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Textbook of

Pediatric Nursing

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

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Unit VI



Childhood Emergencies

Learning Objectives

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

- Develop ability to meet childhood emergencies and perform child CPR.

Unit Outline

Chapter 14 Management of Different Emergencies in Children



Chapter 14

Management of Different Emergencies in Children

Chapter Outline

- Introduction

Managing Common Childhood Emergencies

- Foreign Body Airway Obstruction (FBAO, Choking)
- Snakebite
- Dog Bite

- Drowning
- Poisoning
- Hemorrhage
- Burns
- Pediatric Basic Life Support

INTRODUCTION

There can be different types of specific emergencies in children, like respiratory, cardiovascular, neurologic, gastrointestinal, genitourinary, hematologic, musculoskeletal, ENT, or endocrine emergencies. In this chapter we will study about specific child health emergencies. In case of emergency, it is important to do focused assessment, i.e.

- Take quick history and perform physical examination
- Perform physical examination includes:
 - General appearance
 - Anthropometry
 - Vital signs
 - Developmental assessment
- Perform systemic examination
 - Respiratory system
 - Cardiovascular system
 - Gastrointestinal system
 - Nervous system
 - Integumentary system

MANAGING COMMON CHILDHOOD EMERGENCIES

FOREIGN BODY AIRWAY OBSTRUCTION (FBAO, CHOKING)

Foreign body airway obstruction (FBAO) occurs in children with impaired swallowing mechanism or cough reflex. It is common in infants and toddlers. Generally, occurs in right bronchus since it is short, wide and straight. Things like grapes, peanuts, balloon, food, nuts, beans, buttons are commonly aspirated.

Definition: FBAO is defined as passage of any foreign body into the lung.

Causes of FBAO are as follows:

- Inhalation of foreign body
- Altered level of conscious as in case of sedation, anaesthesia, seizures or stroke
- Tracheoesophageal fistula and CNS disorders

Assessment

- Sudden onset of respiratory distress with coughing, gagging, stridor
- Wheezing, Dyspnea
- Foreign object in the mouth or throat

Diagnosis can be made by bronchoscopy and neck or chest X-ray.

Relief of FBAO

- In case of mild FBAO, child is able to cough and make some sounds
- Do not interfere, allow the victim to clear airway by coughing
- Observe for signs of severe FBAO, i.e., the child is not able to speak.
- In case of infants, try to relieve FBAO by giving up to 5 back blows and 5 chest thrusts (Fig. 14.1). Using two fingers, deliver up to 5 thrusts over the lower half of the breastbone. Repeat the sequence of 5 back blows and 5 chest thrusts until the object is expelled or until the infant becomes unconscious. Depress the sternum 1/2 to 1 inch for each thrust. Avoid the tip of the sternum.

Other modes of management are:

- Tracheotomy or intubation
- Bronchoscopy to identify and remove foreign object
- Heimlich maneuver (Fig. 14.2), which involves abdominal thrusts. It is not to be used for infants as it may damage liver.

SNAKEBITE

Pediatric snakebite mortality and morbidity remains a significant contributor to the national statistics. There are about 216 species of snakes identifiable in India, of which 52 are known to be poisonous. The major families of poisonous snakes in India are Elapidae which includes common cobra (*Naja naja*), king cobra and common krait (*bungarus caeruleus*), viperidae includes *Russell's viper*, *echis carinatus* (saw scaled or carpet viper) and pit viper and hydrophidae (sea snakes).



Figure 14.1: Back blows and chest thrusts



Figure 14.2: Heimlich maneuver

Snake bite is common in Indian forests. Most of the snakes are non-venomous. Snake bite is most common in school-age children, adolescent and young adults. Snake bite is a life-threatening emergency. The key to minimizing mortality and morbidity is aggressive management of the ABCs of resuscitation, and timely and judicious administration of adequate dose of anti-venom.

Assess the child for the following symptoms:

- Mild local pain, burning, swelling, lymphadenopathy
- Autonomic nervous system symptoms, like hypersalivation, gooseflesh
- Neuroparalytic symptoms—ptosis, blurred vision, vertigo, paralysis of facial, neck and intercostal muscles
- Loss of consciousness, convulsions

Diagnosis and Testing

Bite marks do not determine whether the biting species was venomous or non-venomous. Many venomous species have more than one set of fangs and non-venomous species can leave just two punctures from enlarged teeth, which can appear to be fang-like.

The 20 Minute Whole Blood Clotting Test (20 WBCT) was adopted as the standard test for coagulopathy. It is simple to carry out but requires a clean, new and dry test tube. A few mL of fresh venous blood is left undisturbed for 20 minutes, and then gently tilted. If the blood is still liquid this is evidence of coagulopathy and confirms that the biting species is Viperine. Cobras or Kraits do not cause anti-hemostatic symptoms.

Management

- Provide reassurance
- First aid treatment includes immobilizing the limb and rapid transport to hospital. Controversial methods are suctioning by mouth, tourniquets, KCl instillation, incision and cauterization
- If the snake is non-venomous, administer injection TT.
- For venomous snake, administer anti-snake venom (ASV), IV.
- Criteria for giving ASV are (i) Spontaneous bleeding and/or incoagulable blood measured by 20 WBCT; and (ii) visible neurological signs or severe local swelling.
- 8–10 vials of ASV is the initial starting dose for both adults and children.
- Deal with anaphylaxis early and with IM adrenaline (0.5 mg of 1:1000) as drug of choice.
- Observe for 24 hours
- **Adjunct therapy:** Mechanical ventilation, FFP, BT

Prevention

- Wear protective clothing - boot, socks, long trousers
- Avoid travelling across dark areas, especially after heavy rains
- Avoid putting hand or sticks in holes
- Avoid disturbing, attacking live snakes
- Avoid handling dead snakes
- Avoid climbing on rocks and trees covered with dense foliage
- Avoid swimming in overgrown lakes and rivers

DOG BITE

Dog bite is a bite from a pet or street dog which can result to a viral disease known as rabies, bacterial infections, nerve and muscle damage, and tetanus. There is a possibility of contracting rabies from other animals also (horse, cat, sheep, goat).

Transmission

Children are usually infected following a deep bite or scratch from an animal with rabies, and transmission to humans by rabid dog's accounts for up to 99% of cases.

The incubation period ranges from a few days to several months, whereas the duration of illness until death varies from 1 to 7 days.

Symptoms

The incubation period for rabies is typically 2–3 months but may vary from 1 week to 1 year, depending upon factors such as the location of virus entry and viral load. Initial symptoms of rabies include fever with pain and unusual or unexplained tingling, pricking, or burning sensation (paraesthesia) at the

wound site. As the virus spreads to the central nervous system, progressive and fatal inflammation of the brain and spinal cord develops.

There are two forms of the disease:

1. **Furious rabies:** It results in signs of hyperactivity, excitable behavior, hydrophobia (fear of water) and sometimes aerophobia (fear of drafts or of fresh air). Death occurs after a few days due to cardio-respiratory arrest.
2. **Paralytic rabies:** It accounts for about 20% of the total number of human cases. This form of rabies has a longer course than the furious form. Muscles gradually become paralyzed, starting at the site of the bite or scratch. A coma slowly develops, and eventually death occurs.

Management

- Management of wound by cleaning and washing with soap and running water. Later applying alcohol or tincture iodine/aqueous solution of iodine.
- Antirabies serum should be infiltrated around the wound, if the bite is less than 24 hours old. Tetanus toxoid should be given and antibiotics should be administered if wound appears unhealthy.
- Passive immunization with anti-rabies serum combined with local treatment of the wound and active immunization provides best protection to the exposed individual.
- Active immunization of rabies vaccine can be provided even after exposure to the infection due to long incubation period of rabies.

Schedule of Vaccination of Anti-rabies Vaccines

The standard schedule is five doses on days 0, 3, 7, 14 and 30, with day '0' being the day of commencement of vaccination. A regimen of 5 one-mL doses of rabies vaccines should be administered IM to previously unvaccinated persons. The first dose of the 5-dose course should be administered as soon as possible after exposure.

Prevention

- Eliminating rabies in dogs by vaccination
- Awareness on rabies and preventing dog bites
- Immunization of children

DROWNING

Drowning is a process resulting in primary respiratory impairment from submersion in a liquid medium. It is a significant worldwide public health concern, ranking as the third leading cause of unintentional injury death and accounting for 7% of all injury-related deaths. It is a major cause of disability and death, particularly in children. At least one-third of survivors sustain moderate-to-severe neurologic sequelae.

Terminology

- Drowning – victim dies
- Near drowning – submersion victim survives
- Wet drowning – aspiration of fluid in lungs

Causes

Drowning generally happens when a child is left unsupervised at bath tubs, swimming pools, buckets, toilets, lakes, rivers or near irrigation ditches. Bathtub drowning may represent child abuse.

The most important contributory factors to morbidity and mortality from drowning are hypoxemia and acidosis and the multiorgan effects of these processes. CNS damage may occur because of hypoxemia sustained during the drowning episode.

Assessment

- **Place:** Where the drowning has taken place?
- Type of water-sea; fresh
- Temperature of water
- Length of time child was submerged
- Symptoms following submersion—Loss of consciousness, vomiting, coughing
- Associated cervical or spine injuries

Management

- **Prehospital care:** Remove victim from water with attention to cervical spine precautions. Give rescue breaths. Consider giving CPR.
- The problems with drowning include hypoxia, aspiration and hypothermia. The most critical role in management is prompt correction of hypoxemia and acidosis. The degree of hypoxemia is often underrecognized. Patients should receive 100% oxygen and should be monitored closely via pulse oximetry, blood gas analysis, or both. Consider intubation and positive end-expiratory pressure (PEEP) with mechanical ventilation in any patient with poor respiratory effort, altered sensorium, severe hypoxemia, severe acidosis, or significant respiratory distress.
- Obtain venous access, administer IV fluids
- Monitor child's cardiopulmonary and neurologic status
- Obtain blood samples for lab analysis prepare, for diagnostic tests
- Prepare for active rewarming—gastric lavage, peritoneal lavage, warm IV fluids, cardiopulmonary bypass
- Insert NG tube
- Insert indwelling urinary catheter. Measure urinary output
- In case of pulmonary edema administer diuretics
- For metabolic acidosis administer sodium bicarbonate
- In case of convulsions administer phenobarbitone, diazepam

POISONING

It is important to prevent poisoning in children as it can have very serious effects in children. Bodies of children are smaller and less developed than those of adults, and thus children are especially susceptible to the effects of toxic substances. Poisoning can affect lungs, heart, central nervous system, gastrointestinal tract, kidneys and other parts of body.

Most poisonings in children are unintentional and occur in the home. More than half of reported poisonings occur in children under age five. A child may become curious and ingest a toxic substance, inhale it, or absorb these substances through the skin.

In adolescent, intake of toxic agent may be a suicidal attempt.

Causes

- Improper storage of drugs, chemicals, disinfectants, detergents.
- Poor visibility
- Poor lighting
- Purposeful
- Accidental
- Large family, small accommodation
- Environmental – lead, caustic soda, insecticides, kerosene

Assessment

- GI – anorexia, nausea, vomiting, diarrhea, malaise, abdominal pain, cramping
- CNS – seizures, dilated or pinpoint pupils
- Skin – rashes, lesions or burns of mouth, cyanosis in cyanide poisoning
- CVS – dyspnea, arrhythmias, metabolic acidosis
- Others – odor from mouth, respiratory failure
- Save vomitus, stool for identifying poisonous material
- Assess age, weight, CNS, route of poisoning

Management

- Initial stabilization – ABC. Ensure airway is patent
- Reduce absorption by the following methods:
 - Remove poison from body
 - ◆ Gastric lavage
 - ◆ Remove from exposed site (inhalation)
 - ◆ Eye wash, skin wash
 - Administer antidote (Table 14.1)
 - Eliminate absorbed poison
 - ◆ Emesis
 - ◆ Adsorbents – activated charcoal
 - ◆ Laxatives – sorbitol, magnesium
 - ◆ Diuretics
 - ◆ Dialysis
 - ◆ Exchange transfusion

Table 14.1: Antidotes for specific poisoning

Indications	Antidotes
Cyanide	Amyl nitrite
Isoniazid	Pyridoxine
Anticholinergics	Neostigmine
Insulin	Glucose
Paracetamol	Acetylcysteine
Morphine	Naloxone
Lead	Calcium Na edetate
Iron	Desferrioxamine
Methanol	Ethanol
Digoxin	Anti-Digoxin
Organophosphorus	Atropine
Copper	Penicillamine

- Provide emotional support
- Provide symptomatic treatment for the following conditions:
 - Metabolic acidosis
 - Convulsions
 - Hypoglycemia
 - Hyperkalemia
 - Hypotension
- In kerosene poisoning, lavage should be done very cautiously. Better to avoid stomach wash in case of ingestion of kerosene.

Prevention

- Education to parents about potential household poisons, like medicines, pesticides, insecticides, cosmetics lotion, perfume, etc.
- Parental supervision of toddlers
- Safe storage: Out of reach from children, don't store with foods, store in lock and key
- Properly labelled containers
- Don't take medicines in dark
- Do not store kerosene oils in beverage bottles and leave on ground
- Keep emergency numbers available.

HEMORRHAGE

Hemorrhage is a process of loss of blood either through a wound or because of any medical condition. Children are very prone to injuries as they are in the stage of attaining their motor developments. A complex system of clotting, anti-clotting mechanics exists to ensure clot formation only in the presence of blood vessel injury and to limit clotting process. Dysfunction of these systems leads to bleeding.

Definition

Hemorrhage is the loss of blood or blood escape from the circulatory system. Bleeding can occur:

- Internally, where blood leaks from blood vessels inside the body, or
- Externally, either through a natural opening such as the mouth, nose, ear, vagina or anus, or through a break in the skin.

Types

Hemorrhage is classified into four classes by the American College of Surgeons' Advanced Trauma Life Support (ATLS).

- CLASS I hemorrhage:** It involves up to 15% of blood volume. There is typically no change in vital signs and fluid resuscitation is not usually necessary.
- CLASS II hemorrhage:** It involves 15–30% of total blood volume. A patient often has tachycardia with a narrowing of the difference between the systolic and diastolic blood pressures. The body attempts to compensate with peripheral vasoconstriction. Skin may start to look pale and cool to touch. Child may exhibit slight changes in behavior. Volume resuscitation with crystalloids (Saline solution or Lactated Ringer's solution) is required. Blood transfusion is not typically required.
- CLASS III hemorrhage:** It involves loss of 30–40% of circulating blood volume. The patient's blood pressure drops, the heart rate increases, peripheral hypo perfusion (shock), such as capillary refill worsens. The mental status worsens. Fluid resuscitation with crystalloid and blood transfusion are usually required.
- CLASS IV hemorrhage:** It involves loss of >40% of circulating blood volume. The limit of the body's compensation is reached and aggressive resuscitation is required to prevent death.

Causes

Bleeding arises due to either traumatic injury, underlying medical condition, or a combination of injury and medical condition.

- Traumatic bleeding:** It is caused by some type of injury. There are different types of wounds which may cause traumatic bleeding. These include:
 - Abrasions
 - Excoriation
 - Hematoma
 - Laceration
 - Incision
 - Puncture wound
 - Contusion
 - Crushing injuries
- Medical condition:** 'Medical bleeding' denotes hemorrhage as a result of an underlying medical condition and not directly due to trauma. Blood can escape from blood vessels as a result of three basic patterns of injury:

1. Intravascular changes
 2. Intramural changes
 3. Extra vascular changes
1. **Intravascular changes:** Changes of the blood within vessels (e.g., ↑ blood pressure, ↓ clotting factors)
 2. **Intramural changes:** Changes arising within the walls of blood vessels, (e.g., aneurysms, dissections, AVMs, vasculatures)
 3. **Extra vascular changes:** Changes arising outside blood vessels (e.g., H. pylori infection, brain abscess, brain tumor)
- **Causes of hemorrhage:** There are certain medications which causes increased bleeding risk.
 - **NSAIDs:** Exposure to non-steroidal anti-inflammatory drugs, inhibit the activation of platelets and increase risk of bleeding. The effect of aspirin is irreversible, so it will be present until the replacement of platelets.
 - **Warfarin (Coumadin):** It acts by inhibiting the production of vitamin K in the gut. It is required for the production of the clotting factors 2, 7, 9 and 10 in liver. Therefore, it affects production of clotting factors.
 - Deficiency of factor VIII causes classic Hemophilia A, deficiencies of Factor IX cause “Christmas disease” (hemophilia B), deficiency or abnormal function of the “von Willebrand” factor, which is involved in platelet activation causes von Willebrand disease.

Management

For wound management, assess the following:

- Type of wound (incision, laceration, puncture, etc.)
- Area of the body affected
- Presence of any foreign objects in wound.

The key principles of wound management are:

- Elevation
- Direct pressure
- Pressure points

Elevation: Keeping the wound above the level of the heart will decrease the pressure at the point of injury. It will reduce the bleeding.

Direct pressure: Placing pressure on the wound will constrict the blood vessels manually. Ideally a barrier, such as gauze should be used between the pressure supplier and the wound, to help reduce chances of infection and help the wound to seal. Direct pressure can be used with some foreign objects protruding from a wound, and to achieve this, padding is applied from either side of the object to push in and seal the wound, objects are never removed.

Sometimes using icepacks help stopping bleeding. Fill a freezer bag with ice. Bind the wound with tight bandage. Apply ice pack with direct pressure for 10 minutes.

Pressure points: In situations where direct pressure and elevation are either not possible or proving ineffective, use

pressure points to constrict the major artery which feeds the point of the bleed. This is performed at a place where a pulse can be found, such as in the femoral artery. It is used only when other methods have not worked. Use four fingers to feel for a pulse. Once the pulse has been located, apply firm pressure with the heel of the hand or use four fingers along the path of the artery to compress the artery against the underlying bone. For example, when the bleeding is from the leg, the pressure point is over the femoral artery. When the bleeding is coming from the arm, the pressure point is over the brachial artery. **Tourniquet:** Another method of achieving constriction of the supplying artery is via the use of a tourniquet - a tightly tied band which goes around a limb to restrict blood flow.

Epistaxis: Epistaxis or a nosebleed is a special case, where almost all first aid providers train the use of pressure points.

Management: Make the child to sit or stand. Make him to lean forward. Put firm pressure on nose by squeezing the lower half of his nose. Keep firm pressure for ten full minutes and then release your hold and see if it is still bleeding. If the bleeding hasn't stopped, apply pressure for another ten minutes. Get medical help if doesn't stop.

Internal bleeding: The definitive treatment for internal bleeding might be surgical treatment, vitamin K or plasma/blood transfusion. Treatment should be for underlying cause.

BURNS

Burn injury in children continues to be a major epidemiologic problem around the globe. Nearly a fourth of all burn injuries occur in children under the age of 16, of whom the majority are under the age of five. Most burn injuries are minor and do not necessitate hospital admission. A minority of burn injuries are serious and meet criteria for transfer to a burn center; the care of these critically ill children requires a coordinated effort and expertise in the management of the burned patient.

Related Anatomy and Physiology

The skin is the largest organ in the body. It is composed of three main layers, i.e.,:

- Epidermis is outermost layer which is composed of two layers, stratum corneum and Malpighian.
- Dermis
- Subcutaneous tissue

Categories of Burns

Burns are divided into four categories, depending on the depth of the injury as follows:

1. **First-degree burn:** It is limited to the epidermis. A typical sunburn is a first-degree burn. It is characterized by erythema, pain, and minor microscopic changes. Pain usually lasts for 48–72 hours, and the damaged epithelium peels off in 5–10 days. First-degree burns do not lead to scarring and require only local wound care.

2. **Second-degree burns:** The point of injury extends into the dermis, with some residual dermis remaining viable. The healing is directly related to the amount of undamaged dermis. Deep dermal burns lead to severe hypertrophic scarring and may take 25–35 days to heal.
3. **Third-degree or full-thickness burns:** These involve destruction of the entire dermis, leaving only subcutaneous tissue exposed. It is characterized by lack of sensation in the burned skin, a leathery texture, and no capillary refill.
4. **Fourth-degree burn:** This type of burn is usually associated with lethal injury. Fourth degree burns extend beyond the subcutaneous tissue, involving the muscle, fascia, and bone. Occasionally termed transmural burns, these injuries often are associated with complete transection of an extremity.

Pathophysiology

Following a major burn injury, there is release of catecholamine from injured tissues. Fluid volume shift causes hypovolemia. The heart rate and peripheral vascular resistance increases.

Initially cardiac output decreases. At approximately 24 hours after burn injuries (for patients receiving fluid resuscitation) cardiac output returns to normal, then increases to meet the hypermetabolic needs of the body.

Acute upper gastrointestinal tract erosions and ulcers may occur in patients with severe burn injuries. The lesions are termed stress or Curling ulcers. Painless gastrointestinal tract bleeding is the most common clinical finding. Blood loss usually is minimal and can be prevented with prophylactic administration of H₂ blockers.

Deep circumferential burns can cause compartment syndrome. The “5 Ps” associated with compartment syndrome are pain, pallor, paresthesia (numbness feeling), pulselessness and paralysis. High pressure is build up inside the compartment causing tissue ischemia and necrosis.

Management

Accurate estimation of total body surface area (TBSA) of a burn is essential to guide management. Methods to estimate TBSA are **wallace rule of nines**, **palm method**, and **lund and browder method**.

- **Wallace rule of nines:** Essentially, the Rule of Nines (Fig. 14.3) divides the body into 11 areas of 9% each. Each arm is 9% (2), the anterior and posterior portions of each leg are each 9% (4), the anterior upper and lower portions of the thorax are 9% each (2), the posterior upper and lower portions of the thorax are 9% each (2), and the area including the neck and head is 9% (1). The total is 9% times 11, or 99%. The perineum comprises the remaining 1%.
- **Palm method:** A quicker, but less accurate, method for determining burn size is to use the palm of the patient's

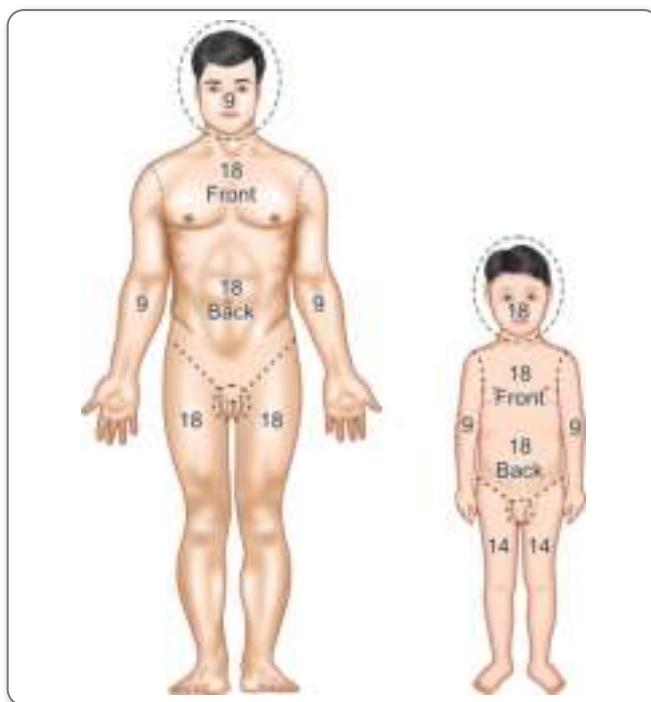


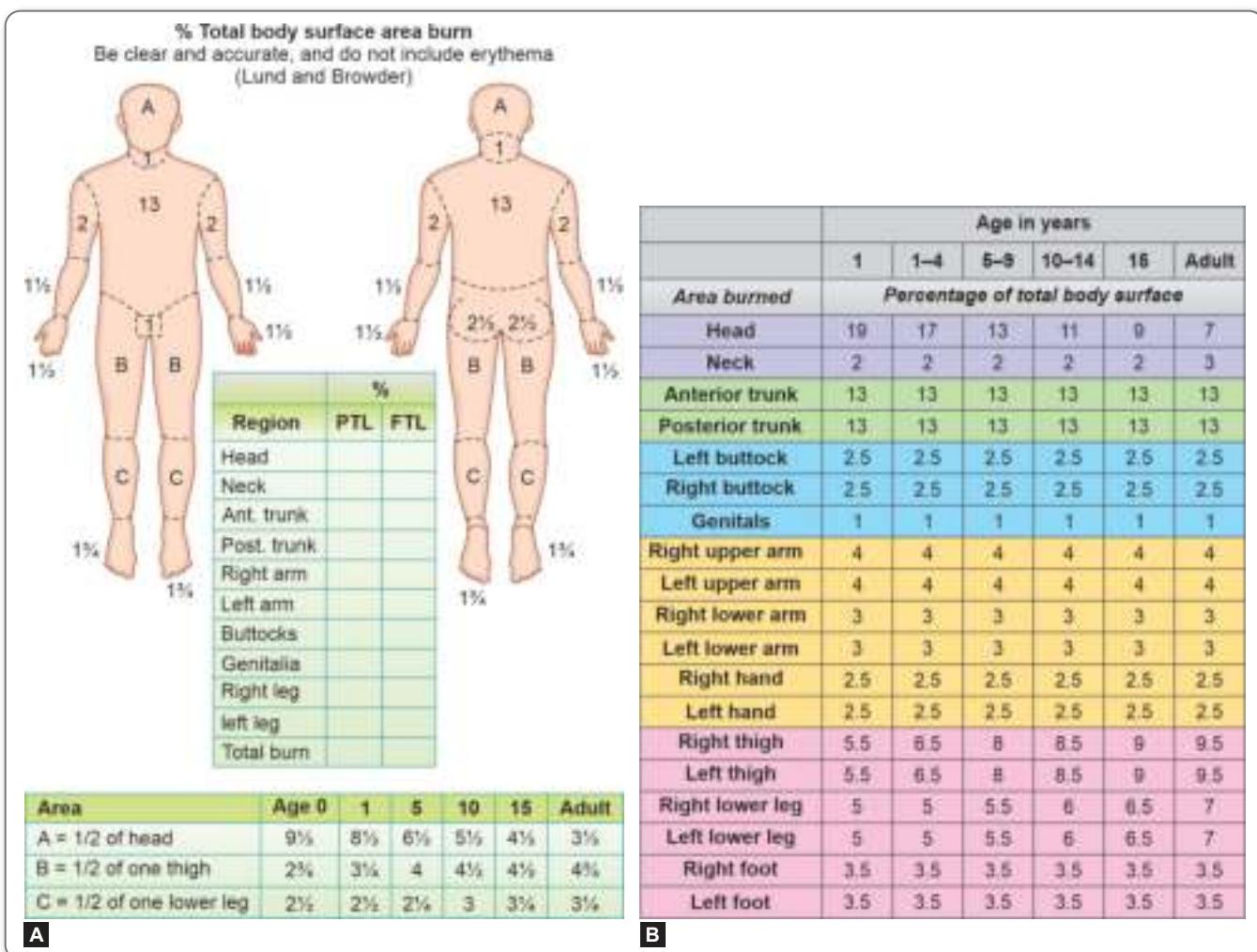
Figure 14.3: Rule of nines

hand, which is roughly equivalent to 1% of the patient's BSA. The palm-of-the-hand approach is most convenient for splash-type no confluent burns and should never be used for significant burns (>10% BSA).

- **Lund and Browder Method:** The Lund and Browder chart (Figures 14.4A and 4B) is a tool useful in the management of burns for estimating the TBSA affected. Unlike the Wallace Rule of Nines, the Lund and Browder chart takes into consideration of age of the person, with decreasing percentage BSA for the head and increasing percentage BSA for the legs as the child ages, making it more useful in pediatric burns.

Diagnosis

- Screen all patients with closed-space smoke exposure (indoor) for carbon monoxide poisoning. In patients with minor burns and in patients in whom arterial puncture is not otherwise indicated, venous carboxyhemoglobin levels are as accurate as arterial levels.
- Evaluate CBC, typing and cross-matching blood, carboxyhemoglobin levels, coagulation studies, basic chemistry panel, arterial blood gas, and chest radiograph.
- Other tests include measurement of the urine myoglobin, serum protein, and ethanol levels; urinalysis; and toxicology screen.
- Patients with heart disease or with cardiac risk factors need a baseline ECG.
- An initial chest radiograph is essential to demonstrate life-threatening injuries, such as rib fractures, hemothorax, or pneumothorax.



Figures 14.4A and B: A. Lund and Browder chart; B. Lund and Browder burn chart

Treatment

For treatment purposes, burns can be divided into 2 categories, i.e., minor and major burns.

Minor Burns

- Infants with burns over <10% BSA and
- Children with burns over <15% BSA without significant inhalation injury or preexisting medical conditions
- Can be treated initially without IV access.

Major Burns

- Infants with burns >10% BSA,
- Children with burns over >15% BSA, or individuals with significant inhalation injury
- Should be treated with IV access and fluid resuscitation.

Management

The goals of management are:

- Manage hypothermia:** In comparison to adults, children have a larger BSA relative to their weight. BSA is a major

determinant of evaporative water loss in burn patients. As a result, children with burns have more evaporative water loss compared by weight than adults. Therefore, children have greater fluid needs during resuscitation. The greater amount of evaporative water loss also leads to greater heat loss. The infant or child with burns is especially prone to hypothermia; therefore, the ambient temperature should be kept high to minimize radiant and evaporative heat losses. For infants younger than 6 months, temperature is largely regulated by non-shivering thermogenesis. This metabolic process involves catabolism of fat stores under the influence of norepinephrine, which requires large amounts of oxygen.

Prolonged periods of thermogenesis in the hypothermic infant can lead to increased amounts of lactate production and metabolic acidosis. Infants and children older than 6 months have the ability to shiver and are not as likely to develop lactic acidosis.

- Administer oxygen:** All burn patients should receive supplementary oxygen at the highest concentration allowed

by patient comfort. Maintain a high flow of oxygen until a negative carboxyhemoglobin level is achieved.

- **Managing fluid imbalance:** Infant with burns have immature kidneys which are inefficient in handling fluid overload. The GFR in infants does not reach adult levels until age 9–12 months due to an imbalance in maturation in tubular and glomerular functions. During the first few weeks of life, infants are likely to retain a larger portion of the water load administered as part of burn resuscitation.

The hypo-osmolality of lactated Ringer solution, when used in accordance with the Parkland formula, already accounts for the free water needs of infants during the first 24-hours of resuscitation. Additional hydration of young infants may result in fluid overload.

Treat children with major burns who require fluid resuscitation according to the Parkland formula. *The Parkland formula is a starting point for fluid resuscitation.*

- Maintain urine output (as measured with a Foley catheter) at 1.0 mL/kg/h. In younger children (<30 kg), maintain a urine output of 1.0–1.5 mL/kg/h.
- The Parkland formula is used during the first 24-hours of fluid resuscitation and is as follows:

Amount of IV fluid in first 24 hours = weight in kg × 4 mL × % BSA burned

Administer one half of the calculated fluid during the first 8 hours and one half of the calculated fluid in the subsequent 16 hours.

Parkland Formula

For second 24 hours: 0.5 mL colloid * weight in Kgs * TBSA + 2,000 mL

5% dextrose in water run concurrently over the 24 hours.

For example, 0.5mL * 70 kg * 80% = 2,800 mL colloid + 2,000 mL 5% D/W yields 117 mL colloid/h.

Boluses of crystalloids or colloid may be necessary to keep a urinary output of 0.5 to 1 mL/kg/h.

- The starting time is considered to be the time at which the burn occurred and not the time at which medical care is initiated.
- Children aged 6 months to 5 years should receive the fluid recommended by calculations using the Parkland formula plus maintenance during the first 24 hours.
- Urine output is the criterion standard for gauging appropriate intravascular volume and hydration status.
- Place NG tube and a Foley catheter. Patients with burns often develop an adynamic ileus and bowel obstruction. Decompression of the stomach and removal of its contents via the NG tube decreases the likelihood of significant aspiration, which could contribute to an already weak respiratory status. A Foley catheter is important to closely follow urinary output, which is the best means to monitor an adequate hydration status.

- **Wound care/prevention of infection:** Infants are at increased risk for developing infection because their immune system is not completely developed.

Treatment of minor burns:

- Debride devitalized tissue. Evaluate the wound for surface area and depth of injury.
- Develop a wound care plan.
- Leave intact blisters alone. Blister fluid contains vasoactive mediators such as thromboxane, which can cause vasoconstriction, promote ischemia, cause progression of the ischemic zone, and inhibit healing. The intact blister also serves as a physiologic dressing against infection, and unless the blister is overlying a large joint, the blister should be left intact. Blisters larger than several inches in diameter are most likely to rupture and should be removed.
- Superficial or partial-thickness burns that are limited in size can be treated with a semi-occlusive dressing. The wound should be pink and moist and exhibit good blanching. Place gauze dressings on a clean wound devoid of devitalized tissue. Apply multiple layers of gauze dressing to avoid moisture evaporation and wound dehydration.
- Cover wound to reduce pain.
- When an extremity is involved, instruct the patient and family regarding immobility and as much elevation as possible. Edema, which is exacerbated when the extremity is held in the natural position, can worsen the ischemic zone and tissue loss.
- Patients with circumferential burns are at risk for development of compartment syndrome, which can compromise circulation to the entire extremity.
 - ◆ Incision of the burned skin (escharotomy) is the treatment for compartment syndrome.

Surgical Care

- Clean burned areas using normal saline solution or mild soap and water, while maintaining normothermia.
- Remove ruptured blisters and devitalized epidermis with forceps and scissors or, by rubbing with gauze soaked in isotonic sodium chloride solution after an adequate level of analgesia is obtained.
- Leave intact blisters alone. Apply a topical antimicrobial (silver sulfadiazine, bacitracin) followed by a sterile dressing after the burn has been cleaned and debrided. Dressings should be changed and wounds cleaned daily in outpatients.
- Escharotomy is done in case of compartment syndrome. It refers to incising the burnt skin to relieve constrictive effects, restore distal circulation, and allow adequate ventilation.

Medication

- Apply silver sulfadiazine to the wound for the first 48 hours after initial treatment. Silver sulfadiazine is most effective against gram-positive organisms and is relatively ineffective against pseudomonads.
- Bacitracin ointment for small and moderate sized burns. Bacitracin is as effective as silver sulfadiazine and is easier to apply. Bacitracin should always be used for burns located above the clavicles because silver sulfadiazine occasionally causes cosmetic complications, (e.g., skin pigmentation).
- Mafenide acetate cream provides more complete coverage against *Pseudomonas* and other gram-negative species. Unlike silver sulfadiazine, mafenide acetate cream is painful on application because it is hyperosmolar. Extensive wounds covered with mafenide acetate may develop metabolic acidosis.
- **Tetanus immunization:** Verify tetanus immunization and administer tetanus toxoid (0.5 mL) if indicated. Patients with more than 50% of the body surface burned should receive tetanus immune globulin.
- **Vaccines:** Active immunization increases resistance to infection. Vaccines consist of microorganisms or cellular components, which act as antigens. Administration of the vaccine stimulates the production of antibodies.
 - Tetanus immune globulin (Hyper-Tet) and tetanus toxoid
 - Tetanus immune globulin (TIG) is used for passive immunization of any person with a wound that may be contaminated with tetanus spores.
 - Tetanus toxoid is used to induce active immunity against tetanus in selected patients.
 - Burns are extremely tetanus-prone wounds. All burn patients with an incomplete immunization history should receive a dosage of tetanus toxoid (Td for adults or children > 7 y, DTP or TD for children < 7 y). Children with up-to-date primary immunization series are considered to be up-to-date for tetanus immunization status. If the patient has a history of complete immunization and the last immunization with absorbed tetanus toxoid is within the last 5 years, further immunization is not required. If the history of tetanus immunization is unknown, both Td and TIG should be administered.
- Pediatric

- Tetanus toxoid:

- **<7 years:** 0.5 mL IM of TD or DTP
- **>7 years:** 0.5 mL IM of Td or Tdap for adolescents
- **TIG:** 250 U IM

Note:

When Td and TIG are administered simultaneously, administer with different syringes in different locations

- **Pain relief:**

- **Morphine sulfate:** Patients who have sustained more than localized burns ($<5\%$ BSA) should receive systemic analgesics. Morphine has a relatively long half-life. Dose: 0.1 mg/kg IV q2-4h prn
- **Fentanyl:** It is shortest acting opioid. Consider continuous infusion Dose: 1-2 mcg/kg/dose IV q 30-60 min

- **Rehabilitation to prevent contractures**

- Rehabilitation involves maximizing positioning, range of motion of all joints, limitation of pressure necrosis, exercise, ambulation, and assistance in daily activity.
- Pressure therapy reduces hypertrophic scar formation. Garments used in pressure therapy can be custom made and are available for different body parts and in varying sizes.
- Pressure therapy is used to deliver consistent pressure on scarred areas, thus shortening the time of scar maturation and thickness and the total affected area.
- Hypertrophic scarring refers to the development of thickened raised skin. Scarring may be characterized by contractures of joints. In general, children scar more than adults. Patients with pigmented skin tend to scar more than patients with lighter skin.
- Continuous wearing of pressure garments for up to 1 year after healing has been shown to help limit the progression of hypertrophic scarring. The garments must be worn nearly 24 hours/day to be effective.

Complications

- **Acute tubular Necrosis** of the kidneys can be caused by myoglobin and hemoglobin released from damaged muscles and red blood cells. This is common in electrical burns or crush injuries where adequate fluid resuscitation has not been achieved.

- **Fever** occurs frequently in children with burns. The burned skin is a potent source of mediators, (e.g., interleukin 1) that produces fever.
- **Wound infections:** They are classified as cellulitis or invasive infections.
 - Cellulitis usually begins on the second or third day after the burn injury occurs. If cellulitis does not resolve and continues to expand, it is treated topically with the appropriate antibiotic, warm soaks, and mafenide acetate cream until the infection is controlled.
 - Invasive infections can be caused by bacterial, fungal, or viral pathogens. Daily examination of the entire wound is necessary to check for signs of infection. Biopsy is performed on suspected lesions and specimens are sent for culture and microscopic evaluation. Treatment with topical antimicrobial drugs or early excision is important for infection control.

PEDIATRIC BASIC LIFE SUPPORT

Pediatric basic life support (PBLS) is a major component of the emergency medical response to the pediatric victims with cardiac arrest, which should be adequately implemented for a series of survival processes. The pediatric chain of survival comprises five components, including:

1. Prevention and early recognition of cardiac arrest,
2. Early access (activation of emergency medical system [EMS]),
3. Early high-quality cardiopulmonary resuscitation (CPR),
4. Early defibrillation, and
5. Effective advanced life support and post-cardiac arrest care.

The first four processes of the survival chain correspond to PBLS.

Steps of PBLS (Figs 14.5A and B)

- **Assess the victim:** Determine quickly for unresponsiveness. Shout for help.
- Look for no breathing or only gasping and check pulse simultaneously for not longer than 10 seconds. There can be 3 scenarios:
 1. **Normal breathing, has pulse**—Activate emergency response system (EMS). Monitor till help arrives.

2. **No normal breathing but has pulse:** Provide rescue breathing: 1 breath every 3–5 seconds or 12–20 breaths/min. Observe for visible chest rise. Add compressions if pulse remains <60/min. activate EMS. Check pulse every 2 minutes. In children aged one to adolescence, the pulse should be checked at the **carotid** artery. In infants, the **brachial** pulse should be assessed. If no pulse, begin CPR.

3. **No breathing, only gasping or no pulse:** Begin CPR

- **Deliver high quality chest compressions**

- **Placement of hands:** Pediatric compression is performed with the head of one hand over the lower $\frac{1}{2}$ of the sternum, between the nipples. In infants, use two fingers, or use the thumb encircling technique if multiple providers are available.
- **Depth of compression:** A minimum of 1/3 the AP diameter of the chest, or approximately 1 $\frac{1}{2}$ inches in infants (4 cm) and 2" in children from age one to adolescence.
- **Ratio of compressions to breaths: 1 rescuer- 30:2, 2 rescuers- 15:2**
 - The rate of compressions should be 100–120/ minute.
 - Chest recoil should be complete between compressions.
 - After 2 minutes, activate the EMS and retrieve the automated external defibrillator (AED) or defibrillator.
- When the AED is available, the victim's rhythm should be quickly assessed.
- **Shockable rhythms** include ventricular fibrillation or pulseless ventricular tachycardia. One shock should be given to the victim, with resumption of CPR immediately after the shock. CPR should continue for 2 minutes. Continue till ALS arrives or victim moves.
- **If the rhythm is not shockable, CPR should be resumed immediately.** The health care provider should check the rhythm once more after two minutes of CPR (5 cycles of 30:2). This should be continued until the victim moves or until advanced life support is available.
- **Open the airway:** The airway should be opened with a head tilt/chin lift for children over the age of one, and with the infant in the sniffing position. If trauma is suspected, then a jaw thrust should be used to open the airway.

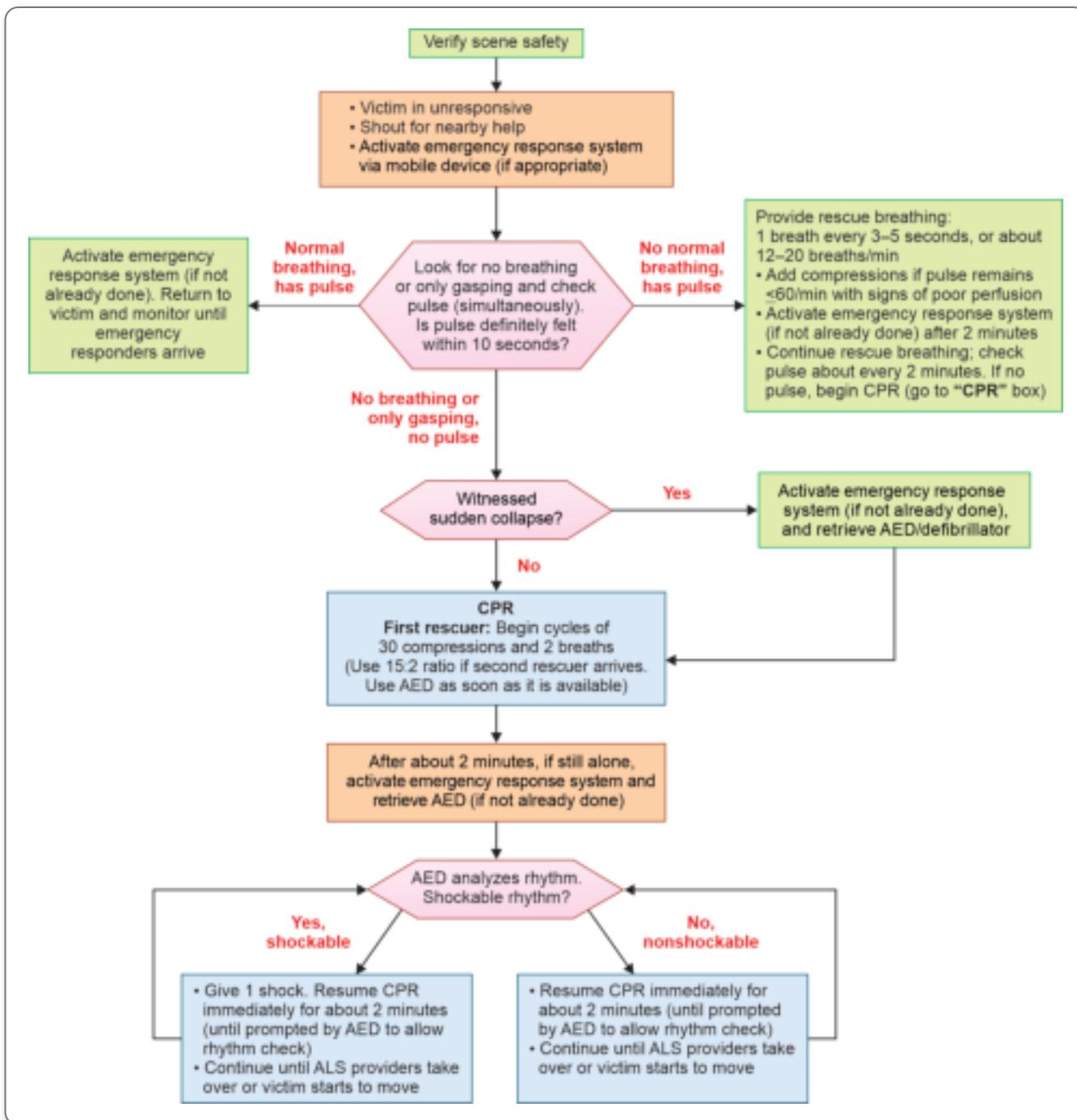


Figure 14.5A: BLS for single rescuer

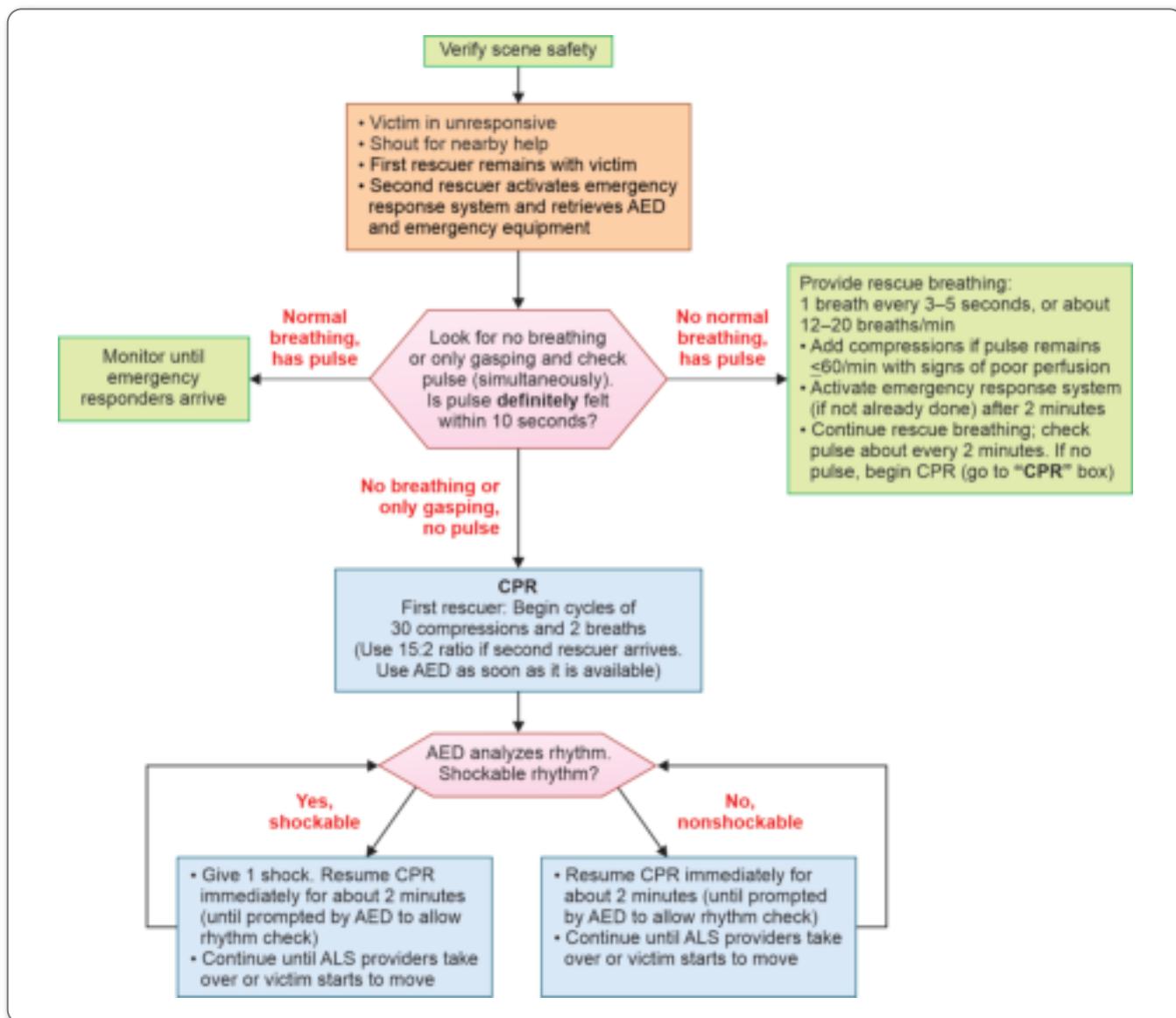


Figure 14.5B: BLS for two or more rescuer



Summary

Acute and life-threatening conditions in children require prompt and meticulous care as faulty treatment or delays in management, can mean the difference between survival and death. Focussed assessment, quick history and physical examination are very essential.

Assess Yourself

- The ratio of chest compressions and breaths while giving CPR to a child in case of 2 rescuers is
- Draw a flowchart of PBLS.
- List the antidotes of Lead, Paracetamol, Insulin and Morphine.
- How do you calculate the fluid requirement in a burnt client for first 24 hours?
- Lund and Browder Burn Chart is used to calculate
- For fluid resuscitation in a burnt client formula is used.