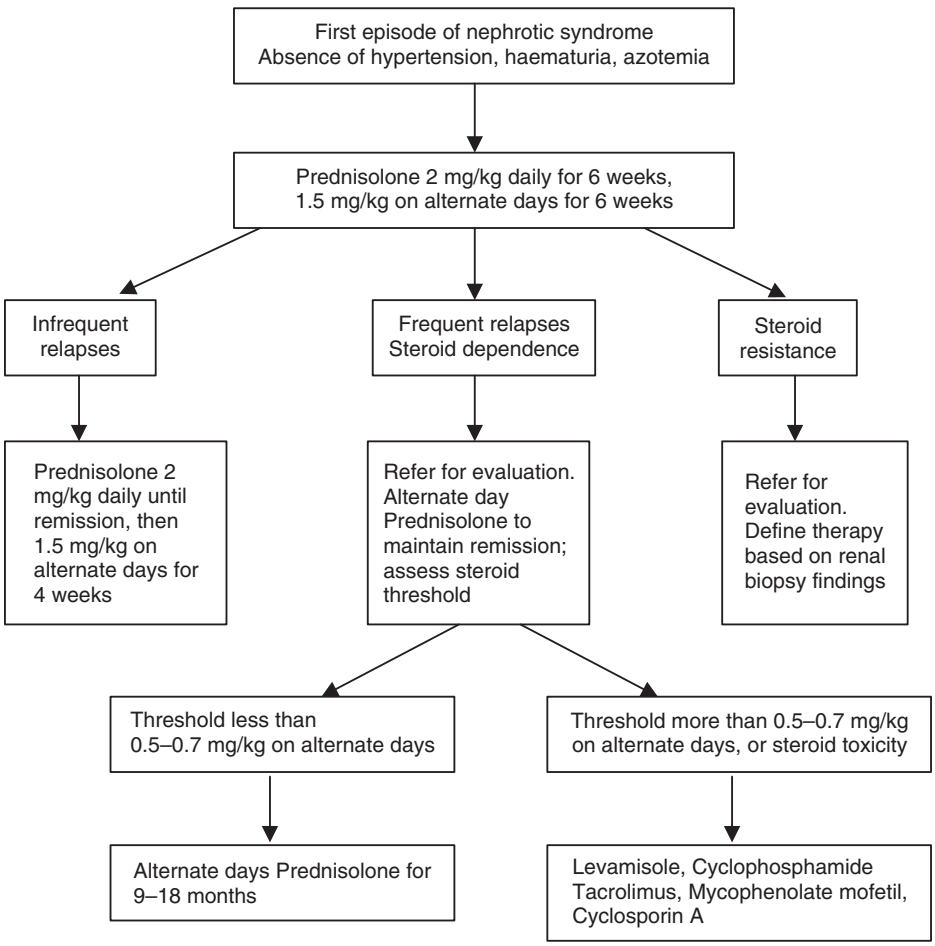


Fig. 19.5. Treatment of steroid sensitive nephrotic syndrome without hypertension, haematuria and azotaemia.

Definitions useful for guiding treatment are as follows:
Remission: Urine albumin nil or trace (or proteinuria <4 mg/m^2/h) for 3 consecutive early morning specimens.

Relapse: Urine albumin 3+ or 4+ (or proteinuria >40 mg/m^2/h) for 3 consecutive early morning specimen having been in remission previously.
Frequent relapses: Two or more relapses in initial 6 months, or more than three relapses in any 12 months.
Steroid dependence: Two consecutive relapses when on alternate day steroids or within 14 days of its discontinuation.
Steroid resistance: Absence of remission despite therapy with 4 weeks of daily prednisolone in a dose of 2 mg/kg per day.

Nonpharmacological

- Avoid saturated fats; not more than 30% calories should be derived from fats.
- Adequate proteins (1.5-2 g/kg), and salt restriction (1-2 g/day) only during oedema, avoid extra salt.
- Good physical activity.

Pharmacological

Investigations to rule out infection, if symptomatic should be done before starting treatment with steroids, i.e. urine culture and sensitivity, Mantoux, X-ray chest, Hb, HBsAg.

Treatment of oedema

Management of oedema in patients with nephrotic syndrome is given in Fig. 19.6. Patients requiring high-dose frusemide or addition of other diuretics should be under close supervision, preferably in a hospital. Monitoring of serum electrolytes is necessary in all patients receiving diuretics. Patients showing hypokalaemia require potassium supplement or co-administration of spironolactone. The medications are stepwise once diuresis ensues.

Monitoring

1. Urine output, weight record
2. Blood pressure
3. Urine albumin daily till remission

Infection in nephrotic syndrome

1. Patients of nephrotic syndrome with positive Mantoux test but no evidence of disease should be put on INH prophylaxis for 6 months.
2. Absence of florid symptoms and signs may delay the diagnosis of serious infections like peritonitis and cellulitis in nephrotics. Systemic antibiotics should be used aggressively, if infection is suspected.

A biopsy is required to identify the underlying renal disease in certain cases (Table 19.20).

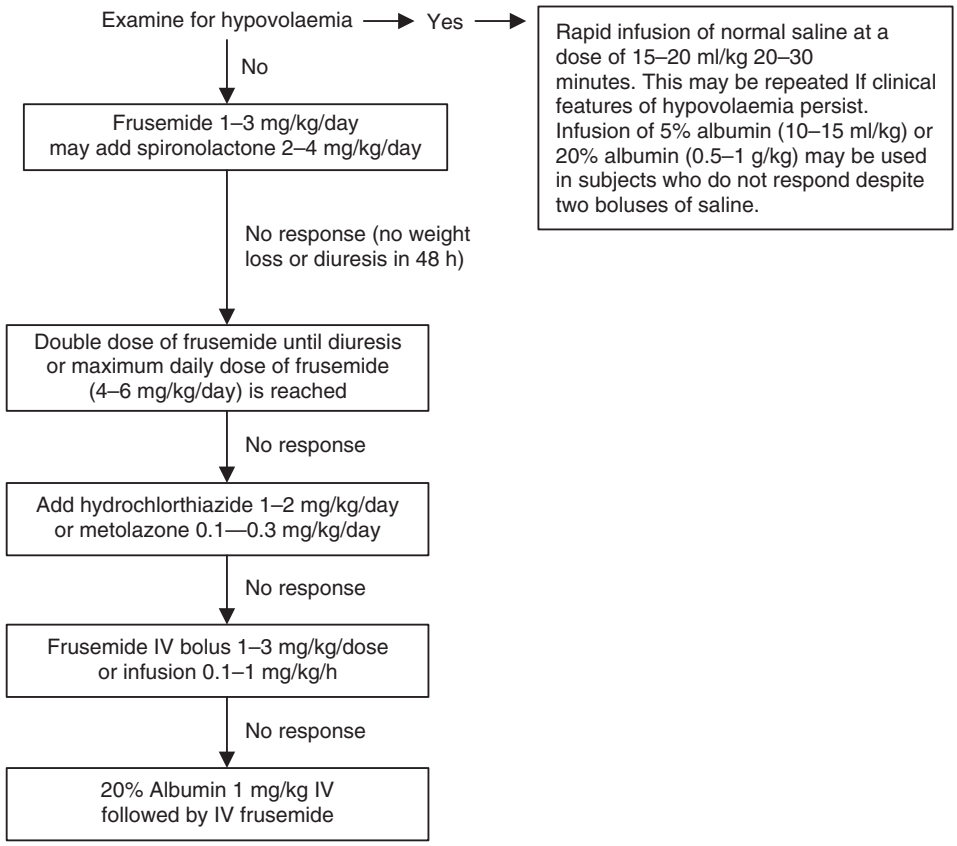


Fig. 19.6. Management of oedema in patients with nephrotic syndrome.

Table 19.20. Indications for kidney biopsy (to be carried out at tertiary care level)

At onset
<1 year, persistent microscopic/gross haematuria or low serum C3; sustained hypertension; renal failure not attributable to hypovolaemia; or suspected secondary causes of nephrotic syndrome.
After initial treatment
Proteinuria persisting despite 4 weeks of daily corticosteroid therapy.
Before starting treatment with cyclosporine-A.
Frequently relapsing or steroid dependent nephrotic syndrome.

Indications for referral to a higher centre (paediatric nephrologist)

- Onset <1 year of age; family history of nephrotic syndrome.
- Nephrotic syndrome presenting with hypertension, persistent microscopic or gross haematuria, or impaired renal function or extra-renal features (e.g. arthritis, serositis, rash).
- Complications like refractory oedema, thrombosis, severe infections and steroid toxicity.

- Resistance to steroids—initial or late.
- Frequently relapsing or steroid dependent nephrotic syndrome.

Patient/parent education

- Reassurance that despite a relapsing course, progression to end stage renal disease is rare.
- Urine examination for proteins at home by sulfosalicylic acid (SSA), dipstick or boiling should be taught; urine examination for protein should be done every morning during a relapse, during intercurrent infections or if there is even mild periorbital puffiness; frequency of urine examination reduced to once or twice a week during remission.
- Maintain a diary showing proteinuria and medication received.
- Ensure normal activity and school attendance.
- Protection against infection.
- Emphasis on need for immunization with Hepatitis B, varicella, pneumococcal vaccine in addition to routine immunization.
- Routine use of antacids or ranitidine is not necessary unless there are symptoms of upper gastrointestinal discomfort.
- Long-term calcium supplementation is necessary, if the patient receives > 3 months of prednisolone.
- Patients with steroid sensitive nephrotic syndrome do not usually require medication for hyperlipidaemia.

Reference

1. Management of steroid sensitive: Nephrotic Syndrome. Revised guidelines. Indian Paediatric Nephrology Group, Indian Academy of Paediatrics, Indian Paediatrics, 2008, 45: 203-214. (See also Nephrotic Syndrome in Chapter 10).

NEONATAL SEIZURES

Neonatal seizures are often acute symptomatic due to underlying brain insults. Focal clonic, multifocal clonic, and focal tonic seizures are usually accompanied by ictal EEG activity while subtle, generalized tonic and myoclonic episodes may be non-epileptic as they are not associated with electrographic ictal activity. True seizures are often accompanied by open eyes. Differentiate between non-epileptic phenomena like jitteriness and benign sleep myoclonus.

Serum glucose, electrolytes, calcium and magesium must be done in all. CSF studies and culture must be done in all except when the diagnosis is definite, e.g. hypoxic ischaemic encephalopathy. A portable 60 minute EEG by a trained technician and interpreter is useful in recognizing subclinical seizures, epileptic encephalopathies and prognosis. A cranial ultrasound is the minimum imaging required, but an in-house MRI with diffusion tensor imaging is the modality of choice, done immediately for aetiology and at 3-6 months for prognosis.

Treatment

Management should be done as per Fig.19.7. Continue oral phenobarbitone till discharge or up to 3 months (especially in those with an abnormal neurologic examination).

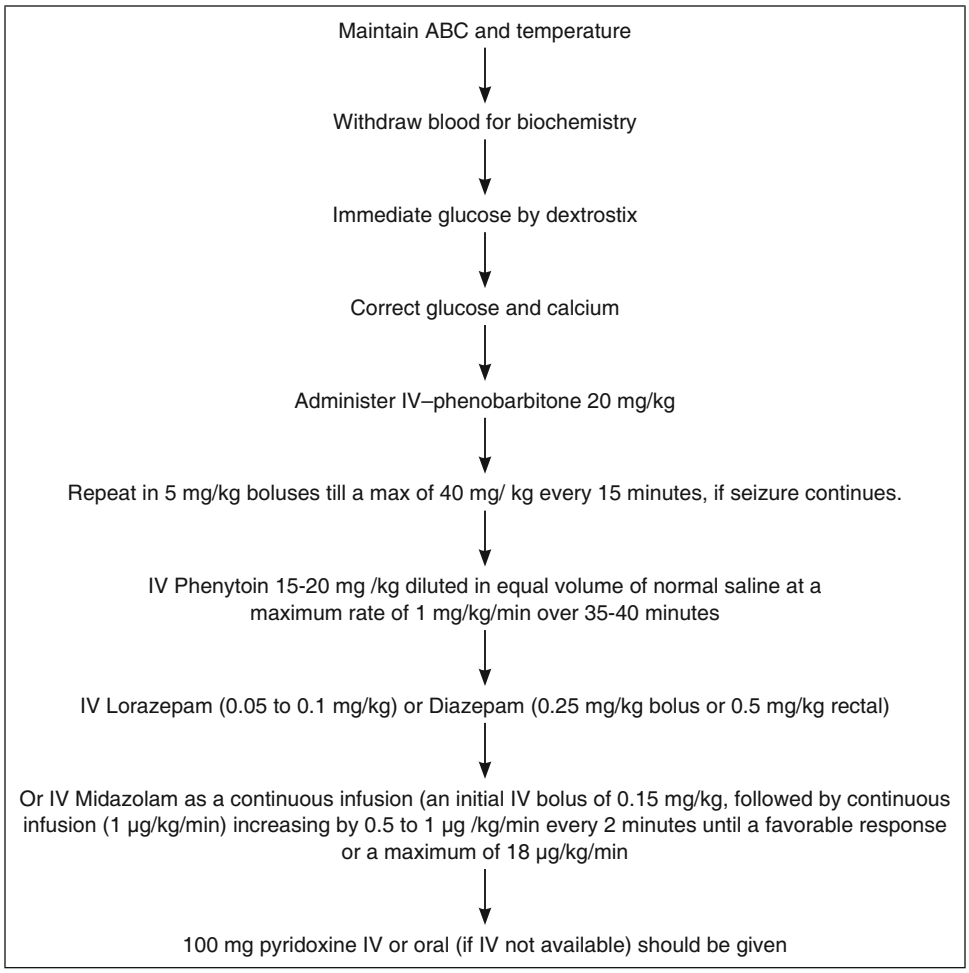


Fig. 19.7. Algorithm for management of neonatal seizure

ACUTE SYMPTOMATIC SEIZURES

A seizure occurring within a week of an acute brain insult (trauma, infection, toxic, metabolic or vascular insult) is called an acute symptomatic seizure. Future risk of unprovoked seizures is only 3-10%.

Serum calcium, magnesium, electrolytes and glucose should be estimated for all children. Lumbar puncture should be done in febrile infants and in those with suspected meningoencephalitis. A plain CT scan is indicated in traumatic brain injury

and a Contrast enhanced CT scan is indicated in children above 2 years, especially those presenting with convulsive seizures, focal seizures, cluster of seizure, or focal neurological deficits to rule out granuloma.

In a hypocalcaemic breastfed infant, an underlying Vitamin D deficiency state in the child and in the feeding mothers should be corrected. Antiepileptic drugs (AEDs) are required in the acute phase and can be withdrawn in a week in acute traumatic brain injury or in 3 months in illnesses with parenchymal involvement (e.g. CNS tuberculosis or pyogenic meningitis with parenchymal involvement). (For AED details see section on Epilepsy in Chapter 1).

FEBRILE SEIZURES

Febrile seizures are brief (2-5 min), generalized tonic-clonic and self-limited seizures followed by a brief post-ictal period of drowsiness, in an otherwise healthy, febrile child of 6 months to 5 years of age, without any evidence of underlying neurological disease. They are the most common seizure disorder during childhood, with a uniformly excellent prognosis. They occur rarely before 6 months and after 5 years of age. The peak age of onset is approximately 14-18 months of age, found in 3-4% of young children. There is a strong family history of febrile convulsions in siblings and parents, suggesting a genetic predisposition. Except for the cases at high risk, simple febrile seizures rarely develop into epilepsy.

SALIENT FEATURES

- Febrile seizures usually occur when the temperature is rising rapidly, to generally 39°C (102°F) or more of core temperature. They are of two types:
  - (i) Typical (simple) febrile seizure occurs on day 1 of fever, does not last for more than 10 minutes; generalized tonic-clonic; generally not more than one episode within 24 hours.
  - (ii) Atypical or complex febrile seizure may persist for more than 15 minutes; it could be focal in nature; more than one episode of seizure in 24 hours; associated with abnormal neurological findings or deficits. An organic cause such as an infectious or toxic process should be considered and investigated.

Late onset febrile seizures, persistent febrile seizures, generalized epilepsy and febrile seizure plus (GEFS+) and febrile status epilepticus (FSE) are part of the spectrum of febrile seizures

- Lumbar puncture: A lumbar puncture with examination of CSF is essential to rule out possibility of meningitis in cases with first episode of febrile seizures.
- EEG has no role in case of simple febrile seizures. However, in cases with atypical febrile seizure or in a child with high risk for developing epilepsy, it may be helpful.

- High risk for developing epilepsy, include a positive family history of epilepsy, initial febrile convulsion prior to 9 months of age, a prolonged or atypical febrile seizure, delayed developmental milestones and an abnormal neurological examination.

Treatment

Most febrile seizures are brief and would be over by the time a child is brought to the doctor or health facility. Management includes definitive diagnosis, restraint in investigations, treatment of an acute episode, prophylaxis for future episodes and family counselling. Role of defervescence in preventing febrile seizures is questionable.

Out-of-hospital treatment

Rectal liquid diazepam (0.5 mg/kg) or buccal Midazolam (0.3 mg/kg) for acute termination of seizures that last for two minutes or more.

Nonpharmacological

Clear the airway, semi-prone lateral position and oxygen therapy.

Pharmacological

In cases presenting with seizures, the mainstay of management is prompt administration of anticonvulsants.

The best drug is Diazepam/Midazolam/Lorazepam in a dose of 0.3 mg/kg by slow intravenous or rectal route. It can be repeated, if seizures do not subside (per rectal dose may be given up to 0.5 mg/kg/dose).

Intermittent prophylaxis (during febrile illness)

It is a safe and effective method of prophylaxis *but does not reduce the risk of future epilepsy.*

Tab Clobazam 0.75 mg/kg for 2-3 days in 2 divided doses during fever or Tab/Syr. Diazepam 0.3 mg/kg/dose every 8 hours (1 mg/kg/day) for 2-3 days of febrile illness, started on the day of onset of fever. Dose can be adjusted, if over sedation or ataxia noted.

Continuous prophylaxis

Febrile status, complex and recurrent febrile seizures (>6/year in spite of intermittent prophylaxis) may need EEG, neuroimaging and continuous prophylaxis with AED. Phenobarbitone and valproate may be used in infants and older children, respectively, for 1-2 years. Carbamazepine and phenytoin are not useful.

Patient/parent education

- The parents and caretaker should be assured of the benign nature of the disease and should be told that no neurological deficit or mental retardation occurs as a result of simple febrile seizure.

- They should be taught about control of fever at home. They can be taught to give diazepam per rectally at home.
- Routine immunization as per schedule should be followed. After DPT vaccination, oral paracetamol 15 mg/kg/dose every 6 h for 2 or 3 days and similarly, after measles vaccination, oral paracetamol in the same dose started on the 4th day from the day of vaccination and given for 3 to 4 days to avoid precipitation of febrile seizures.
  (See also Epilepsy in chapter 1)

References

1. Febrile Seizures. In: Nelson's Textbook of Paediatrics. Behrman RE, Kliegman RM, Jenson HB (eds), 19th Edition, WB Saunders Co, 2011; pp 2017-2019.
2. Facility Based IMNCI (F-IMNCI) Participants Manual. WHO, UNICEF, and Ministry of Health & Family Welfare, Government of India, 2009.

NEUROCYSTICERCOSIS

Neurocysticercosis (NCC) is the disease produced by invasion of the CNS by the cystic stage (cysticercus) of pork-tapeworm (*Taenia solium*). It is the most common parasitic cause of CNS disease and is prevalent in every continent except Antarctica. In humans, the disease is acquired by ingestion of contaminated food or water with the eggs of *Taenia solium*.

SALIENT FEATURES

- The clinical features depend upon site and number of cysts in the CNS, and the inflammatory response of the CNS. It can present as a 'silent' case on one hand to encephalitis like symptoms. On the other hand any neurologic, cognitive or personality disorder in an individual from an endemic area may represent neurocysticercosis. However, seizures, either focal or generalized, remain the most common form of presentation.
- Less common is the feature of meningeal irritation, hydrocephalus or increased intracranial tension. Decreased visual acuity may be seen in ocular cysticercosis. In spinal neurocysticercosis, patients present with evidence of cord compression, nerve root pain, transverse myelitis, or meningitis.
- On neuroimaging studies (CT and MRI), the presence of an eccentric scolex in a cystic lesion is pathognomic of an NCC. Cystic lesions with or without enhancement and calcifications are the commonest findings. Serologic tests (ELISA or immunoblot) are also done.

Treatment

Pharmacological

1. In live NCC cysts and transitional NCC granuloma, Tab. Albendazole 15 mg/kg/day in 2 doses per day for 7 days or 28 days in dose of 15 mg/kg, taken with fatty meals.

(**Caution**: Cysticidal drugs are absolutely contraindicated in ophthalmic lesions; perform fundoscopy before use of cysticidal drugs; monitor patients carefully for development of raised ICP.)
Tab. Prednisolone 1-2 mg/kg/day started 2-3 days prior to cysticidal drugs and continued for 5-7 days to reduce the risk of cerebral oedema at the time of cyst breakdown.

2. Anticonvulsants, such as carbamazepine or phenytoin should be used in appropriate doses to control the seizures. An optimum duration of therapy has not been settled. However, a seizure free interval for even one year may be taken as indication to taper off the therapy (for details see section on Epilepsy and Status Epilepticus).
3. Corticosteroid: Use of corticosteroid is limited to following category of patients only:
   i. Patients who develop signs of increased intracranial tension during treatment.
   ii. Large subarachnoid cysts (these cases have risk of developing cerebral infarcts due to occlusive endarteritis).
   iii. Encephalitis like features.
   iv. Cysticercal angitis.

Surgical treatment

1. A ventricular shunt must be placed, if there is evidence of hydrocephalus. This should precede the medical treatment.
2. Surgical intervention is also required for removal of large solitary cyst for decompression, removal of mobile cysts causing ventricular obstruction, and some cases that fail to respond to medical therapy (spillage of cyst contents is not seen in these cases as is seen in cases of echinococcosis).
3. Ocular cysticercosis should be treated surgically only; enucleation is frequently required.

Patient/parent education

- Minimizing the opportunities for ingestion of faecally derived eggs by means of good personal hygiene, effective faecal disposal and treatment and prevention of human intestinal infections.
- All members of a family of an index case of cysticercosis should be examined for the presence of eggs or signs of disease.
- Prolonged freezing or thorough cooking of food items will kill the parasite.

References

1. Cysticercosis. In: Nelson's Textbook of Paediatrics. Behrman RE, Kliegman RM, Jenson HB (eds), 19th Edition, WB Saunders Co, 2011; pp. 1234-1237.
2. Guidelines for the Diagnosis & Management of Childhood Epilepsy. Indian Pediatrics 2009; 46: 681-698.
(See also Neurocysticercosis in Chapter 9).

ACUTE MENINGOENCEPHALITIS

Acute meningoencephalitis is an acute inflammatory process involving meninges and brain tissue, due to infectious causes. The common aetiological agents are viruses and bacteria. Children of any age may be affected.

SALIENT FEATURES

- Fever, headache, vomiting, irritability altered state of consciousness, signs of meningeal irritation and seizures.
- CSF examination differentiates the viral from bacterial cause of acute meningoencephalitis (Table 19.21).

Table 19.21. CSF findings in meningoencephalitis

	Pressure (mmH_2O)	Leucocytosis (mm^3)	Protein (mg/dl)	Glucose (mg/dl)
Normal	50-80	<5, >75% lymphocytes	20-45	>50 or 75% serum glucose
Acute bacterial meningitis	Usually elevated (100-300)	100-10,000 PMN's* predominate	100-500	Decreased (<40)
Acute viral meningoencephalitis	Normal or elevated	Rarely >1000 PMN's early but lymphocytes predominate in the most of the course	50-200	Normal rarely decreased
Tubercular meningoencephalitis	Usually elevated	100-500 PMN's early but later lymphocytes predominate	100-3000	<50

*PMN's = Polymorphonuclear leucocytes

Treatment

Supportive treatment is the mainstay of therapy and is started immediately.

1. Maintain airway, breathing and circulation.
2. Control of seizures with IV injection of Diazepam 0.2 to 0.4 mg/kg stat followed by Inj. Phenytoin 10-20 mg/kg stat followed by 5 mg/kg/day in divided doses.
3. Increased intracranial tension is treated by proper positioning of patient with head elevated at 15-30° position, fluid restriction to 2/3rd of maintenance, 20% Mannitol 5 ml/kg over 10-15 min followed by 3 ml/kg every 6 hourly for 48 hours and then SOS.

   Or

   Acetazolamide 50-75 mg/kg/day in 3 divided doses through feeding tube

   Or

Glycerine 1 ml/kg/day through feeding tube may be added, if increased intracranial tension persists.

4. Fever is controlled as given in section on fever.
   (**Caution**: Never give aspirin).
5. The intravenous fluid at two-thirds of the maintenance requirement initially. The electrolyte concentration of the blood is monitored very closely. Any imbalance is treated promptly. Fluid restriction is not done, if patient is dehydrated or is in shock.
6. Feeding: Initially the patient is kept nil orally for first 24-48 hours. Later on the feeding is guided by the level of sensorium. A tube feeding is helpful for feeding as well as for giving medicines.

Specific treatment

Until a bacterial cause is excluded, parenteral antibiotic therapy should be administered. The choice of antibiotics depends upon age of the patient and prevalence of organism in the area.

Age 0-3 months

1. Inj Cefotaxime 200 mg/kg/day IV in 4 divided doses for 14 days .
2. Inj Ampicillin 300 mg/kg/day IV in 4 divided doses for 14 days.

Age 3 months-12 years

1. Inj Ceftriaxone 100 mg/kg/day IV over 30-60 minutes in 2 divided doses for 10 days
   Or
   Inj Cefotaxime 200 mg/kg/day IV in 3 divided doses for 10 days
   Or
   Inj Ampicillin 300 mg/kg/day IV in 4 divided doses for 10 days
2. Inj Chloramphenicol 100 mg/kg/day in 4 divided doses for 10 days

If *Meningococci* is suspected/isolated, Inj Penicillin G 300,000-400,000 IU/kg/day in 4 divided doses for 7-10 days.

Viral meningoencephalitis

Herpes simplex virus (generally diagnosed by focal encephalitis or CT scan):

Inj Acyclovir 30 mg/kg/day in 3 divided doses for 14-21 days. Non-HSV viral encephalitis is treated by supportive therapy only.

Lumbar puncture is repeated at 48 hours to see the response. However, if the patient is improving well, a repeat lumbar puncture may not be necessary.

Advice at discharge

- Regular follow-up for neurological assessment including deafness is advised.
- Anticonvulsant therapy to be continued, if seizures are recurrent during course of meningitis.

- Children with sequalae would require assessment of handicap and multidisciplinary management. Occupational/physiotherapy may be taught during hospital stay itself.

References

1. Central Nervous System Infections. In: Nelson's Textbook of Paediatrics. Behrman RE, Kliegman RM, Jenson HB (eds), 19th Edition, WB Saunders Co, 2011; pp. 2086-2098.
2. Facility Based IMNCI (F-IMNCI) Participants Manual. WHO, UNICEF, and Ministry of Health & Family Welfare, Government of India, 2009.
(See also Encephalitis in Chapter 9).

TUBERCULOUS MENINGITIS

Tuberculous meningitis is the inflammation of meninges due to lymphohaematogenous spread of the primary infection of tuberculosis to the meninges, found in about 0.3% of untreated primary infection in children. It is the most dangerous form of extrapulmonary tuberculosis. 70% of the cases are found in children less than 5 years of age.

SALIENT FEATURES

- The clinical progression of tubercular meningitis (TBM) may be rapid or gradual. The signs and symptoms progress slowly over several weeks and can be divided into three stages.
  - The 1st stage, which typically lasts 1-2 weeks, is characterized by non-specific symptoms, such as fever, headache, irritability, drowsiness and malaise. Focal neurologic signs are absent.
  - The 2nd stage usually begins more abruptly. The most common features are lethargy, neck-rigidity, seizures, positive Kernig or Brudzinski signs, hypertonia, vomiting, cranial nerve palsies and other focal neurologic signs.
  - The 3rd stage is marked by coma, hemiplegia or paraplegia, hypertension, decerebrate posturing, deterioration of vital signs, and eventually, death.
- Complications: Survivors may have motor deficits, cranial nerve deficits, mental retardation, learning disabilities, seizures, hydrocephalus, blindness, deafness and diabetes insipidus.
- The diagnosis is made by analysis of CSF on lumbar puncture, which shows lymphocytic leucocytosis with elevated protein and a low sugar (for details see Table 19.21 in section on Meningoencephalitis).
- Demonstration of AFB in CSF confirms the diagnosis, but the yield is very poor. Culture of CSF shows growth of *M. tuberculosis*, takes too much time. Positive tuberculin skin test corroborates the diagnosis but may be negative in severely malnourished/disseminated disease. 20-50% of children have a normal chest radiograph others may show primary disease. CT scan or MRI of brain may be normal during early stages of the disease. Later, it can show exudates in the basal cisterns of brain, periventricular ooze and hydrocephalus. Some may show tuberculomas even.

Treatment

Treatment consists of proper supportive care, including nonpharmacological treatment, specific antitubercular therapy, treatment of increased intracranial tension and, if required, surgical treatment.

Nonpharmacological

- Nutrition: After initial stabilization, nutritional rehabilitation should be done as given in section on protein energy malnutrition.
- Skin care and prevention of bedsores.
- Care of bowel and bladder.
- Physiotherapy and occupational therapy should be instituted early to prevent deformities and contractures.

Pharmacological

1. Appropriate fluid therapy to correct dehydration due to frequent vomiting and decreased oral intake.
2. Treatment of SIADH. Fluid restriction to 3/4th or 2/3rd of maintenance. Treatment of raised intracranial tension
3. Inj. Dexamethasone: 0.15 mg/kg IV 6 hourly for 2 weeks followed by Tab. Prednisolone 1.5 mg/kg/day orally through feeding tube for 4 weeks. This should be tapered over another 2 weeks. A total of 6-8 weeks therapy with steroid is recommended.
4. Mannitol (20% solution) 1.5 to 2 g/kg or 8-10 ml/kg over 30-60 minutes. Repeated every 6-8 hours for 7 days. Lower doses (0.25 g/kg/dose) can also be tried.
   Or
   Glycerol 1 ml/kg/dose every 6-8 hours, diluted in orange juice or water, given through feeding tube.
   Or
   Tab. Acetazolamide 50 mg/kg/day in 3 divided doses for 2-3 weeks.
5. Presence of seizures necessitates treatment with phenytoin or carbamazepine in appropriate doses (for details see section on Epilepsy in Chapter 1).
6. Specific antitubercular therapy—as given in management of tuberculosis (see section on Tuberculosis in Chapter 1).
7. Surgical treatment—ventriculoperitoneal shunt (VP shunt): TBM shows some degree of hydrocephalus by 4 weeks. Obstructive hydrocephalus should be shunted immediately. Non-obstructive hydrocephalus with increased intracranial pressure as shown by ventricular tap or CT scan will also be benefited by VP shunt. An early shunt is preferable.

Follow-up

1. Patient should be kept under follow-up after discharge from the hospital and assessed for neurological deficit and features of increased intracranial pressure

(ICP). One of the common causes of increased ICP is untreated hydrocephalus or blocked shunt.
2. Check compliance to drugs and ensure that occupational therapy/physiotherapy is being continued.
3. Assess physical, mental, visual and auditory handicap and take expert opinion for rehabilitation from other specialists.

Patient/parent education

- Seriousness of disease must be explained.
- Context survey should be done and any other member in the family found to have active TB should be counselled to attend TB clinic for therapy.
- Need for compliance should be emphasized.
- Drug toxicity and side effects must be explained.
- Neurological deficits may appear even in a patient on therapy.

References

1. Tuberculosis. In: Harrison's Principles of Internal Medicine. Fauci, Braunwald, Kasper et al (eds), 18th Edition, McGraw Hill Company Inc., New York, 2012; pp 1340-1359.
2. RNTCP: TB in Children. Consensus Guidelines of Paediatricians, TB experts and TB Control Programme Managers, Central TB Divisons. Directorate of Health and Family Welfare, Nirman Bhavan, New Delhi, 2012.
3. Technical Guidelines for Tuberculosis Control. Central TB Division. Directorate General of Health Services, Ministry of Health and Family Welfare, Nirman Bhawan, New Delhi, 2009.
4. Mycobacterial Infections. In: Nelson's Textbook of Paediatrics. Behrman RE, Kliegman RM, Jenson HB (eds), 19th Edition, WB Saunders Co, 2011; pp 996-1016.
5. Facility Based IMNCI (F-IMNCI) Participants Manual. WHO, UNICEF, and Ministry of Health & Family Welfare, Government of India, 2009.
(see also Tuberculous Meningitis in Chapter 9).

HIV/AIDS IN CHILDREN

There are two HIV types: HIV1 and HIV2, which show 40 to 60% amino acid homology. HIV1 accounts for nearly all cases except for a minority of strains which originate in West Africa. Compared to HIV1, HIV2 is less transmissible and rarely the cause of vertical transmission, is associated with a lower viral load, and is associated with a slower rate of both CD4 cell decline and clinical progression.

India has an estimated 202,000 children infected by HIV/AIDS (UNAIDS 2004). Using a conservative vertical transmission rate of 30%, a new cohort of approximately 56,700 HIV infected infants is added every year (NACO, 2005). In September 2006, the National AIDS control programme had about 45000 individuals on ART and 2300 children were receiving ART (NACO 2006), however, half of HIV positive children die undiagnosed before their second birthday. The reasons for lack of access for treatment of children with HIV/AIDS are manifold and include among others issues of diagnosis in infants, lack of clear guidelines for the treatment of children, and lack of access to appropriate paediatrics ART formulations.

Natural history of untreated HIV infection is divided into the following stages.

Viral transmission —2-3 weeks→ Acute retroviral syndrome —2-3 weeks→

Recovery and seroconversion —2-4 weeks→ Asymptomatic chronic

HIV infection —Avg 8 years→ AIDS —Avg 1.3 years→ Death

Prevention of mother to child transmission of HIV

Mother to child transmission (MTCT) is by far the most significant route of transmission of HIV infection in children below the age of 15 years. The estimated risk and timing of MTCT in the absence of interventions is shown in Table 19.22.

Table 19.22. Estimated risk and timing of MTCT in the absence of interventions

During pregnancy	5-10 %
During labour and delivery	10-15%
During breastfeeding	5-20%
Overall without breastfeeding	15-25%
Overall with breastfeeding to 6 months	20-35%
Overall with breastfeeding to 18-24 months	30-45%

Prolonged breastfeeding, 18 to 24 months, accounts for increased risk of HIV transmission to infant compared to shortened breastfeeding, up to 6 months. Mixed feeding the norm for the majority of women in India (>90%), has been shown to double the risk of postnatal HIV transmission.

Care of exposed child immediately at birth

Definition of HIV exposure: Infants and children born to mothers living with HIV, until HIV infection in the infant or child is reliably excluded, and the infant or child is no longer exposed through breastfeeding. Care of HIV exposed infants should follow standard neonatal care according to safe motherhood guidelines including the following:

- The baby's mouth and nostrils should be wiped as soon as the head is delivered.
- Infant should be handled with gloves until all maternal secretions and blood have been washed off (early baby bathing).
- Cover the cord with gloved hand and gauze before cutting to avoid blood splattering.

Prevention of parent to child transmission (PPTCT): Prophylactic ARV for infants

ARV prophylaxis to the infant must be given according to the current National PPTCT programme guidelines. This includes single dose nevirapine to mother during labour and to the baby 5 mg/kg within 72 hours after birth.

(For more details see also PPTCT in Chapter 7 and 15)

Infant feeding choices

Wherever exclusive replacement feeding is AFASS (acceptable, feasible, affordable, sustainable and safe) avoidance of all breastfeeding is recommended. Instead of breastfeeds, animal milk or formula milk is recommended. In case mother is on ART, exclusive breastfeeding for the first 6 months of life, thereafter mixed feeding.

Immunization and vitamin a supplementation

HIV exposed children should be immunized according to the routine national immunization schedule.

- BCG should not be given in symptomatic HIV infected children.
- HiB vaccine should be given to all who are confirmed HIV infected on the basis of 2 positive DNA PCR tests done at 6 weeks of age.
- Additional vaccines such as pneumococcal, varicella, hepatitis A, influenza, etc. may be given as necessary.
- Vitamin A supplementation should be as per the UIP schedule.

Indications for Cotrimoxazole prophylaxis and duration of prophylaxis are shown in Tables 19.23 and 19.24.

Table 19.23. Indications for cotrimoxazole prophylaxis

Group	Give Cotrimoxazole
All HIV exposed infants.	• From 4 – 6 weeks of age until HIV infection can be excluded
All HIV infected infants <1 year of age.	• Irrespective of symptoms or CD4 counts
All HIV infected children between 1 and 5 years of age.	• WHO stage 2, 3 and 4 or CD4 <25%
All symptomatic HIV infected children >5 years of age.	• WHO stage 2, 3 and 4, if CD4 counts are not available or • WHO stage 3 and 4 irrespective of CD4 • CD4 <350 cells /mm^3 irrespective of WHO staging
As secondary prophylaxis	After initial treatment for PCP < 5 years old do not stop >5 years old, if immune restoration has occurred

Diagnosis of HIV infection in children

As maternal HIV antibody transferred passively during pregnancy can persist for as long as 18 months the interpretation of positive HIV antibody test results is more difficult in children below this age.

Table 19.24. Duration of cotrimoxazole (CTx) therapy.

Group	Discontinue CTx when
HIV exposed children.	Give CTx until HIV infection has been ruled out and the mother is no longer breastfeeding.
Infants and children living with HIV <5years	Maintain on CTx prophylaxis until age 5 irrespective of clinical and immune response.
HIV infected children on ART and >5 years old	CTx can be stopped only when clinical or immunological indicators confirm restoration of the immune system for more than 6 months i.e. in a child >5 years of age with a CD4 count of >350 cells/mm^3 on two occasions not less than 3 months apart.

The recommended dose is 5 mg/kg/day as a single daily dose.

Diagnosis of HIV infection in children <18 months

For children <18 months both breastfed and non-breastfed, born to an HIV positive mother, the following testing strategy applies according to the NACO programme.

- The first HIV DNA PCR should be conducted at 6 weeks of age. If the PCR test is positive, the test is to be repeated immediately for confirmation.
- If the first PCR is negative in a non-breastfed baby, confirm with a second PCR test at 6 months of age.
- If the child is breastfed and initial PCR test at 6 weeks is negative, PCR testing should be repeated at 6-8 weeks after cessation of breastfeeding to rule out HIV infection.

A report of "HIV Positive" is given when 2 PCR tests are positive and a report of "HIV negative" is given when 2 PCR tests are negative.

Diagnosis of HIV infection in children ≥ 18 months

For children ≥ 18 months, test according to adult national testing strategy.

- If an infant is positive at 12 months, a confirmation with a second test should be done at 18 months to exclude a positive test result due to passively transferred maternal antibodies.
- Two positive HIV antibody test results (done sequentially) in a clinically symptomatic child more than 18 months indicate HIV infection in the child.
- Three positive HIV antibody test results in a clinically asymptomatic child more than 18 months old indicate the child has HIV infection.

Clinical staging of HIV infection

Clinical staging can be used to guide when to start cotrimoxazole and when to start ART particularly in situation where CD4 count is not available (Table 19.25).

Table 19.25. WHO classification of HIV associated clinical disease

Classification of HIV – associated clinical disease	WHO clinical staging
Asymptomatic	1
Mild	2
Advanced	3
Severe	4

Staging according to immunological criteria

CD4 count is used to assess the immunological status of the HIV infected child. There are variations in CD4 counts due to diurnal change, intercurrent illness, steroid treatment, splenectomy and after immunizations. CD4 % varies less than CD4 counts, hence considered more valuable in children <5 years of age. CD4 cell counts for children under the national care and treatment programme should be done at baseline and subsequently every 6 months, more frequently if clinically indicated 3–6 monthly.

Revised classification of immune suppression in children is shown in Table 19.26.

Table 19.26. Revised classification of immune suppression in children

Classification of HIV associated immunodeficiency	Age-related CD4 cell values			
	<11 mo (%)	12–35 mo (%)	36–59 mo (%)	≥ 5 years cells/mm^3
Normal CD4	>35	>30	>25	>500
Mild	30–35	25–30	20–25	350–499
Advanced	25–30	20–25	15–20	200–349
Severe	<25% or <1500 cells/mm^3	<20% or <750 cells/mm^3	<15% or <350 cells/mm^3	<15% or <200 cells/mm^3

WHO Clinical staging

Clinical stage 1

- Asymptomatic
- Persistent generalized lymphadenopathy

Clinical stage 2

- Unexplained persistent hepatosplenomegaly
- Papular pruritic infections
- Fungal nail infections
- Angular cheilitis
- Linear gingival erythema
- Extensive wart virus infection

- Extensive molluscum contagiosum infection
- Recurrent oral ulcerations
- Unexpected parotid enlargement
- Herpes zoster
- Recurrent upper respiratory tract infection

Clinical stage 3

- Unexpected moderate malnutrition
- Unexplained persistent diarrhoea
- Unexpected persistent fever
- Oral candida outside first 6-8 weeks of life
- Oral hairy leucoplakia
- Lymph node TB
- Pulmonary TB
- Severe recurrent presumed bacterial pneumonia
- Acute necrotizing ulcerative gingivitis or stomatitis
- Symptomatic lymphoid interstitial pneumonia
- Chronic HIV associated lung disease (including bronchiectasis)
- Unexplained anaemia (<8 g/dl) or neutropenia (<1000/mm^3)
- Or chronic thrombocytopenia (<50,000/mm^3)

Clinical stage 4

Unexplained severe wasting, stunting or severe malnutrition not adequately responding to standard therapy.

- Pneumocystis pneumonia
- Recurrent severe presumed bacterial infection, e.g. meningitis, empyema.
- Chronic herpes simplex infection
- Oesophageal candidiasis
- Extrapulmonary/disseminated TB.

When to start ART

Under the national programme, CD4 counts/% should be done to screen the medical eligibility for ART, however, CD4 counts/% is not available there should be no delay in offering ART based on clinical staging.

When to start ART in children, guided by CD4

- <11 months: if CD4 <1500 cells/mm^3 (<25%)
- 12 – 35 months: if CD4 <750 cells/mm^3 (<20%)
- 36 – 59 months: if CD4 <350 cells/mm^3 (15%)
- >5 years old: follow adult guidelines, i.e. start ART, if <350 cells/mm^3, especially, if symptomatic.

Antiretroviral therapy in children

The recommended preferred firstline ARV regimens for infants and children are:

- Regimen of 2 NRTI plus 1NNRTI:
- Stavudine (d4T) + Lamivudine (3TC) + Nevirapine (NVP) or Efavirenz (EFV)
- Zidovudine (AZT) + Lamivudine (3TC) + Nevirapine (NVP) or Efavirenz (EFV)

Paediatric formulations are provided at all ART centres as FDC (fixed dose combinations), which are stavudine based regimens. Since no AZT based FDC paediatric formulations are available at present for children <20 kg, d4T based FDCs are considered as the first choice drugs for all children below 15 kg weight. Studies have increasingly shown long-term adverse effects with d4T based therapy and hence, with availability of preferred formulations of FDCs with AZT these would be preferred except in those with moderate to severe anaemia. EFV (Efavirenz) is not currently recommended for children <3 years of age or <10 kg. Also EFV is used to substitute nevirapine when antituberculous treatment has to be provided concomitantly.

Common opportunistic infections in HIV infected children are as follows:

- Pneumocystis pneumonia (PCP)
- Candidiasis (oral, esophageal)
- Tuberculosis
- Mycobacterium avium complex (MAC)
- Cryptosporidiosis
- Herpes simplex
- Herpes zoster
- Cryptococcosis
- Penicillosis
- Cytomegalovirus infection
- Toxoplasmosis

For details of management of opportunistic infections see section on Opportunistic Infections in Chapter 7.

Adherence Counselling and monitoring (patient/parent education)

Caregiver should be able to:

1. Understand natural history of HIV infection in children, benefits and side effects of ART.
2. Understand the importance of taking ART on time everyday and able to ensure adherence to treatment.
3. Assume the primary responsibility to directly observe daily ARV intake of the child.
4. Assume the primary responsibility to ensure compliance in adolescents.
5. Appropriate storage of ARV.
6. Correctly demonstrate mixing/measuring of the selected ART regimen.

The child should be able to:

1. Children who know their HIV status (explanation is given by health care personnel according to childs maturity level) should be able to understand natural history of HIV infection, benefits and side effects of ART.
2. Understand the importance of taking ART on time everyday and is able to adhere to treatment.

References

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