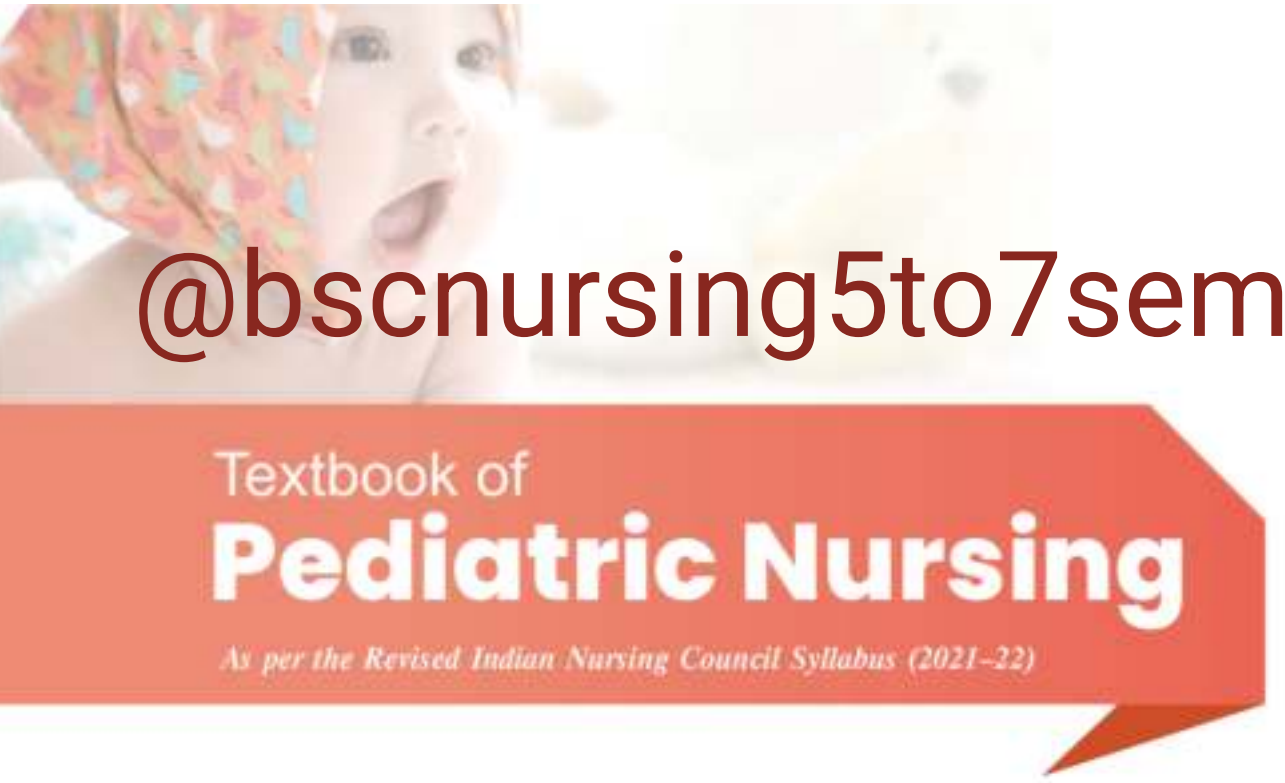


Textbook of Pediatric Nursing

As per the Revised Indian Nursing Council Syllabus (2021–22)

Unit VIII

Disease Conditions–II

Learning Objectives

At the end of this unit, the students will be able to:

- Describe the etiology, pathophysiology, clinical manifestation and nursing management of children with orthopedic disorders, eye, ear and skin disorders.
- Explain the preventive measures and strategies for children with communicable diseases.

Unit Outline

Chapter 21

Musculoskeletal Disorders

Chapter Outline

- Introduction
- Bowleg and Knock-Knee
- Clubfoot
- Fracture
- Dislocation of Hip
- Juvenile Rheumatoid Arthritis
- Duchenne's Muscular Dystrophy
- Osteogenesis Imperfecta
- Scoliosis
- Myasthenia Gravis
- Therapeutic Techniques for Musculoskeletal Disorders

INTRODUCTION

The skeletal system comprises more than 200 bones which are connected by the joints and tendons. It provides the protective structure for the internal organs of the body. Skeletal muscles are attached to the bones by connective tissue, tendons, and ligaments, allow for voluntary movement, like gross motor activities, such as running, and fine motor activities, like writing. Together, the skeletal and muscular systems both support the body and make coordinated movement possible.

The bones and muscles are still growing in children; therefore, they suffer more from musculoskeletal system disorders as compared to adults.

Common manifestations of bone disorders include pain, stiffness, swollen joints, rigidity, etc. The usual diagnostic tests to detect musculoskeletal dysfunction include X-ray and bone scans, bone and muscle biopsies, electromyography, and arthroscopy. Ultrasound and magnetic resonance imaging (MRI) studies are used to reveal soft tissue disorders.

Management of these disorders includes warm compresses, analgesics, exercises, and surgery.

Let us discuss these disorders in detail.

BOWLEG AND KNOCK-KNEE

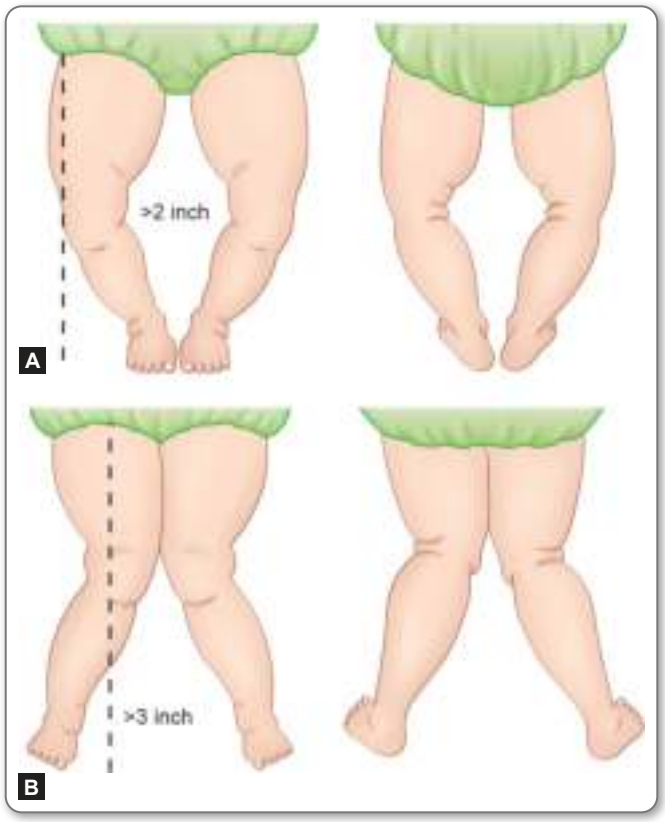
Bowleg (Genu Varum)

Genu varum is lateral bowing of the tibia. If this is present, the malleoli (rounded prominence on either side of the ankles) will be touching and the medial surfaces of the knees will be more than 2 inches (5 cm) apart (Fig. 21.1A). Children develop this condition as part of normal development; it is seen most commonly in 2-year-old infants. It can also occur in athletes who play load-bearing sports, such as football.

The extent of the bowing is recorded at health maintenance visits by approximating the medial malleoli of the ankles and measuring the distance between the patellas (knees) for changes. Genu varum gradually corrects itself in young children by about 3 years of age or, at the latest, by school age. Referral to an orthopedist for further evaluation is needed if the problem is unilateral, becomes rapidly worse, or persists beyond this time.

Knock-Knee (Genu Valgum)

Genu valgum, or knock-knee, is the opposite of genu varum. The medial surfaces of the knees touch and the medial surfaces of the ankle malleoli are separated by more than 3 inches (7.5 cm) (Fig. 21.1B).



Figures 21.1A and B: **A.** Genu varum; **B.** Genu valgum

This is seen most commonly in children 3–4-year-old and corrects itself by school age as the child grows. Children who continue to have this problem and those in whom the abnormality is unilateral or becomes more pronounced need a referral to an orthopedist for further evaluation because obesity as well as both vitamin D and calcium deficiencies can cause the deformity.

CLUBFOOT

Introduction

Clubfoot, also called congenital talipes equinovarus (CTEV), is a congenital deformity involving one foot or both. The affected foot appears to have been rotated internally at the ankle. Without treatment, children with clubfeet often appear to walk on their ankles or on the sides of their feet. However, with treatment, vast majority of patients recover completely during early childhood.

Clubfoot is found in 1–3 per live birth. Boys are affected more. In 50% cases, it is bilateral.

Types of Clubfoot (Fig. 21.2)

Common types of clubfoot are:

- **Talipes equinus:** In this type, there is planter flexion and toe is lower than the heel.

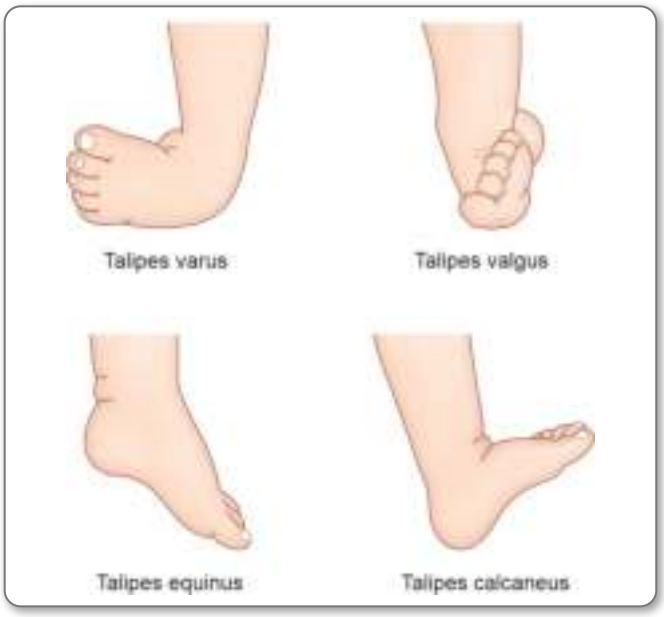


Figure 21.2: Types of clubfoot

- **Talipes calcaneus:** In this type, there is dorsiflexion and toe is higher than the heel.
- **Talipes varus:** The foot is adducted and inverted.
- **Talipes valgus:** The foot is abducted and everted.
- **Talipes equinovarus:** The foot is in plantar flexion and deviated medially. Heel is elevated and foot is twisted inward. It is the most common type (95%).
- **Talipes calcaneovalgus:** The deformity is found as dorsiflexion and lateral deviation of the foot.

Etiology

The exact cause of clubfoot is unknown. Some of the contributing factors are:

- Familial tendency in about 10% of cases
- Intrauterine malposition of the fetal foot
- Oligohydramnios
- Primary arrest or anomalous development of the foot in fetal life.
- Exposure to teratogenic agents like sodium aminopterin
- There is also an increased risk for clubfoot associated with certain neurogenic conditions (spina bifida, cerebral palsy, tethered cord).

Clinical Manifestations

The clinical manifestations of clubfoot include:

- Fixed plantar flexion (equinus) of the ankle, characterized by the drawn up position of the heel and inability to bring to foot to a plantigrade (flat) standing position. This is caused by a tight Achilles tendon.
- Adduction (varus), or turning in of the heel or hindfoot
- Adduction of the forefoot and midfoot giving the foot a kidney-shaped appearance.

Diagnosis

- Physical examination of the newborn.
- Prenatally, it can be diagnosed during the 16-week ultrasound.
- Radiographs of the affected foot.

Management

It is important to treat clubfoot as early as possible, i.e., shortly after birth. The treatment is determined by child's age, overall health, and medical history. The long-term goal of treatment is to correct the clubfoot and maintain as normal a foot as possible while facilitating normal growth and development of the child.

Ponseti's Method of Treatment (Fig. 21.3)

The treatment ideally starts immediately after birth. The treatment involves serial manipulation and plaster casting of the clubfoot. The ligaments and tendons of the foot are gently stretched with weekly, gently manipulations. A soft fiberglass cast is then applied after each weekly session, to retain the degree of correction obtained and to soften the ligaments. Thus, the displaced bones are gradually brought into the correct alignment. Four to five long leg casts (from the toes to the hip) are applied with the knee at a right angle.

Surgical Treatment of Clubfoot

Surgery is indicated in case manipulation or serial casting treatment fails. The surgical correction is usually done after the child is 6 or 9 months of age. Surgery is performed to correct clubfoot and align the foot in a more normal position. The surgical procedure consists of releasing and lengthening the tight tendons/joint capsule of the foot. The surgery usually takes 2–3 hours, and involves 1 or 2 days in the hospital. The corrections are typically held in place by inserting small pins, which are removed approximately 4–6 weeks after surgery. Following surgery, the cast is applied on foot for another 6–12 weeks. The leg is positioned in a bent knee long leg cast. The casting may be followed by full-time or night time use of brace for varying periods of time.

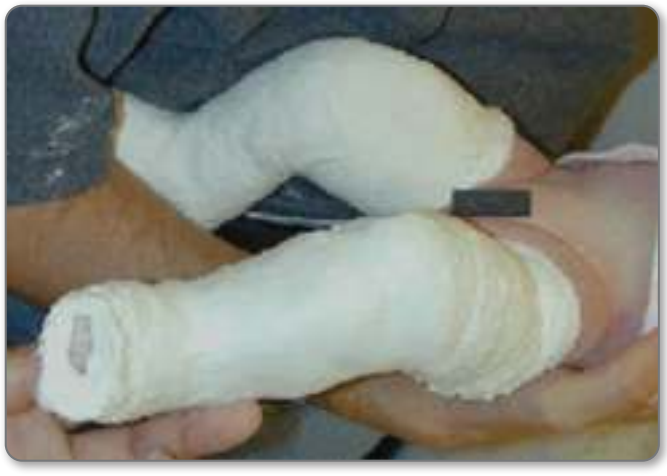


Figure 21.3: Example of the Ponseti's method of treatment

Two Categories of Surgical Treatment

1. Soft tissue releases—it releases the tight tendons/ligament around the joints and result in lengthening of the tendons.
2. Bony procedures—such as osteotomies/arthrodesis that divides bone or surgically stabilizes joints to enable the bones to grow solidly together.

Follow-up is needed for several years after treatment (casting or surgery) to ensure that the clubfoot does not recur. The most common time for recurrence is within 1–2 years following treatment. However, clubfoot can also recur several years after casting or surgery. Clubfoot recurrence can be treated with manipulation/casting or additional surgery. Therefore, patients should continue follow-up care until the end of growth (around 18 years of age).

Nursing Management

- Assessment of the patient.
- Maintain skin integrity as the patient has to undergo repeated casting.
- Assess the condition of the skin under the cast; it should not be too tight.
- The skin at cast edges must be frequently assessed and care should be provided.
- Support family members and encourage them to express their feelings.
- Encourage the family members for constant and regular follow-up till the child reaches maturity.
- Assist in the range of motion exercises once the caste is removed, teach the parents also so that they can help the child at home.

Timely and complete treatment of clubfoot is important. Without any treatment, a child's clubfoot will result in severe functional disability; however with treatment, the child should have a nearly normal foot. He or she can run and play without pain and wear normal shoes. The corrected clubfoot will still not be perfect; however, a clubfoot usually stays 1–1.5 sizes smaller and somewhat less mobile than a normal foot. The calf muscles in a leg with a clubfoot will also stay smaller. Many will require orthopedic shoes as adults; some will require a leg brace despite previous surgery.

FRACTURE

Introduction

A fracture is a medical condition in which a bone of a child is cracked or broken. About 15% of all injuries in children are fracture injuries. Bone fractures in children are different from adult bone fractures because a child's bones are still growing.

Definition

Fracture can be defined as a break in the continuity of bone resulting from trauma, pathological cause or child abuse.

Common Sites of Fracture in Children

- **Clavicle fracture:** It occurs due to birth injury, at the time of rotation or manipulation.
- **Forearm fracture:** It is the most common site and involves the distal third of radius and ulna.
- **Humerus:** It occurs due to fall onto an outstretched arm or hand involving proximal part of the shaft of humerus.
- **Femur:** It is common in children involving mid shaft of the femur.
- **Tibia and ankle:** The most common lower extremity fracture in children occurs in the tibial and fibular shaft.
- Others like pelvis and hip fracture.

Common Types of Fracture in Children (Fig. 21.4)

- **Open fracture:** It is a type of fracture in which a wound through the adjacent or overlying soft tissues communicates with the environment.
- **Closed fracture:** The fracture that does not produce an open wound in the skin.
- **Greenstick fracture:** A fracture in which a bone is partially bent and partially broken but fracture does not cross the entire bone.
- **Complete fracture:** A fracture in which the bone is completely broken, neither fragment is connected to the other.
- **Pathological fracture:** It occurs due to weakening of bones by pathological processes like osteomyelitis, neoplasm, etc.
- **Depressed fracture:** It may found in the neonates in which a fragment of fractured bone is depressed.

Symptoms of Fracture

Even though symptoms vary widely after experiencing a bone fracture, the most common fracture symptoms include:

- Pain in the fractured area
- Swelling in the fractured area
- Obvious deformity in the fractured area
- Inability to use or move the fractured area in a normal manner
- Bruising, warmth or redness in the fractured area.

Diagnostic Evaluation

- History of any injury or trauma, chronic diseases like osteomyelitis.
- Clinical examination; radiological studies (X-ray, CT scan, MRI Bone scan)

Management

Management of fracture in children depends on age, type of fracture and its location.

- Broken fingers, wrists, and hands are most commonly treated in children with casting or splinting.
- If the broken bone is not lined up, the bone may need to be "set" or "reduced" with a manual manipulation by a physician.
- In more severe fractures, surgery may be needed to reset the fracture and a metal plate, screws, pins, or rods placed in order to keep the bone in proper position while it is healing.
- Traction (surface or skeletal) for slow reduction of fracture followed by a period of immobilization.
  - **Bryant's traction:** It is indicated in fractures of femur and congenital dislocation of hip.
  - **Buck's extension:** It is used to prevent or correct knee and hip contractures, to rest the limb, to immobilize the fractured limb temporarily.

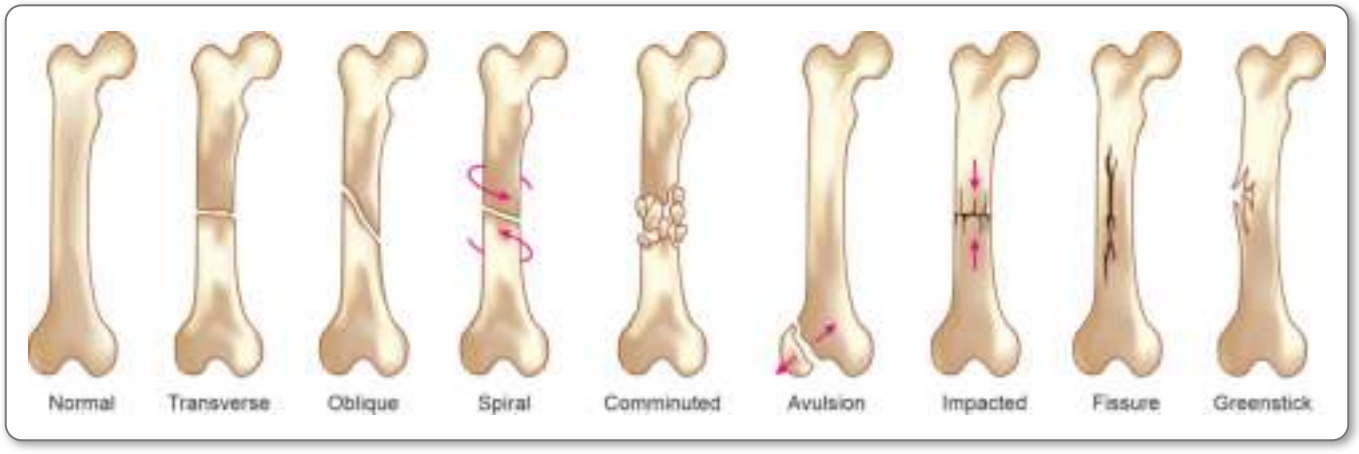


Figure 21.4: Types of fracture

- **Russell's traction:** It is used to reduce the fracture of the femur or hip.
- **Dunlop's traction:** It is used to treat the fractures of the humerus and injuries around shoulder girdle.

- Fractures heal at different rates, depending upon the age of the child and the type of fracture. For example, young children may heal in as little as 3 weeks, while it may take 6 weeks for the same kind of fracture to heal in teens.

Nursing Management

- Assess the child for life-threatening problems.
- Assess the level of consciousness, vital signs and perform head to toe examination.
- Administer analgesics to relieve pain.
- Promote comfort by rest and positioning.
- Maintain tissue perfusion by elevating extremity above heart level.
- Assess the limb by checking the temperature, color, sensation, and pulse.
- Promote skin integrity by frequent change of position, care of pressure points.
- Provide high-protein and well-balanced diet.
- Promote mobility by exercise of uninvolved joints, appropriate ambulation and use of ambulatory aids.
- Prevent infection by proper wound care, administering prescribed antibiotic therapy, using aseptic precautions, proper handwashing techniques and universal precautions.
- Teach parents about continuation of care at home after discharge (especially with cast, splint, traction, etc.).
- Explain the importance of follow-up.

A child bone fracture is a medical condition in which a bone of a child (a person younger than the age of 18) is cracked or broken. About 15% of all injuries in children are fracture injuries. There are differences in the bone structure of a child and an adult and these differences are important for the correct evaluation and treatment of the fractures. A child's bones heal faster than an adult's because a thicker, stronger and more active dense fibrous membrane (periosteum) covers the surface of their bones. Proper medical and nursing care helps a child in early recover and minimizing complications.

DISLOCATION OF HIP

Hip dislocation is also known as developmental dysplasia of hip (DDH). It can be acquired or congenital. The hip is a "ball-and-socket" joint. In a normal hip, the ball at the upper end of the femur fits firmly into the socket, which is part of the large pelvis bone. In babies and children with developmental dysplasia of the hip, the hip joint has not formed normally. The ball is loose in the socket and may be easy to dislocate.

Developmental dysplasia of hip ranges from a minor laxity of the ligament that holds the ball in the socket to a complete dislocation in which the ball is entirely out of the socket (Fig. 21.5). This can be unilateral or bilateral:

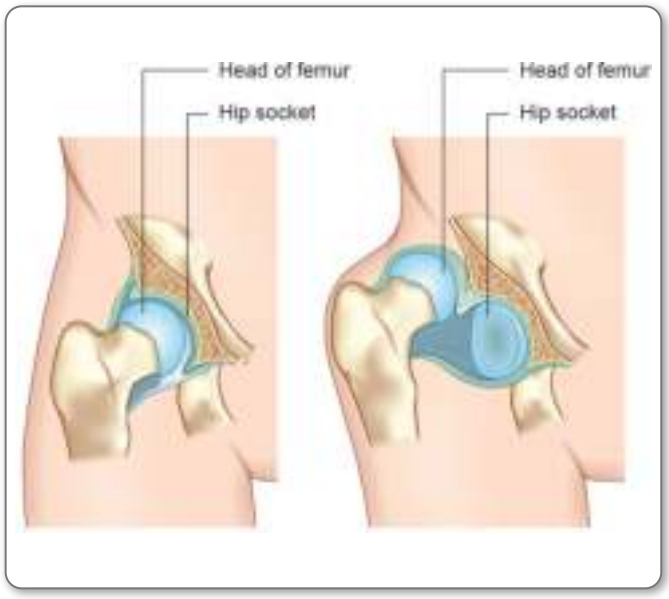


Figure 21.5: (Left) Head of the femur fitting firmly inside the hip socket; (Right) Thighbone is completely out of the hip socket (dislocated)

- **Unilateral dysplasia:** If only one hip is affected, it is unilateral dysplasia.
- **Bilateral dysplasia:** If both hips are affected, it is bilateral dysplasia.

There are three degrees of DDH:

1. **Dislocated:** In the most severe cases of DDH, the head of the femur is completely out of the socket.
2. **Dislocatable:** In these cases, the head of the femur lies within the acetabulum, but can easily be pushed out of the socket during a physical examination.
3. **Subluxatable:** In mild cases of DDH, the head of the femur is simply loose in the socket. During a physical examination, the bone can be moved within the socket, but it will not dislocate.

Causes

The cause of hip dislocation is unknown in many cases. Contributing factors include:

- More common in girls
- Firstborn child
- Babies born in the breech position
- Family history of DDH
- Oligohydramnios (low levels of amniotic fluid)

Clinical Manifestations

- Legs of different lengths
- Uneven skin folds on the thigh
- Less mobility or flexibility on one side
- Limping, toe walking, or a waddling, duck-like gait
- Delayed gross motor development

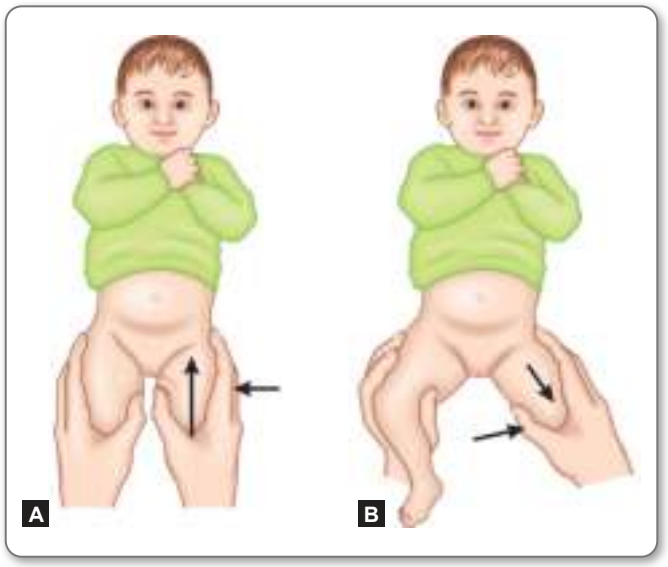


Figure 21.6A and B: A. Barlow's test; B. Ortolani's test

Diagnosis

The diagnosis of hip dislocation is made on the following basis:

- **Barlow's test:** Barlow's test is a maneuver performed by bringing the thigh toward the midline of the body. Feeling of femoral head slipping out of the socket posterolaterally is considered as a positive **Barlow's sign (Fig. 21.6A).**
- **Ortolani's test:** It is done to assess congenital hip dysplasia. The maneuver is performed by abducting the infant's hip and assessing for a clicking sound. A positive **Ortolani's sign (Fig. 21.6B)** is noted when a clicking or distinctive "clunk" is heard when femoral head re-enters the acetabulum. Ortolani's maneuver is performed before 2–3 months of age. The maneuver is done in early infancy because after 2–3 months, the development of soft tissue contracture prevents the hip from being relocated, thus no clicking sound will be assessed in children with congenital hip dysplasia.
- Dynamic ultrasound is used to assess hip stability and acetabular development in infants. Ultrasound helps diagnosis in children under 4–5 months but pelvic X-rays are more useful in older infants and children once the femoral head ossification center has developed.
- CT and MRI scanning may also be needed but may require sedation.
- Arthrography is commonly used perioperatively when deciding between closed and open reduction.

Treatment

When DDH is detected at birth, it can be corrected with the use of a harness or brace. If the hip is not dislocated at birth, the condition may not be noticed until the child begins walking.

Nonsurgical Treatment

Treatment methods depend on a child's age.

- **Newborn:** The baby is placed in a soft positioning device, called a Pavlik harness (Fig. 21.7), for 1–2 months to keep the thighbone in the socket. This brace holds the hip in the proper position while allowing free movement of the legs and easy diaper care. The Pavlik harness helps tighten the ligaments around the hip joint and promotes normal hip socket formation.
- **1–6 months:** Similar to newborn treatment, a baby's thighbone is repositioned in the socket using a harness or similar device. This method is usually successful, even with hips that are initially dislocated. It is usually worn full-time for at least 6 weeks, and then part-time for an additional 6 weeks.
  In some cases, a closed reduction procedure is required to place the thighbone in proper position and then apply a body cast, i.e., spica to hold the bones in place. This procedure is done while the baby is under anesthesia.
- **6 months to 2 years:** Older babies may also be treated with closed reduction and spica casting. In most cases, skin traction is used for a few weeks prior to repositioning the thighbone. Skin traction prepares the soft tissues around the hip for the change in bone positioning.

Surgical Treatment

- **6 months to 2 years:** If a closed reduction procedure is not successful in putting the thighbone is proper position, open surgery is indicated. In this procedure, an incision is made at the baby's hip that allows the surgeon to clearly see the bones and soft tissues. In some cases, the thighbone will be shortened to properly fit the bone into the socket. X-rays are taken during the operation to confirm that the bones are in position. Later on, the child is placed in a spica cast to maintain the proper hip position.

Figure 21.7: Pavlik harness

- **Older than 2 years:** In some children, the looseness worsens as the child grows and becomes more active. Open surgery is necessary to realign the hip. A spica cast is usually applied to maintain the hip in the socket.

Nursing Management

- Promote normal growth and development of the child by proper stimulation and love and affection.
- Maintain correct position of the hip. The nurse must maintain the proper position and explain the purpose of splint to the parents. Parents should be explained about the time for which the splint to be worn and when the splint to be removed for physical care.
- Maintain physical mobility of the child.
- Protect the skin of the child from irritation. This can be done by:
  - Washing the skin daily with mild soap and water and thoroughly drying it.
  - Child can wear long cotton socks and cotton shirt under the harness.
  - Change the diapers daily to keep the child dry and clean.
  - Explain the family members not to apply oil or lotions under the harness.
- Provide optimum nutrition to the child. The child should be provided with well-balanced diet rich in proteins and elevate the head of the child while feeding.
- Educate the parents and support the parents. Parents should be taught about the correct use of harness and about lifting, holding and feeding the child with such devices. Parents should be given opportunities to verbalize their concerns, fear, and anxiety.

JUVENILE RHEUMATOID ARTHRITIS

Juvenile rheumatoid arthritis is an inflammatory, multisystem disorder. Girls are affected more than boys, and the age of onset is 2–16 years. It is autoimmune in nature and belongs to group of a chronic diseases, prognosis is good. Approximately 75% of children having long remissions (partial or complete disappearance of symptoms) without impaired function.

Assessment

- Joint stiffness that is worse in the morning on arising, swelling, decreased range of motion, joints are warm to touch and tender or painful.
- Systemic signs and symptoms like fever, malaise, myalgia,
- Hepatosplenomegaly, rash, pleuritis or pericarditis.

Diagnosis

- WBC, ESR—increased
- RF—may or may not be present
- X-rays—widening joint spaces, articular destruction

Medical Management

Drugs in the management of arthritis include NSAIDs like acetaminophen, ibuprofen, and naproxen. Other groups of drugs are:

- Slow-acting antirheumatic drugs (SAARDs), also called *disease-modifying antirheumatic drugs* (DMARDs): These drugs modify the natural progress of the disease over weeks to months. Methotrexate, a cytotoxic drug, is another drug which is usually prescribed.
- Steroids—such as prednisone. Prednisone is added to the drug therapy if the disease is extremely severe or not responded to other anti-inflammatory agents. Steroids are injected directly into the affected joint.
- Tumor necrosis factor (TNF) inhibitors—such as etanercept (Enbrel) or infliximab (Remicade). These drugs reduce inflammation by blocking the action of TNFs, which cause inflammation. Etanercept is subcutaneously injected every week, so parents need instructions regarding injection and guarding against infections because children are more susceptible to infection than usual while taking these drugs. Infliximab is given IV and so usually requires a short-term health care facility stay for safe administration.
- Kinase inhibitors—such as tofacitinib. Tofacitinib is an oral medication that has shown clinical response in as little as 2 weeks with sustained response up to 12 months.

Nursing Management

Nursing Diagnosis

- Impaired physical mobility-joint stiffness and pain
- Pain related to inflammation of joint
- Self-care deficit related to pain and impaired joint mobility
- Knowledge deficit

Nursing Goals and Interventions

- Maintain joint reduction
  - Apply splints or sand bags as ordered
  - Perform ROM exercise
  - Have patient use firm mattress, lie flat in bed and keep joints extended, alternate with prone position without pillow
  - Incorporate play into therapeutic exercise
  - Encourage child to be as active as possible without straining joints
  - Assess joint function frequently
- Provide relief from pain
  - Provide heat to painful joints with warm showers or baths, warm soaks or moist pads.
  - Avoid over exercising painful or swollen joints
  - Avoid excessive weight gain
  - Use nonpharmacological measures to relieve pain
- Prepare child to perform ADL as independently as possible
  - Assist only when child is unable to do so

MYASTHENIA GRAVIS

Pathophysiology

For nerve conduction to cause muscles to contract effectively, a neurotransmitter, acetylcholine (ACh), must be released at synaptic junctions. The release of ACh is governed by the enzyme cholinesterase. With myasthenia gravis, there is interference in ACh processing, which leads to symptoms of progressive muscle weakness or inability to contract. The cause may be impaired synthesis or storage of ACh, insufficient ACh release, inadequate ACh receptors present at motor end plates, opposition of ACh by an anti-ACh factor, or excessive cholinesterase. In children, myasthenia gravis probably occurs most often from an autoimmune process [autoantibodies may block receptor sites for ACh or other receptors, such as muscle-specific kinase (MuSK) receptors].

The three forms of this disease in children are: (1) neonatal transient myasthenia, (2) congenital myasthenia, and (3) juvenile myasthenia.

Assessment

- **Neonatal transient myasthenia:** The mother has myasthenia gravis and the infant depicts transient disease symptoms at birth because of the transfer of antibodies from the mother. The newborn appears "floppy," sucks poorly, and has weak respiratory effort. Ptosis may also be present. The symptoms disappear within 2–4 weeks, but if they are not recognized when present, they could prove fatal because of respiratory muscle dysfunction.
- **Congenital myasthenia:** It is an inherited disorder that results in defective ACh transmission or reception.
- **Juvenile myasthenia gravis:** It is an autoimmune process that occurs usually at 10–13 years of age and is more frequently found in girls than boys. Most children with this form have thymus hypertrophy.
- Diplopia and ptosis are seen with all forms of myasthenia gravis because of weakness of the extraocular muscles. Symptoms grow intense as facial, neck, jaw, swallowing, and intercostal muscles become affected. Child is extremely fatigued. All symptoms increase with emotional stress, fatigue, menstruation, and respiratory infections.

Diagnosis

- History taking and physical examination to assess for ptosis (ask child to look upward). Assess for repetitive motions, such as walking up stairs or clapping.
- Myography reveals poor muscle function.
- An MRI or a CT scan demonstrates the enlarged thymus gland.
- Edrophonium (Tensilon) is a drug that prolongs the action of ACh and therefore increases muscle strength. If the child's muscle strength improves after an injection, the child's diagnosis is positive for myasthenia gravis (Fig. 21.12).

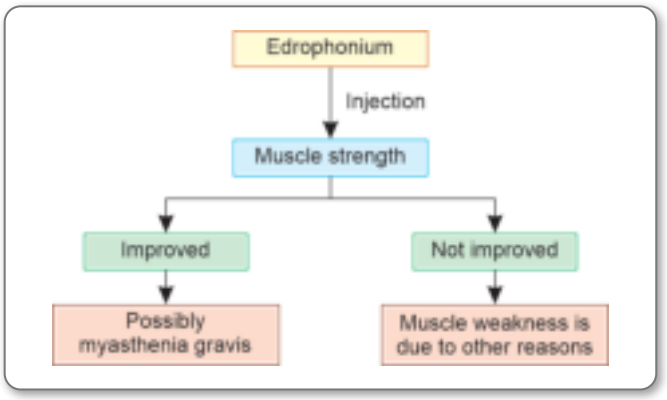


Figure 21.12: Tensilon test

Management

- The goal of treatment for myasthenia gravis is to improve the strength and endurance of a patient by facilitating neuromuscular transmission.
- Myasthenia gravis is treated by the administration of neostigmine (Prostigmin) or pyridostigmine bromide (Mestinon), acetylcholinesterase inhibitors that prolong the action of ACh. The dosage of these agents is individually determined. If toxicity occurs, symptoms similar to those of the original disease occur because excessive ACh leads to continued neurotransmitter stimulation and the inability of muscles to repolarize for a new contraction.
- In some children, prednisone or an immunosuppressant such as azathioprine may be added to their medication regimen to decrease the amount of anticholinesterase medication required.
- In still others, plasmapheresis to remove immune complexes from the bloodstream or the administration of IV immunoglobulin to provide immune suppression will reduce symptoms.

THERAPEUTIC TECHNIQUES FOR MUSCULOSKELETAL DISORDERS

Various methods are used as therapy for children with musculoskeletal disorders, including casts, traction, distraction, and open reduction.

Casting

Casts are used to treat a wide range of musculoskeletal disorders, from simple fractures in the extremities to correction of congenital structural bone disorders.

Casts are created from either plaster of Paris or fiberglass. Fiberglass is light weight, comes in variety of colors and is waterproof.

But, it is more expensive and may not be practical for casts that need frequent changing, such as those used to correct talipes disorders that require serial casting.

A plaster cast takes 10–72 hours to dry depending on its size. Fiberglass casts usually dry within 5–30 minutes. A "window" may be placed in a cast if an infection is suspected, so that the area can be observed. If the child has a body or hip spica cast, windowing can prevent uncomfortable abdominal distension and allow bowel sounds to be assessed.

Compartment syndrome is a phenomenon that can occur when a cast or tight constrictive dressing puts pressure on an enclosed space, such as the forearm. This pressure can result in severely decreased blood flow that potentially threatens damage to and necrosis of surrounding soft tissue or nerves. An injury to a major artery with inadequate collateral circulation can lead to decreased perfusion and ischemia of both capillaries and muscles, resulting in an increase in permeability of the capillary walls and, ultimately, edema.

Assess fingers or toes carefully for warmth, pain, and function after application of a cast to ensure compartment syndrome is not developing. If signs of compartment syndrome are present, the cast needs to be released immediately to prevent permanent nerve and tissue damage. A fasciotomy (surgically opening the compartment) may be necessary to prevent nerve damage.

Nursing Management for a Child in Cast

Case 1

Nursing diagnosis: Risk for ineffective peripheral tissue perfusion related to pressure from cast.
Goal: Child states he feels no pain or numbness in extremity; distal nail bed blanches and refills in less than 3 seconds; pedal pulses are palpable.
Interventions:

- Keep the extremity elevated by a cushion to prevent edema.
- Check circulation frequently, every 15 minutes during the first hour, hourly for the next 4 hours, and then every 4 hours throughout the first day.
- Assess for color, warmth, presence of pedal or radial pulses, and sensations of numbness or tingling. Signs of impaired neurovascular function include pallor including blueness or coldness of the distal part, pulselessness, pain in the casted part, paresthesia and paralysis.
- If a cast surrounds the genital area, cover the edges with plastic or waterproof material to help keep it dry. Keeping children in a semi-Fowler position by using pillows or raising the head of the bed helps to direct urine and feces downward and away from the cast. Because a cast is heavy, infants tend to slip down in bed a great deal, so they need frequent repositioning to remain in this raised position.
- If young children have a body cast, make certain they have a bib or cover over the top edge of their cast so crumbs or fluids do not spill inside. Choose toys carefully so small parts cannot drop inside. A piece of food inside a cast will mold and macerate the skin; a small part of a toy could cause irritation and a pressure ulcer.

Case 2

Nursing diagnosis: Parental health-seeking behaviors related to care of child with cast at home
Goal: Parents state plans for adapting home environment and lifestyle to accommodate child with cast; parents demonstrate measures to check neurovascular status.
Interventions:

- Teach child to use crutches safely if prescribed.
- Do not use abduction bar as a handle for lifting as it may break the cast.
- Cuddle the child on areas which are not covered with cast.
- Itching under the cast can be relieved by applying lotion or blowing cool air through the cast with a fan or a hair dryer. Do not use knitting needle or hanger as it may cause injury and infection.
- Keep the cast dry (cover it with a plastic bag to shower); no swimming is allowed. Remind her not to use magic markers for autographs because fiberglass is a porous material.
- Discuss how the child will eat, play or work with cast at school
- Follow-up because children can outgrow a cast rapidly. Outgrowing a cast can put pressure on nerves and can lead to permanent disability.

Medical Boots (Fracture Boots) or Splints

In some cases, a fracture does not require a cast for immobility but can be immobilized by a supportive boot or splint. The child wears the boot or arm splint continuously for effective bone healing as if it were a cast. The advantage is that, if a complication should occur, it can be readily removed by its Velcro attachments.

Crutches

Purposes of crutches:

- To keep weight off one or both legs
- To support weakened legs
- To maintain balance

Usually, a physiotherapist measures crutch length and gives instruction in crutch walking. Emotional support must be offered to children as they learn to use crutches and assess progress at follow-up visits.

Fit and Adjustment

If crutches are properly fitted, there should be a space of 1–1.5 inches between the axilla crutch pad and the child's axilla. When the child stands upright and places his hands on the hand rests of the crutches, the elbows should flex about 20°. This degree of flexion ensures that when the child bears

weight on the crutch, the body weight will be borne by the arm and not the axilla. Pressure of a crutch against the axilla could lead to compression and damage of the brachial nerve plexus crossing the axilla, resulting in permanent nerve palsy. Teach children not to rest with the crutch pad pressing on the axilla but to always support their weight at the hand grip.

Always assess the tips of crutches to ensure the rubber tip is intact and not worn out as the tip prevents the crutch from slipping. Be certain the child is walking with the crutches placed about 6 inches to the side of the foot. This distance provides a wide, balanced base for support.

Before discharge from a health care facility, explore with children any problems crutches may cause with their daily activities.

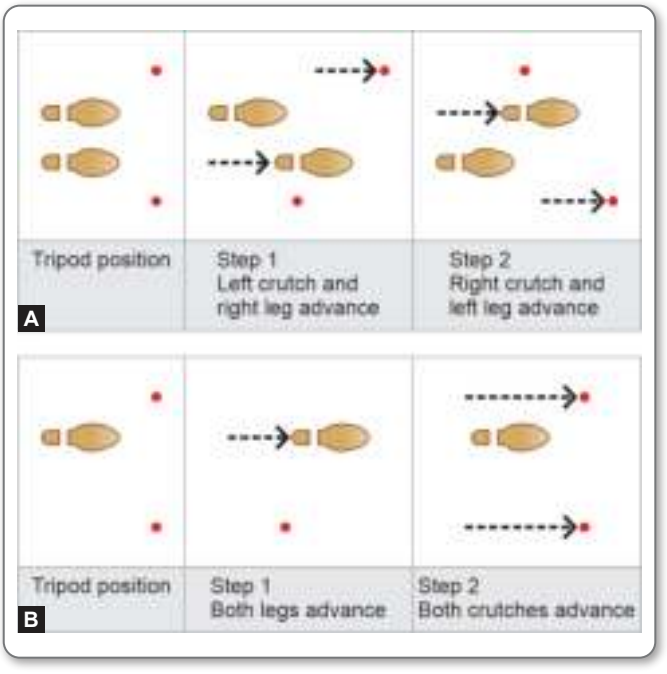
Crutch Walking

Two main crutch-walking patterns are used (Figs 21.13A and B): (1) two-point gate and (2) three-point swing-through gate.

A *two-point gait* is used when a child needs support for weakened muscles or balance but may bear weight on both lower extremities. The child places the right crutch and left foot forward, then the left crutch and right foot forward, and so on. Using the crutch opposite a foot provides a wider base of support than using the crutch next to the foot. Teach children to take small steps until they feel confident.

A *three-point swing-through gait* is used when no weight-bearing is allowed on one foot. For this, the crutches are both brought forward. The weight of the body is then shifted forward as both legs are swung through the crutches. The child bears weight on the unaffected (good) leg and moves the crutches forward again. It takes strong arm support to bear full weight on crutches this way. Ensure that the child is bearing weight on the hands and not on the axillae.

To walk downstairs using a swing-through gait, children place their crutches on the lower step and then swing the unaffected (good) foot forward and down to that step. To go upstairs, they place their unaffected (good) foot on the elevated step and then raise the crutches onto the step and lift themselves up.



Figures 21.13A and B: Crutch-walking patterns. **A.** The two-point gait; **B.** The swing-through gait

Traction

Traction is used to reduce dislocations and immobilize fractures. It involves pulling on a body part in one direction against a counterpull exerted in the opposite direction. It is often used with intramedullary rods.

In straight or running traction, the child's body weight serves as the counterpull.

In suspended or balanced traction, the body part is suspended by a sling, and the counterpull and primary pull are accomplished by pulleys and weights. Either skin traction (in which skin provides the counterpull) or skeletal traction (in which bone provides the counterpull) may be used.

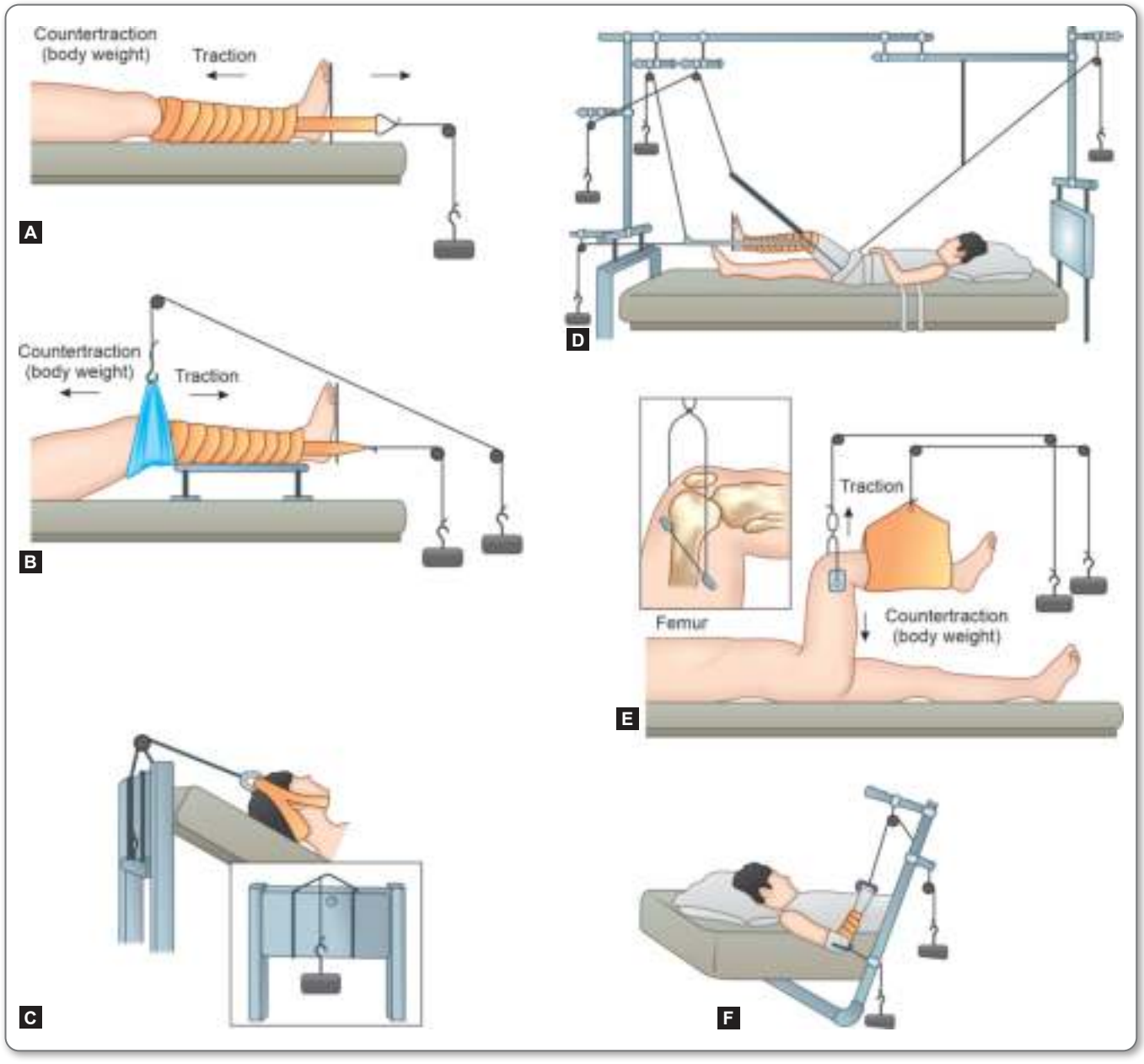
Skin traction (Figs 21.14A to F) is used if only minimal traction is necessary, the child's skin must be in good condition for this procedure.

Skeletal traction is used if traction is needed for greater period or a greater strength of traction pull is needed. Use of traction in the home shortens hospital stays and enables a child to interact with family members, so it should be encouraged when possible.

Skin Traction

Skin traction means a child's extremity is wrapped in a material such as an elastic bandage and then suspended from a nearby pole or frame so the weight of the body part produces traction.

- Bryant's traction: It is used for fractured femurs in children younger than 2 years of age (Fig. 21.15). It may also be used in preparation for surgical repair of congenital developmental disorders, such as developmental hip dysplasia. This type of traction is used less frequently now because the elevation of the extremities causes blood to pool at the hips. This and the possible tourniquet effect of the traction strips, bandages, and traction itself increase the risk for vasospasm and avascular hip necrosis.
- Buck's extension: It is used for immobilizing lower extremity fractures in older children.
- Dunlop's traction: It is used to immobilize an upper extremity.
- Cervical skin traction: It is used to decrease muscle spasms in the back. This type of traction uses a halter-type device attached to weights. The head of the bed is elevated to provide countertraction.



Figures 21.14A to F: Types of skin traction: **A.** Buck's extension; **B.** Russell; **C.** Cervical skin traction. Types of skeletal traction: **D.** Balanced suspension; **E.** 90°; **F.** Dunlop's traction with pin insertion

Skeletal Traction

Skeletal traction involves the use of a pin, such as a Steinmann pin, or a wire, such as a Kirschner wire, that is passed through the skin into the end of a bone under general anesthesia. With skeletal traction, ropes strung over pulleys and attached to weights exert a pull on the extremity at the pin site. Cotton gauze squares are usually placed around the ends of the pin on the outside. The sites are cleaned with half-strength hydrogen peroxide using sterile technique to keep them free of drainage.

Observe pin sites daily for drainage because odorous or excessive drainage or local erythema may be a sign of infection.

Care of Child in Traction

- Assess child for neurovascular impairment, the same as children in casts. Assess the extremity in traction every 15 minutes during the first hour, hourly for 24 hours, and every 4 hours thereafter for signs of pallor (or blueness), lack of warmth, tingling, absent peripheral pulse, edema, or pain.
- Traction can lead to hypertension because the head typically is positioned lower than the lower extremities. Assess BP daily.
- Be careful when changing a child's bed linens or carrying out nursing functions so that the weights are not moved.

Figure 21.15: An infant in Bryant's traction

Figure 21.16: Ilizarov device

- Provide skin care on the child's back, elbows, and heels because they may become irritated from friction against the sheets.
- A Trapeze bar suspended over the bed provides a great deal of mobility and assists children in using a bedpan or positioning themselves in bed.
- Ensure that the child is occupied and involved in activities like reading, or texting.

Distraction

Distraction is the use of an external device to separate opposing bones, which then encourages new bone growth. It can be used to lengthen a bone if one limb is shorter than the other. It can also be used to immobilize fractures or to correct defects if the bone is rotated or angled.

A device like Ilizarov external fixator is used to achieve distraction (Fig. 21.16). It consists of wires that are inserted through the bone then attached to either full or half rings, which are secured to telescoping rods. For bone lengthening, the rods are adjusted approximately 1 mm each day to stimulate bone growth until the desired length is achieved. The device remains in place until the consolidation is complete; there is no pain, limp, or edema; and the bone is healed and can bear weight.

Both the child and parents need thorough preparation for the surgery, application of the device and how it will appear. If it seems important to parents, provide suggestions of ways to minimize the device's appearance, such as wide-legged pants with adjustable closures. If parents will be adjusting the telescoping rods, providing care to the wire insertion sites, or restricting activity, be certain they have full and clear instructions on what to do as well as how to assess for signs and symptoms of infection. Ascertain that they have follow-up appointments because continued care is essential to ensure an optimal outcome for their child.

Open Reduction

Open reduction is a surgical technique used to align and repair bone. If there is a spinal fracture or both bones of a forearm or lower leg are fractured, open reduction and insertion of a rod or screw stabilizes the bones.

Once an open reduction is completed, the area usually is casted to provide support. Invariably, at least a small amount of serosanguineous fluid oozes from the open reduction site into the cast. Outline with a ballpoint pen, any stain that suggests oozing from a surgical incision, so that an increase in the size of the mark can be detected. Because children with an open reduction are prone to infection, be aware of systemic symptoms (e.g., increased pulse, increased temperature, lethargy) as well as local signs (e.g., edema, pain, tingling, blueness or coolness of the distal extremity) of infection.

Summary

As children and young people develop physically, socially and psychologically from vulnerable infants into adults ready for the world of work, musculoskeletal health needs a continuous, cohesive approach taking into account emerging needs. Knowledge of the most frequent conditions will facilitate early diagnosis and management.

Assess Yourself

1. List the symptoms of DDH.
2. What is compartment syndrome?
3. The device used to treat hip dislocation is .....
4. The disorder in which head of the femur and acetabulum cavity are malaligned is .....
5. Discuss the care of a child aged 8 years with right upper limb cast.
6. Name the disorders with which these are associated:
   - Gowers sign .....
   - Adams test .....
   - Tensilon test .....
   - Pavlik harness .....
   - Ortolani's test .....

Chapter 23

Communicable Diseases

Chapter Outline

- Common Communicable Diseases
- HIV/AIDS
- Dengue Fever
- COVID-19

COMMON COMMUNICABLE DISEASES

The common communicable diseases found in children are chicken pox, mumps, measles, rubella, diphtheria, tetanus, and pertussis. Overview of communicable diseases is shown in Table 23.1. TB is explained in Unit V.

Table 23.1: Overview of communicable diseases

Disease	Characteristics	Transmission	Nursing care
Chicken pox (Varicella)	Acute viral disease; onset is sudden with high fever; maculopapular rash and vesicular scabs in multiple stages of healing Incubation period is 10–21 days	Spread by droplet or airborne secretions; scabs not infectious	• Isolate • Treat symptoms: fluids for fever, Tylenol • Prevent scratching • Observe for signs of complications
Mumps	• Acute viral disease, characterized by fever, swelling and tenderness of one or more salivary glands • Potential complications, including meningoencephalitis • Incubation period is 14–21 days	• Spread by droplet and direct and indirect contact with saliva of infected person • Most infectious 48 hours prior to swelling	• Prevent by vaccination • Isolate • Treat symptoms: ice pack to neck and force fluids, • Tylenol • Watch for symptoms of neurological involvement: fever, headache, vomiting, stiff neck
Measles (Rubeola)	• Acute viral disease, characterized by conjunctivitis, bronchitis, Koplik's spots on buccal mucosa • Dusky red and splotchy rash 3–4 days • Usually photophobia • Complications can be severe in respiratory tract, eye, ear, and nervous system • Incubation period is 10–12 days	Spread by droplet or direct contact	• Symptomatic: bed rest until cough and fever subside; force fluids; dim lights in room; tepid baths and lotion to relieve itching • Observe for signs of neurological involvement

Contd...

Disease	Characteristics	Transmission	Nursing care
German measles (Rubella)	• Viral infection • Slight fever, mild coryza, and headache • Discrete pink red maculopapules that last about 3 days • Incubation period is 14–21 days	• Spread by direct and indirect contact with droplets • Fetus may contract measles in utero if mother has the disease	Symptomatic: Bed rest until fever subsides
Diphtheria	• Local and systemic manifestations • Malaise, fever, cough with stridor • Toxin has affinity for renal, cardiac and nervous tissue • Incubation period is 2–6 days or longer	Spread by droplets from respiratory tract or carrier	• Antitoxin and antibiotic therapy to kill toxin • Strict bed rest; prevent exertion • Liquid or soft diet • Observe for respiratory obstruction • Suctioning, oxygen and emergency tracheostomy may be necessary
Tetanus (Lockjaw)	• Acute or gradual onset • Muscle rigidity and spasms, headache, fever, and convulsions • Death may result from aspiration, pneumonia or exhaustion • Incubation period is 3–21 days	• Organisms in soil • Enter body through wound • Not communicable man to man	• Toxins must be neutralized • Bed rest during illness in quite, darkened room • Avoid stimulation which may cause spasms • Observe for complications of laryngospasm and respiratory failure
Pertussis (Whooping cough)	• Dry cough occurring in paroxysms • Dyspnea and fever may be present • Lymphocytosis • Incubation period is 5–21 days	• Direct contact or droplet from infected person	• Symptomatic: rest, warm, humid air • Maintain nutritional status • Need to protect from secondary infections

HIV/AIDS

Human immunodeficiency virus (HIV) is a major global public health issue. HIV infection is a viral infection that progressively destroys certain white blood cells and causes acquired immunodeficiency syndrome (AIDS). HIV attacks the body's immune system, specifically the CD4 cells (T cells), which help the immune system to fight with infections, making the person more likely to get infections and disease. T cells/lymphocytes found in the blood are of two types: (1) helper (T4 or CD4) and (2) killer (T8 or CD8) cells. Helper T cells help other cells of the immune system and killer T cells kill virally infected cells and tumors.

Since the first case of HIV infection was identified, the number of children infected with HIV has risen dramatically in developing countries. India has the third largest HIV epidemic in the world, with 2.1 million people living with HIV. As the HIV infection spreads in India, increasing number of children are affected. HIV infection in young children is typically acquired from the mother at the time of birth.

Definition of Pediatric AIDS (WHO)

Pediatric AIDS is suspected in a child presenting with at least two major signs associated with two minor signs (Table 23.2) in the absence of known causes of immunosuppression, such as cancer, malnutrition or other recognized etiology.

Table 23.2: Signs of pediatric AIDS

Major signs	Minor signs
• Weight loss or abnormally slow growth • Chronic diarrhea of >1 month duration • Prolonged fever of >1 month duration	• Generalized lymphadenopathy • Oropharyngeal candidiasis • Repeated common infections • Persistent cough • Generalized dermatitis • Confirmed maternal HIV infection

Structure of HIV

Human immunodeficiency virus is a retrovirus. The core contains RNA and reverse transcriptase and several other enzymes. The protein coat capsid around the core consists of a protein called P24. Outside the protein coat is a layer composed of another protein called P17. The envelope consists of a phospholipids bilayer studded with glycoproteins Gp120 and Gp41 (Fig. 23.1).

Types of HIV

HIV-1 and HIV-2 are the two main types of HIV. HIV-1 is the most widespread type worldwide. HIV-2, a less prevalent and less pathogenic (disease-causing) type, is found principally in western Africa.

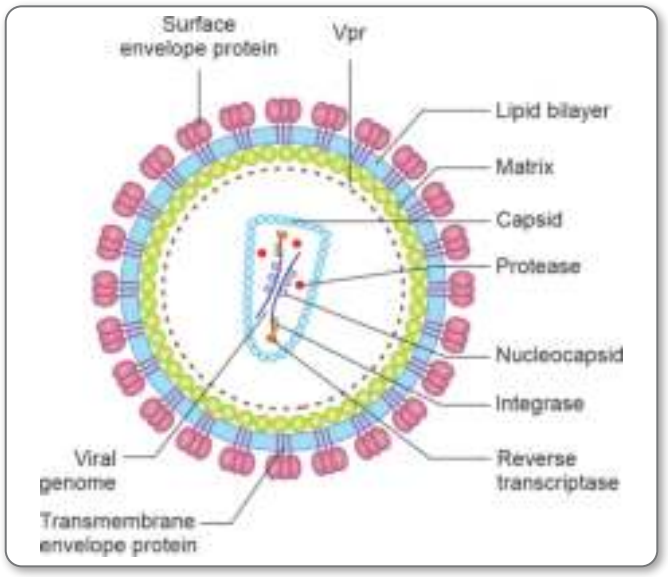


Figure 23.1: Structure of HIV

Mode of Transmission

Human immunodeficiency virus can be transmitted by:

- Vertically (mother to fetus)
- Unprotected sexual contact (oral, anal, or vaginal)
- Contaminated blood products
- Direct contact with infected body fluids (semen, vaginal fluids, and cervical secretion)
- IV drug abuse

Vertical HIV infection can occur during three periods, i.e., before birth, during delivery, or after birth. With infection before birth (period 1), the fetus can be hematologically infected by transmission of virus across the placenta or across the amniotic membranes, especially if the membranes are inflamed or infected.

Most vertical infections occur during delivery (period 2)—the longer and the greater amount of contact the neonate has with infected maternal blood and cervicovaginal secretions, the greater the risk of vertical transmission. Premature and low birth weight neonates appear to have an increased risk of infection during delivery because of their reduced skin barrier and immunologic defenses.

Postnatal vertical transmission (period 3) occurs due to breastfeeding.

HIV Life Cycle/Pathophysiology (Fig. 23.2)

- Virus enters the body of host via any mode of transmission.
- Free virus circulates in the bloodstream.
- Virus binds to CD4 cell at two receptor sites.
- Virus penetrates cell, HIV empties its contents into the cell.
- Single strands of viral RNA are converted into double-stranded DNA by the reverse transcriptase enzyme.
- Viral DNA is combined with the cell's own DNA by the enzyme known as integrase.
- When the infected cell divides, the viral DNA is read and long chains of proteins are made. It activates the HIV DNA, which makes the raw material for new viruses.
- Sets of viral protein chains come together.
- Immature virus pushes out of the cell taking some cell membrane with it.
- Immature virus breaks free of the infected cell.
- The protein chains in the new viral particle are cut by the enzyme protease into individual proteins that combine to make a working virus (the new HIV virus matures).

Human immunodeficiency virus produces cellular immune deficiency characterized by the depletion of helper T lymphocytes (CD4+ cells). The loss of CD4+ cells results in the development of opportunistic infections and neoplastic processes. There is decline in the CD4+ helper T cells, resulting in inversion of the normal CD4/CD8 T-cell ratio and dysregulation of B-cell antibody production. Immune responses to certain antigens begin to decline, and the host fails to adequately respond to opportunistic infections and normally harmless organisms.

Phases of HIV Infection

Clinically HIV infection undergoes three distinct phases: (1) acute seroconversion, (2) asymptomatic HIV infection, and (3) AIDS.

1. **Acute seroconversion:** At this point, the viral load is typically very high, and the CD4+ T-cell count drops quickly. With the appearance of anti-HIV antibodies and CD8+ T-cell responses, the viral load drops to a steady state and the CD4+ T-cell count returns to levels within the reference range, although slightly lower than before infection. Seroconversion may take a few weeks, up to several months. Symptoms during this time may include fever, flu-like illness, lymphadenopathy, and rash. These manifestations develop in approximately half of all people infected with HIV.

   Window period: This refers to the time period, after becoming infected, when an HIV test is negative. 90% of cases test positive within 3 months of exposure and 10% of cases test positive within 3–6 months of exposure.
2. **Asymptomatic HIV infection:** At this stage of infection, persons infected with HIV exhibit few or no signs or symptoms for a few years to a decade or more. Viral replication is ongoing during this time, and the immune response against the virus is effective and vigorous.

   In some patients, persistent generalized lymphadenopathy is an outward sign of infection. During this time, the viral load, if untreated, tends to persist at a relatively steady state, but the CD4+ T-cell count steadily declines.
3. **AIDS:** When the immune system is damaged enough that significant opportunistic infections begin to develop, the person is considered to have AIDS. A CD4+ T-cell

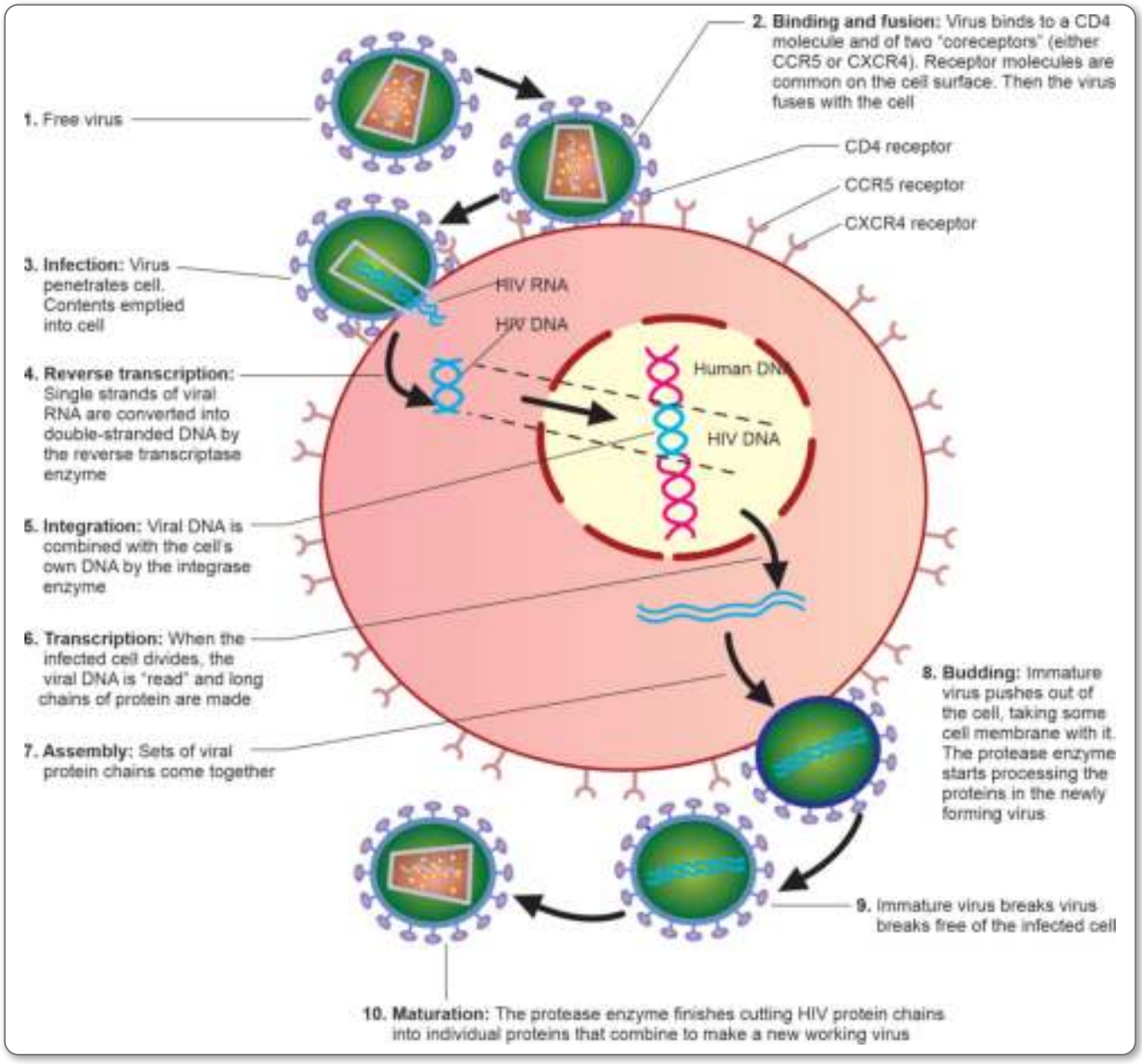


Figure 23.2: HIV life cycle

count less than 200/μL is used as a measure to diagnose AIDS, although some opportunistic infections develop when CD4+ T-cell counts are higher.

Signs and Symptoms

Signs and symptoms of pediatric HIV infection include:

- Unusually frequent and severe occurrences of common childhood bacterial infections, such as OM, sinusitis, and pneumonia.
- Recurrent fungal infections, such as candidiasis (thrush), that do not respond to standard antifungal agents.
- Recurrent or unusually severe viral infections, such as recurrent or disseminated herpes simplex or zoster infection or cytomegalovirus (CMV) retinitis; seen with moderate to severe cellular immune deficiency.
- Growth failure, failure to thrive, wasting.
- Failure to attain typical milestones: for example, impairment in the development of expressive language.
- Behavioral abnormalities (in older children), such as loss of concentration and memory, which indicate HIV encephalopathy.

Findings on physical examination may include:

- **Candidiasis:** This is most common oral and mucocutaneous presentation in HIV infection.
- Thrush in the oral cavity and posterior pharynx.
- Gingival erythema and glossitis.

- Oral hairy leukoplakia.
- Parotid enlargement and recurrent ulcers.
- Herpetic infection with herpes simplex virus: It may manifest as herpes labialis, gingivostomatitis, esophagitis, or chronic erosive, vesicular, and skin lesions; the involved areas of the lips, mouth, tongue, and esophagus are ulcerated.
- **HIV dermatitis:** An erythematous, papular rash.
- **Dermatophytosis:** Manifests as an aggressive tinea capitis, corporis, versicolor, or onychomycosis.
- *Pneumocystis jirovecii* (formerly *Pneumocystis carinii*) pneumonia (PCP): It manifests as cough, dyspnea, tachypnea, and fever.
- Lipodystrophy.
- **Digital clubbing:** As a result of chronic lung disease.
- Pitting or nonpitting edema in the extremities.
- Generalized cervical, axillary, or inguinal lymphadenopathy.

Clinical Staging for HIV-Infected Children

Stage 1

- Asymptomatic
- Persistent generalized lymphadenopathy.

Stage 2

- Unexplained persistent hepatosplenomegaly
- Papular pruritic eruptions
- Extensive wart virus infection
- Extensive molluscum contagiosum
- Recurrent oral ulcerations
- Unexplained persistent parotid enlargement
- Lineal gingival erythema
- Herpes zoster
- Recurrent or chronic upper respiratory tract infections (OM, otorrhea, sinusitis, tonsillitis)
- Fungal nail infections

Infections are seen more often than usual. Medication may help the patient to fight these and it is possible to continue with daily life. Weight loss is common.

Stage 3

- Unexplained moderate malnutrition not adequately responding to standard therapy
- Unexplained persistent diarrhea (14 days or more)
- Unexplained persistent fever (above 37.5°C, intermittent or constant) for longer than 1 month
- Persistent oral candidiasis (after first 6–8 weeks of life)
- **Oral** hairy leukoplakia
- Acute necrotizing ulcerative gingivitis/periodontitis
- Lymph node TB
- Pulmonary TB
- Severe recurrent bacterial pneumonia
- Symptomatic lymphoid interstitial pneumonitis
- Chronic HIV-associated lung disease including bronchiectasis
- Unexplained anemia (<8 g/dL), neutropenia (<0.5 × 109/L^3) or chronic thrombocytopenia (<50 × 109/L^3)

Advanced, debilitating opportunistic infections occur. Weight loss continues, along with a lack of energy and reduced ability to carry out daily activities. Again, primary health care, early treatment of infections and prophylaxis is all essential to promote health and preserve any remaining immune function for as long as possible. Antiretrovirals (ARVs) should be started now if available.

Stage 4

- Unexplained severe wasting, stunting or severe malnutrition not responding to standard therapy
- Pneumocystis pneumonia and recurrent severe bacterial infections (e.g., empyema, pyomyositis, bone or joint infection, meningitis, but excluding pneumonia)
- Chronic herpes simplex infection (orolabial or cutaneous of more than 1 month duration or visceral at any site)
- Extrapulmonary TB, Kaposi's sarcoma and esophageal candidiasis (or candidiasis of trachea, bronchi or lungs)
- Central nervous system toxoplasmosis (after 1 month of life)
- HIV encephalopathy and cytomegalovirus infection: Retinitis or CMV infection affecting another organ, with onset at age over 1 month
- Extrapulmonary cryptococcosis (including meningitis) and disseminated endemic mycosis (extrapulmonary histoplasmosis, coccidioidomycosis)
- Chronic cryptosporidiosis
- Chronic isosporiasis
- Disseminated nontuberculous mycobacteria infection, cerebral or B-cell non-Hodgkin lymphoma
- Progressive multifocal leukoencephalopathy
- Symptomatic HIV-associated nephropathy or HIV-associated cardiomyopathy

Children are often extremely sick and very serious opportunistic infections occur. Weight loss is considerable. Treatment of infections and symptom management is of paramount importance. Children may be cared for in the home or a hospice. The need for prophylaxis continues as does the need for ARVs.

Investigations

Common tests done are:

- HIV DNA PCR—since maternal HIV antibody is present after birth, infants younger than 18 months require virologic assays that directly detect HIV in order to diagnose HIV infection. Preferred virologic assays include HIV DNA polymerase chain reaction (PCR) and HIV RNA assays. The HIV DNA PCR is a qualitative test and usually less expensive. Further virologic testing in infants

with known perinatal HIV exposure is recommended at 2 weeks, 4 weeks, and 4 months.
- In older children and adults, an enzyme-linked immunosorbent assay (ELISA) is done to detect HIV antibody, followed by a confirmatory Western blot to diagnose HIV infection.
- Rapid HIV tests, which provide results in minutes, must be followed with confirmatory Western blotting or immunofluorescence antibody testing.

Medical Management

Normal CD4 counts for children are:
- **<12 months:** >1,500 cells/mm^3
- **1–5 years:** >1,000 cells/mm^3
- **>6 years:** >550 cells/mm^3

National AIDS Control Organisation (NACO) Guidelines for initiating ART in children is given in Table 23.3.

NACO has set guidelines for ARV treatment for children which follow the WHO guidelines.
- Stabilize any opportunistic infection (OI) before initiation of ART.

In children with pulmonary or lymph node tuberculosis, the CD4 level and clinical status should be used to determine the need for and timing of initiation of ART in relation to tuberculosis (TB is an OI but can occur at any CD4 count, it is best to treat TB first because of drug interactions with TB and ART drugs unless low CD4).
- **Antiretroviral therapy (ART):** The goal of ART is to suppress HIV viral load and to maintain CD4 cell numbers. Classes of antiretroviral agents include the following:
  - Nucleoside or nucleotide reverse transcriptase inhibitors (NRTIs): Zidovudine (AZT), lamivudine (3TC)
  - Protease inhibitors (PIs): Indinavir, ritonavir
  - Non-nucleoside reverse transcriptase inhibitors (NNRTIs): Nevirapine (NVP)

The reverse transcriptase inhibitors (NRTIs, NNRTIs) suppress HIV replication by competitive inhibition of viral reverse transcriptase. Protease inhibitors prevent the late stages of viral replication by interfering with the formation of structural proteins of the virion core.

Table 23.3: Guidelines for initiating antiretroviral therapy in children (NACO)

Age	CD4 Count
<11-month-infant	Irrespective of CD4 count, ART to be given
12–35 months	CD4 <750 cells/mm^3 (<20% of total lymphocytes)
36–59 months	CD4 <350 cells/mm^3 (15% of total lymphocytes)
>5-year-old	Follow adult guidelines, i.e., initiate ART before CD4 drops below 250 cells/mm^3. Start ART if <350 cells/mm^3 if symptomatic

Highly active antiretroviral therapy (HAART) is a combination of 2 NRTIs with a PI or NNRTI.
- Cotrimoxazole prophylaxis from 4 to 6 weeks of age till immune status is known.
- Adequate nutrition with micronutrients like zinc.
- *Immunization:* Children with asymptomatic HIV infection can receive all immunizations.

Prevention of Mother-to-Child Transmission (MTCT)

Pregnant women who are found to be HIV positive are initiated on lifelong ART irrespective of CD4 count and WHO clinical Staging; their newborn (HIV exposed) babies are initiated on 6 weeks of Syrup Nevirapine immediately after birth to prevent transmission of HIV from mother to child and is extended to 12 weeks of Syrup Nevirapine if the duration of the ART of mother is less than 24 weeks.

The HIV exposed baby is initiated on Cotrimoxazole prophylaxis at 6 weeks and is tested for HIV DNA PCR at 6 weeks by DBS (Dry Blood Spot) collection. If the DBS sample is positive for HIV DNA PCR, then a repeat DBS sample is tested for HIV DNA PCR. The HIV exposed baby is then initiated on lifelong ART at the earliest if confirmed HIV positive through 2 DNA PCR test (NACO, 2014).
- **ARV drug regimens for pregnant women:** Recommended regimen for pregnant woman with indication for ART is combination of AZT, 3TC, and NVP in antepartum, intrapartum, and postpartum period.

  Recommended regimen for pregnant woman not eligible for ART but for preventing MTCT:
  - **Antepartum:** AZT from 28 weeks of pregnancy
  - **Intrapartum:** combination of single dose of NVP, AZT, and 3TC
  - **Postpartum:** combination of AZT and 3TC for 7 days

  Recommended regimen for pregnant woman in labor and not received ART:
  - **Intrapartum:** Combination of single dose of NVP, AZT, and 3TC
  - **Postpartum:** Combination of AZT and 3TC for 7 weeks
- **Intrapartum interventions:** Avoid ARM unless medically indicated, elective cesarean section at 38 weeks before onset of labor and rupture of membranes. Avoid procedures increasing risk of exposure to maternal blood and secretions like use of scalp electrodes.
- **Breastfeeding:** Avoiding breastfeeding when replacement feeding is acceptable, feasible, and affordable. It is safe to prevent transmission of infection through breast milk.

Nursing Management

Nursing assessment: Assess the child for infections like candidiasis, CD4 count, pain.

Nursing Diagnosis

- Risk for infection related to impaired body defenses.
- Altered nutrition: less than body requirement related to recurrent illness, diarrhea, anorexia, and oral candidiasis.
- Impaired social interaction related to physical limitation and social stigma.
- Chronic pain related to disease process.
- Interrupted family process related to having a child with life-threatening disease.
- Anxiety
- Deficient knowledge

Nursing Goals

- No infection will be evident and disease will not spread to others.
- Adequate nutrition will be maintained.
- Child will participate in activities with peer group and family.
- Pain will be controlled or alleviated.
- Child and family will receive appropriate support.

Nursing Interventions

- Institute and teach parents blood and body fluid precautions. Follow standard precautions.
- Educate child about methods of transmission, safe sex practices, abstinence, and hazards of IV drug abuse.
- Encourage at risk adolescent to undergo HIV testing.
- Manage pain using pharmacologic and nonpharmacologic interventions like NSAIDs, opioids, guided imagery and distraction techniques.
- Provide age appropriate information; carefully disclose the diagnosis to child and family members.
- Administer prophylactic antibiotics (cotrimoxazole) to prevent opportunistic infections and antiretroviral agents (syrup zidovudine).
- Monitor CD4 cell counts.
- Provide human contact to meet emotional needs.
- Promote ART adherence among children using play therapy.
- Refer the family to PLHIV network, NGOs, etc.

Strategies for Prevention of HIV Transmission

- Safe practices, follow ABC—Abstinence from sex, being faithful to partner and use of condoms.
- Apply prevention of parent-to-child transmission (PPTCT) approach to prevent vertical transmission of HIV.
- Harm reduction strategies, i.e., use of disposable needles, shifting to less dependent drug in case of drug abusers.
- Screen all blood and blood products.
- Follow universal precautions.
- Follow safer sex practices, e.g., masturbation, avoiding anal sex.
- Identify and treat STIs and other infections.
- Provide referral for treatment of drug dependence.
- The National AIDS Control Programme, launched in 1992, is being implemented as a comprehensive programme for prevention and control of HIV/AIDS in India.

DENGUE FEVER

Dengue fever is transmitted by the bite of an *Aedes* mosquito infected with a dengue virus. The mosquito becomes infected when it bites a person with dengue virus in their blood. It cannot spread directly from one person to another person.

Symptoms of Dengue Fever

Symptoms usually begin 4–6 days after infection and last for up to 10 days, it may include:

- Sudden, high fever
- Severe headaches
- Pain behind the eyes
- Severe joint and muscle pain
- Fatigue
- Nausea
- Vomiting
- Skin rash, which appears 2–5 days after the onset of fever
- Mild bleeding (such a nosebleed, bleeding gums, or easy bruising)

Complications

The complication of dengue fever is dengue hemorrhagic fever, characterized by high fever, damage to lymph and blood vessels, bleeding from the nose and gums, enlargement of the liver, and failure of the circulatory system. The symptoms may progress to massive bleeding, shock, and death. This is called dengue shock syndrome (DSS).

Diagnosis

Blood test to check for the virus or antibodies.

Treatment

- Analgesics like acetaminophen
- Rest
- Maintain hydration—drink plenty of fluids
- Monitor for complications like hemorrhagic spots, bleeding

Prevention

- Prevent bites by infected mosquitoes.
- Use mosquito repellents, even indoors.
- When outdoors, wear long-sleeved shirts and long pants tucked into socks.
- When indoors, use air conditioning if available.
- Make sure window and door screens are secure and free of holes.

- Use mosquito nets.
- To reduce the mosquito population, clean spaces regularly where mosquitoes can breed. These include old tires, cans, or flower pots that collect rain. Regularly change the water in pots for birds and pets' water dishes.

COVID-19

Introduction

The SARS-CoV-2 enters host lung cells via the ACE2 receptor. The virus can spread to other organs and infect ACE2-expressing cells at local sites, causing multiorgan injury.

Mode of Transmission

Coronavirus disease 2019 (COVID-19) is transmitted in three main ways:

1. Contact transmission
2. Droplet transmission
3. Airborne transmission

Incubation Period

The typical incubation period of COVID-19 ranges from 2–14 days, mean is 6 days (Fig. 23.3).

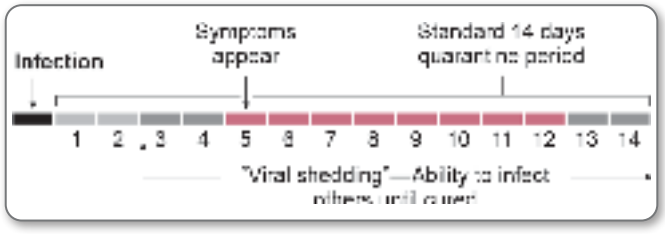


Figure 23.3: Incubation period

Diagnostic Tests

- PCR (Polymerase chain reaction)
- RT (Reverse transcriptase) PCR
- CBNAAT: Xpert: TruNat
- CRISPR-mediated detection
- Loop mediated isothermal amplification
- Antigen detection: Point of care tests
- Antibody detection: Not for acute disease

Preferred sample is throat and nasal swab in viral transport media and transported on ice.

Spectrum of COVID-19 in children includes (Fig. 23.4):

- Asymptomatic
- Mild
- Moderate
- Severe—acute respiratory distress syndrome (ARDS), pneumonia, septic shock, multiorgan dysfunction syndrome (MODS)
- Multisystem inflammatory syndrome-children (MIS-C)

The common symptoms of COVID-19 in children are shown in Figure 23.5.

Management

For the management purpose, severe cases are admitted in **dedicated COVID-19 hospitals (DCHs)**, cases with moderate symptoms, particularly those requiring oxygen support are admitted in **dedicated COVID-19 health centers (DCHCs)** and mild or asymptomatic cases are either home isolated or admitted in **COVID-19 care centers (CCCs)**.

The guidelines for management of asymptomatic, mild, moderate, and severe cases are shown in Figure 23.6.

Severe category of COVID-19 includes ARDS, shock, and MIS-C.

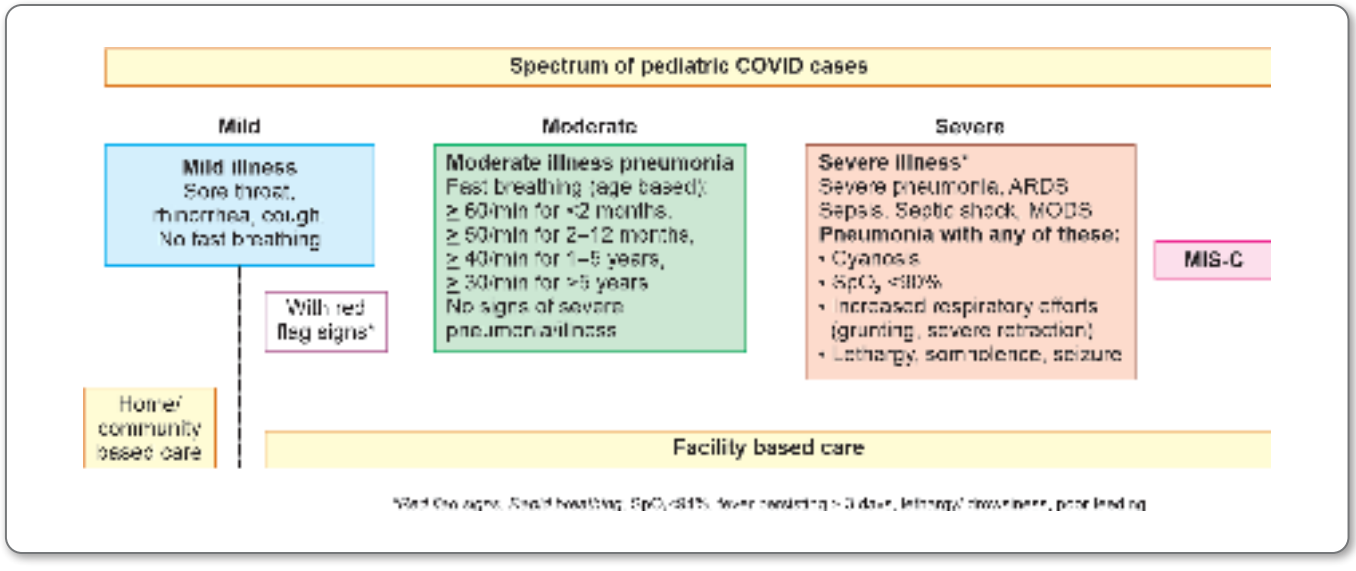


Figure 23.4: Spectrum of pediatric COVID cases and scope of management

Common symptoms		
Fever	Sore throat/throat irritation	Diarrhea
Cough	Body ache/headache	Anorexia/nausea/vomiting
Rhinorrhea	Malaise/weakness	Loss of sense of smell and/or taste

Differentiating symptoms/signs	Asymptomatic	Mild	Moderate	Severe
Respiratory rate/min	**Normal** with age dependent variation	**Normal** with age dependent variation	**Rapid respiration** (age based) <2 months ≥60/min 2–12 months ≥50/min 1–5 years ≥40/min >5 years ≥30/min	**Rapid respiration** (age based) <2 months ≥60/min 2–12 months ≥50/min 1–5 years ≥40/min >5 years ≥30 min
SpO_2 on room air	≥94%	≥94%	≥90%	<90%
Grunting, severe retraction of chest	X	X	X	+/–
Lethargy, somnolence	X	X	X	+/–
Seizure	X	X	X	+/–

Figure 23.5: COVID-19 symptoms in children

Management of ARDS and Shock

Management/Treatment of ARDS

Acute respiratory distress syndrome may be classified based on Pediatric Acute Lung Injury Consensus Conference (PALICC) definition into mild, moderate, and severe.

Mild ARDS

High flow nasal oxygen (start with 0.5 L/kg/min to begin with and increase to 2 L/kg/min with monitoring) or noninvasive ventilation (BiPAP or CPAP) may be given.

Moderate-Severe ARDS

- Lung protective mechanical ventilation may be initiated; low tidal volume (4–8 mL/kg); plateau pressure <28–30 cm H_2O; MAP <18–20 cm H_2O; driving pressure <15 cm H_2O; PEEP 6–10 cm H_2O (or higher if severe ARDS); FiO_2 <60%; sedoanalgesia ± neuromuscular blockers; cuffed ETT, inline suction, heat and moisture exchange filters (HMEF).
- Avoid frequent disconnection of ventilator circuit, nebulization or metered-dose inhaler.
- Restrict fluids; calculate fluid overload percentage, keeping it <10%.
- Prone position may be considered in hypoxemic children if they are able to tolerate it.
- Daily assessment for weaning and early extubation; enteral nutrition within 24 hours, achieve full feeds by 48 hours.
- Transfusion trigger Hb <7 g/dL if stable oxygenation and hemodynamics, and <10 g/dL if refractory hypoxemia or shock.

Management of Shock

- Consider crystalloid fluid bolus 10–20 mL/kg cautiously over 30–60 minutes with early vasoactive support (epinephrine).
- Start antimicrobials within the first hour, after taking blood cultures, according to hospital antibiogram or treatment guidelines.
- Consider inotropes (milrinone or dobutamine) if poor perfusion and myocardial dysfunction persists despite fluid boluses, vasoactive drugs and achievement of target mean arterial pressure.
- Hydrocortisone may be added if there is fluid refractory catecholamine resistant shock (avoid if already on dexamethasone or methylprednisolone).
- Once stabilized, restrict IV fluids to avoid fluid overload.
- Initiate enteral nutrition—sooner the better.
- Transfusion trigger Hb <7 g/dL if stable oxygenation and hemodynamics, and <10 g/dL if refractory hypoxemia or shock.

Management of MIS in Children and Adolescents Temporally Related to COVID-19

Multisystem inflammatory syndrome in children (MIS-C) is a new syndrome in children characterized by unremitting fever >38°C and epidemiological linkage with SARS-CoV-2.

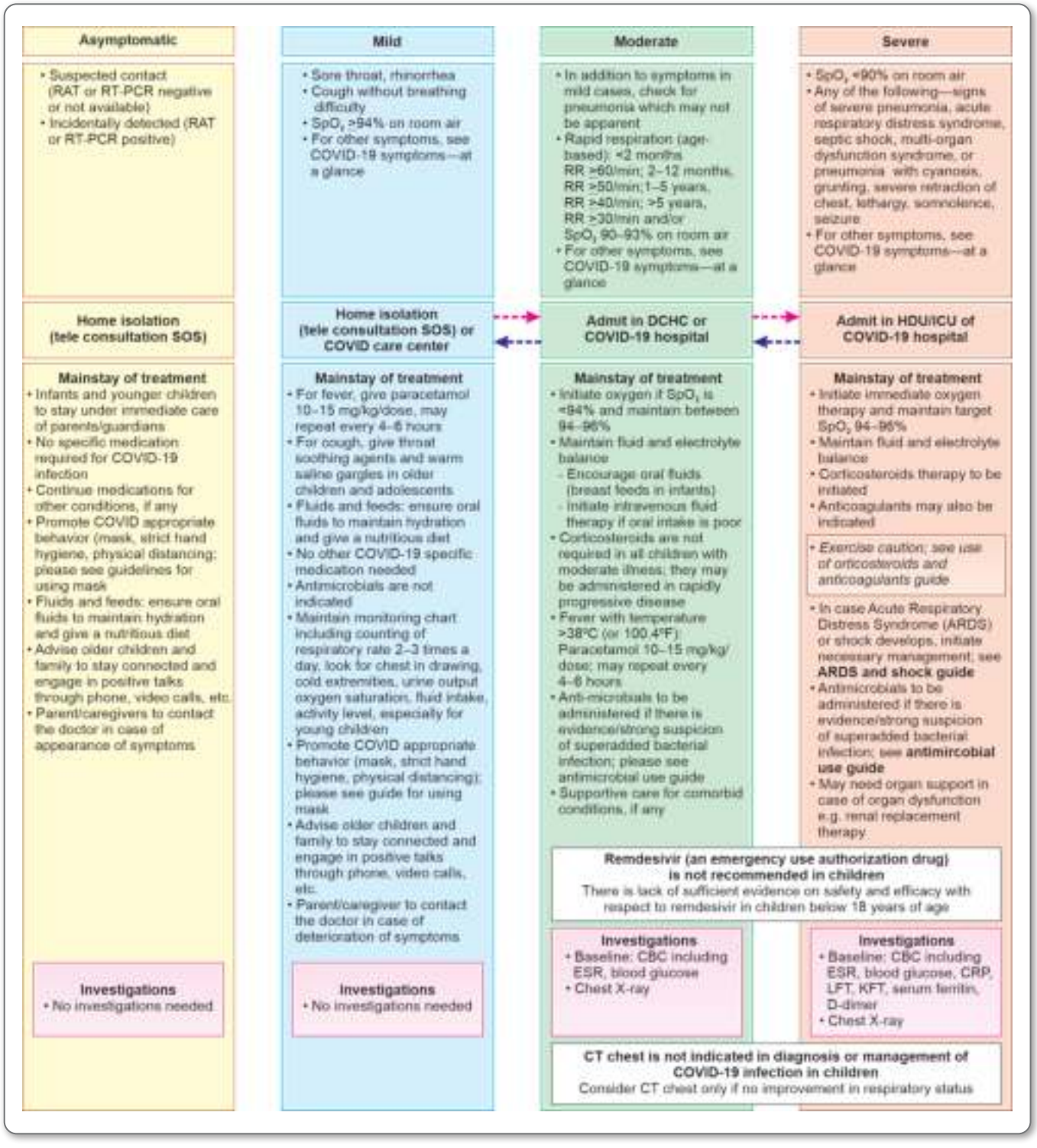


Figure 23.6: Guidelines for management of COVID-19 in children

Diagnostic Criteria (WHO)

Children and adolescents 0–18 years of age with fever ≥3 days
And any two of the following:

- Rash or bilateral nonpurulent conjunctivitis or mucocutaneous inflammation signs (oral, hands or feet)
- Hypotension or shock
- Features of myocardial dysfunction, pericarditis, valvulitis, or coronary abnormalities (including ECHO findings or elevated troponin/NT-proBNP)
- Evidence of coagulopathy (PT, PTT, elevated D-dimers)

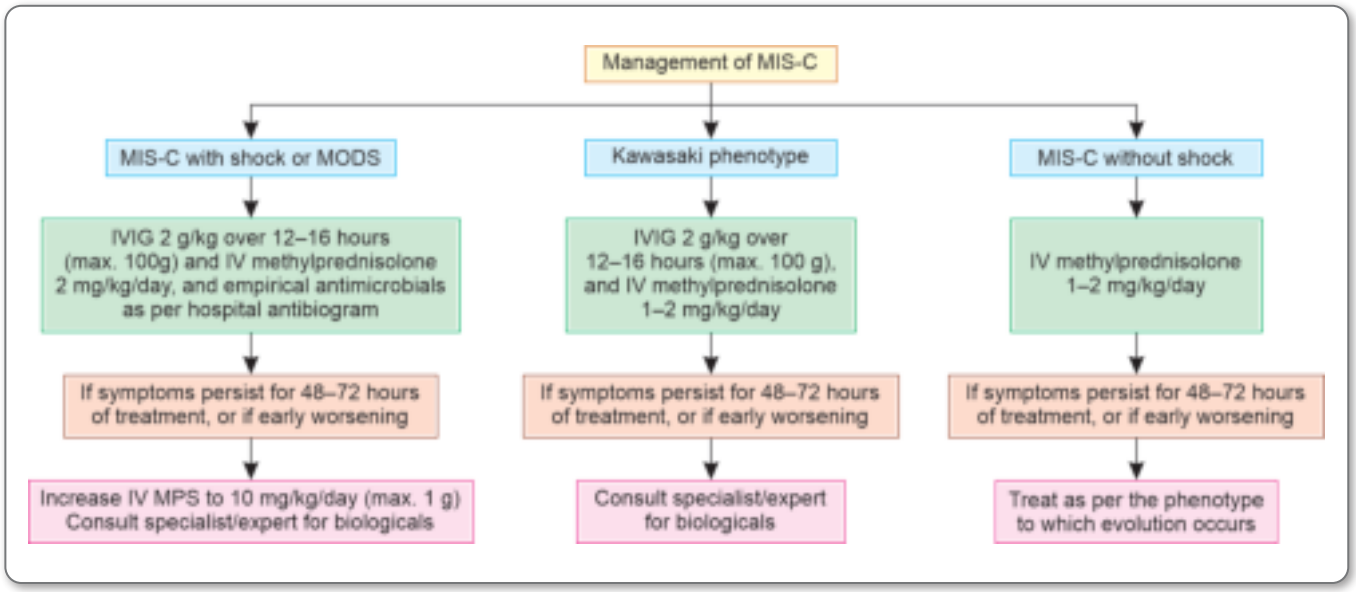


Figure 23.7: Management of multisystem inflammatory syndrome in children (MIS-C)

- Acute gastrointestinal problems (diarrhea, vomiting, or abdominal pain)

And elevated markers of inflammation, such as ESR (>40 mm), C-reactive protein (>5 mg/L), or procalcitonin

And no other obvious microbial cause of inflammation, including bacterial sepsis, staphylococcal or streptococcal shock syndromes

And evidence of recent COVID-19 infection (RT-PCR, antigen test or serology positive), or likely contact with patients with COVID-19

Alternative diagnoses that must be excluded before making a diagnosis of MIS-C, i.e., tropical fevers (malaria, dengue, scrub typhus, enteric fever), toxic shock syndrome (staphylococcal or streptococcal), bacterial sepsis.

MIS-C with Kawasaki disease (KD) phenotype is characterized by fever, conjunctival redness, oropharyngeal findings (red and/or cracked lips, strawberry tongue), rash, swollen and/or erythematous hands and feet and cervical lymphadenopathy. For management, refer Figure 23.7.

- Appropriate supportive care is needed preferably in ICU for treatment of cardiac dysfunction, coronary involvement, shock or multiorgan dysfunction syndrome.
- IVIG to be given slower (over up to 48 hours) in children with cardiac failure/fluid overload.
- Taper steroids over 2–3 weeks with clinical and CRP monitoring.
- Aspirin 3–5 mg/kg/day, maximum 75 mg/day in all children for 4–6 weeks (with platelet count >80,000/µL) for at least 4–6 weeks or longer for those with coronary aneurysms.
- Low molecular weight heparin (Enoxaparin) 1 mg/kg/dose twice daily s/c in >2 months (0.75 mg/kg/dose in <2 months) if patient has thrombosis or giant aneurysm with absolute coronary diameter ≥8 mm or Z score ≥10 or LVEF <30%.
- For children with cardiac involvement, repeat ECG 48 hourly and repeat ECHO at 7–14 days and between 4 and 6 weeks, and after 1 year if initial ECHO was abnormal.

Nursing Management

- Close clinical monitoring—HR, RR, BP, and SpO_2, work of breathing and oxygen requirement.
- Institute oxygen therapy—HFNC, NIV, mechanical ventilation.
- Monitor ventilatory setting: Low tidal volume, moderate to high PEEP, permissive hypercapnia, use cuffed ET tube.
- Prone ventilation.
- Administer medications—antimicrobials, corticosteroids, anticoagulants, IVIG.
- Administer IV fluids.
- Prevent aerosols spread by following airborne/droplet/contact precautions.
- Collaboration with all the members of health team.
- Educating and counseling caregivers.

Summary

Children under 5 are especially vulnerable to infectious diseases like malaria, pneumonia, diarrhea, HIV and tuberculosis. Despite being preventable and treatable these diseases are still killing children in large numbers. It is important to understand how the diseases are spread, incubation period (time of exposure to symptoms), signs and symptoms and time period when a person is contagious.

Assess Yourself

1. Define window period, opportunistic infections.
2. Write full forms of HIV/AIDS, ELISA, PCR, HAART, PPTCT, and MIS-C.
3. What is the mode of transmission of HIV infection? Discuss the medical management of a child with HIV infection.
4. Fill in the blanks:
   a. The cells which help in fighting infections are …
   b. Normal CD4 count in children is ……
   c. The example of NRTI is …….. and NNRTI is ……..
5. Discuss the management of a child with COVID-19 infection with moderate category.
6. What are the facilities where children with COVID-19 can be treated?