Prehospital Life Support Manual

Prehospital Life Support Manual

Kundan Mittal
Professor
Head of Unit IV & I/C Respiratory Clinic
(Pediatric Emergency and Intensive Care Unit)
Pandit Bhagwat Dayal Sharma, Postgraduate Institute of
Medical Sciences (PGIMS) (University of Health Sciences)
Rohtak, Haryana, India

Forewords
SS Sangwan
Narendra Rungta

JAYPEE BROTHERS MEDICAL PUBLISHERS (P) LTD
New Delhi • St Louis (USA) • Panama City (Panama) • London (UK)
Ahmedabad • Bengaluru • Chennai • Hyderabad • Kochi • Kolkata
Lucknow • Mumbai • Nagpur

Published by

Jitendar P Vij
Jaypee Brothers Medical Publishers (P) Ltd

Corporate Office
4838/24 Ansari Road, Daryaganj, **New Delhi** - 110002, India, Phone: +91-11-43574357
Fax: +91-11-43574314

Registered Office
B-3 EMCA House, 23/23B Ansari Road, Daryaganj, **New Delhi** - 110 002, India
Phones: +91-11-23272143, +91-11-23272703, +91-11-23282021
+91-11-23245672, Rel: +91-11-32558559, Fax: +91-11-23276490, +91-11-23245683
e-mail: jaypee@jaypeebrothers.com, Website: www.jaypeebrothers.com

Offices in India

- **Ahmedabad**, Phone: Rel: +91-79-32988717, e-mail: ahmedabad@jaypeebrothers.com
- **Bengaluru**, Phone: Rel: +91-80-32714073, e-mail: bangalore@jaypeebrothers.com
- **Chennai**, Phone: Rel: +91-44-32972089, e-mail: chennai@jaypeebrothers.com
- **Hyderabad**, Phone: Rel:+91-40-32940929, e-mail: hyderabad@jaypeebrothers.com
- **Kochi**, Phone: +91-484-2395740, e-mail: kochi@jaypeebrothers.com
- **Kolkata**, Phone: +91-33-22276415, e-mail: kolkata@jaypeebrothers.com
- **Lucknow**, Phone: +91-522-3040554, e-mail: lucknow@jaypeebrothers.com
- **Mumbai**, Phone: Rel: +91-22-32926896, e-mail: mumbai@jaypeebrothers.com
- **Nagpur**, Phone: Rel: +91-712-3245220, e-mail: nagpur@jaypeebrothers.com

Overseas Offices

- **North America Office, USA,** Ph: 001-636-6279734
  e-mail: jaypee@jaypeebrothers.com, anjulav@jaypeebrothers.com
- **Central America Office, Panama City, Panama,** Ph: 001-507-317-0160
  e-mail: cservice@jphmedical.com, Website: www.jphmedical.com
- **Europe Office, UK,** Ph: +44 (0) 2031708910, e-mail: info@jpmedpub.com

Prehospital Life Support Manual

First Edition: **2010**

ISBN 978-93-80704-26-5

Typeset at JPBMP typesetting unit
Printed at

Dedicated to
my wife
Dr Anupama
and sons
Utkarsh and Anindya

Pandit Bhagwat Dayal Sharma
UNIVERSITY OF HEALTH SCIENCES
ROHTAK-124001, (HARYANA) INDIA
Ph: 01262-212812, EPBX No. 211300-03, 212641,
212643-46, 48 & 50 Ext. 2660
Fax : 01262-212811 E-mail: vicechancellor.uhsr@gmail.com

Dr SS Sangwan
MS, DNB, FICS, IAMS
Vice Chancellor

DO No. UHSR/09/

Foreword

Health care facilities in many countries are mainly urban oriented. Seventy percent of Indian population lives in rural area. India has seen tremendous growth in economy and population over last decades. There is great disparity between demand and delivery of health care. The doctor population ratio is also inadequate. Crude death rate has decreased but still well behind target. Deaths due to preventable diseases have also decreased. Deficient prehospital life support care in acute illnesses and trauma contribute significantly to morbidity and mortality. Improper handling of accident scene and delayed transport of seriously injured also contributes significantly. If seriously ill/injured patients are handled by skilled personnel in prehospital settings, it will help us bring down mortality. Small interventions like cervical spine immobilization in trauma victims, providing oxygen and fluids in acute care can prevent further deterioration and can bring large change in quality of life. Minimal effective interventions in actue care settings can be cost effective. There is no concept of prehospital life support care in India. I congratulate Dr Kundan Mittal, Professor in Pediatric Emergency and Intensive Care who has highlighted this issue and brought out a manual on prehospital life support. This manual primarily

discusses the issues like accident scene management, initial global assessment, technique to secure airway, providing oxygenation and ventilation, control of bleeding and circulatory support and efficient transport of all sick and injured patients. This will be useful manual for primary health care providers and paramedics involved in medical transport.

SS Sangwan

Dr Narendra Rungta
MD FISCCM

- Fellow of Indian Society of Critical Care Medicine
- President Elect, Indian Society of Critical Care Medicine
- Immediate Past Chairman, Intensive Care Chapter IAP
- Editor, Critical Care Communications
- FCCS Course Consultant

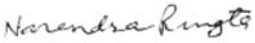
Head Critical Care

RUNGTA HOSPITAL
Malviya Nagar, Jaipur-302 017 (INDIA)
Phone : 0141-4039999
Email: drnrungta@gmail.com

Foreword

Trauma and acute illnesses will be leading causes of morbidity and mortality in India in coming times. Such cases must receive evidence-based treatment at the earliest possible even before the patient reaches the hospital which is called prehospital treatment. This modality is almost nonexistent in India at present. Therefore, it does not over-emphasize that this area needs very urgent attention. *Prehospital Life Support Manual* is focused exclusively on this area. India will need strong infrastructure and force of doctors and nurses with evidence-based knowledge and quality training for delivery of these services. This manual provides meticulous guidance and approach by these professionals in managing such patients effectively. Chapters have been written in simple and easy-to-understand language. A large number of relevant photographs, flow charts and tables at right spots deliver the message clear and loud. This also reflects hard homework of author in preparing this manual. This will make implementation of these guidelines easy in field in Indian circumstances. Chapters on assessment of acutely ill/injured, airway, circulation, basic life support, fluid therapy, trauma, drowning and infection control in prehospital settings including ambulance have been written on the basis of present available evidence. The author has adequately provided approach for preventing secondary and tertiary problems by suggesting continuous secondary

assessment. The chapter on art of communication and breaking news is special one. The manual is a welcome guide on prehospital care of a critically sick patient and should become a must for all transport ambulance groups, nurses, doctors or other para-medicals who are taking up these challenges. This manual is recommended for any Indian curriculum, library or training program on acute care facility, nurse or doctor irrespective of whether he or she is a teacher or a student.



Narendra Rungta

Preface

'Safe hands safe lives.' If you are not perfect in driving, then there is a chance, that you may endanger the lives of all the occupants and others. Similarly, if you are not attended by qualified persons when seriously ill, your life will be in danger. System of delivering "advanced health care" in hospital setting is well established, but there is no system of prehospital life support in existence in India. Prehospital life support is an important and integral part of effective health care system. Prehospital life support includes extrication of trauma victims, assessment of all seriously ill and injured, initial stabilization, and arranging transport to appropriate level of care without doing further harm. The concept of prehospital care is not new in the West, but in developing countries like India, there is no concept of prehospital life support. Timely intervention in seriously ill patients will be of great help and life saving. It is difficult to reach at door step with advanced care, but if basic life support services are given by health care providers (primary physicians, nurses, paramedics, and others) in time at door step, the survival can be improved. This manual has been designed keeping in view the great need of prehospital life support care of acutely ill. This manual primarily focuses on the initial assessment using ABCDE's approach, stabilization, and transport of acutely ill or injured patients to the appropriate facility.

Kundan Mittal

Acknowledgments

The most difficult task is to say thanks and acknowledge the contribution of others. I am indebted and grateful to the following persons who have taught me concepts of humanity, basic pediatrics, basic acute care, working for common man, and also suggested and edited the topics at various stage of preparation of this manual. I feel my gratitude to the persons/publishers for their references used by me during preparation of this manual. Due to unavoidable reasons, I was not able to communicate personally to all of them. I am also thankful to M/s Jaypee Brothers Medical Publishers (P) Ltd, New Delhi for printing this manual.

- SS Sangwan, Vice-Chancellor, Pt BD Sharma, University of Health Sciences, Rohtak
- SN Chugh, Pro-VC, Pt BD Sharma, University of Health Sciences, Rohtak
- CS Dhull, Director, Pt BD Sharma, Postgraduate Institute of Medical Sciences, Rohtak
- VK Jain, Dean, Pt BD Sharma, Postgraduate Institute of Medical Sciences, Rohtak
- Krishan Chugh, Director, Centre for Child Health, SGRH, New Delhi
- Narender Rungta, Director, Rungta Hospital, Jaipur
- Sunit Singhi, Professor and Head Pediatrics, PGIMER, Chandigarh
- Dharuv Chaudhary, Head, Department of Pulmonary and Critical Care Medicine, PGIMS, Rohtak
- Prashant Kumar, Assistant Professor, Department of Anesthesiology, PGIMS, Rohtak
- Naveen Malhotra, Associate Professor, Department of Anesthesiology, PGIMS, Rohtak
- HK Aggarwal, Sr Professor, Department of Medicine, PGIMS, Rohtak

- Sanjay Marwah, Professor, Department of Surgery, PGIMS, Rohtak
- RC Siwach, Senior Professor and Head of Orthopedics, PGIMS, Rohtak
- VK Katyal, Senior Professor Medicine and Incharge Coronary Care Unit, PGIMS, Rohtak
- Krishna Sangwan, Formerly HOD, Department of Obstetrics and Gynecology, PGIMS, Rohtak
- Meenakshi Chauhan, Professor, Department of Obstetrics and Gynecology, PGIMS, Rohtak
- Rajkanwar Yadav, Assistant Professor, Department of Medicine, PGIMS, Rohtak
- Rajeev Sen, Sr Professor in Pathology, PGIMS, Rohtak
- AD Tewari, Formerly HOD, Pediatrics, PGIMS, Rohtak
- Manish Munjal, Senior Anesthetist and Intensivist, Rungta Hospital, Jaipur
- Dhiren Gupta, Consultant, PICU, CHC, SGRH, New Delhi
- Vinathi, Consultant Chest Physician and Critical Care Fellow at NIMS, Hyderabad
- PL Gautam, Professor and Head, Anesthesia and Intensive Care, DMC, Ludhiana
- Prakash Shastri, Sr Consultant and Intensivist at SGRH, New Delhi
- Kunal, Fellow in PICU, PGIMS, Rohtak
- Manish Goel, Assistant Professor, Community Medicine, PGIMS, Rohtak
- Atul Kulkarni, Additional Professor, Tata Memorial Hospital, Mumbai
- Rajesh Pandey, Head of Critical Care, BL Kapoor Hospital, New Delhi
- Amit Deswal, Data Operator, Telemedicine, PGIMS, Rohtak
- Sahil Hans, Meenakshi Photo Studio, Rohtak
- Dilshad Kumar, Delhi Surgicals
- Atul Jain, Jain Book Depot, Rohtak

Contents

List of Abbreviations

ABC	Airway, Breathing, Circulation
ABCDE	Airway, Breathing, Circulation, Disability, Environment
AED	Automated External Defibrillator
BP	Blood Pressure
BLS	Basic Life Support
COPD	Chronic Obstructive Pulmonary Disease
CPR	Cardiopulmonary Resuscitation
ECG	Electrocardiography
ET	Endotracheal Tube
FiO_2	Fraction Concentration of Oxygen
GCS	Glasgow Coma Scale
Hr	Hour
IO	Intraosseous
IV	Intravenous
L	Liter
LMA	Laryngeal Mask Airway
MAP	Mean Arterial Pressure
mg	Milligram
Min	Minute
ml	Milliliter
NPA	Nasopharyngeal Airway
O_2	Oxygen
OPA	Oropharyngeal Airway
PHLS	Prehospital Life Support
PPE	Personal Protection Device
SBP	Systolic Blood Pressure
Sec	Second
SpO_2	Oxygen Saturation
µg	Microgram
VF	Ventricular Fibrillation
VT	Ventricular Tachycardia

CHAPTER 1

Introduction

Tremendous growth in population, vehicles, economy and industries has increased the chance of accidents/injuries. Overcrowding, change in lifestyle, environment and poor access to advanced health activities are also contributing to morbidity and mortality. Many of the areas are manned by unskilled personnel. Many countries have brought down morbidity and mortality in relation to preventable diseases, chronic ailments, and many of acute illnesses which do not require intensive care monitoring. There are certain areas/illnesses where we are still fighting. Inadequate prehospital life support care and inefficient transport system in acute illnesses also contribute significantly. Many lives can be saved if such patients are provided efficient prehospital and transport care in acute stage.

In prehospital setting seriously ill patients require, initial assessment using visual and auditory clues, ABCDE's approach, and stabilization before transport. In case of trauma victim the **"Golden period"** of management is important for functional survival. In many countries there is no transport policy and guidelines. There are also no prehospital life support services available. Our health facilities are primarily urban oriented and there is no concept of regionalization of services. Government sector is trying best to handle all the sick patients yet inadequate. Private or corporate sectors are out of reach to the common man. In our country though we have sufficient private/public transport facility and well connectivity but these transport vehicles (ambulances) are neither well equipped nor managed by skilled staff. Few of the centers in India do have well equipped ambulances but they are rarely managed by skilled personnel. In recently concluded study by author it was observed that most of the medical transport occurs like **"scoop and run"** and

carried by unskilled persons. Also there is no concept in existence regarding prehospital care of acutely ill and medical transport. There is no data available about adverse events occurring during transport in India, though many deaths have been seen due to improper transport. If the primary responder or paramedics are well trained in handling the acutely ill and trauma patients which includes initial assessment, prioritization of intervention, securing airway, providing effective breathing, control of hemorrhage, and effective medical transport then we will be definitely able to bring down morbidity and mortality. Good communication skills during acute care are also important part of management. Frequent counselling of patient/family parents is required. One may also be involved in breaking the bad news in acute care. This manual primarily focuses management of acute illnesses in prehospital settings by prehospital life support provider including medical transport and counselling of seriously ill patients.

CHAPTER 2

Assessment of Seriously Ill Adults

The aim of initial assessment is to identify physiological abnormalities, appropriate measures to correct these physiological abnormalities, and to diagnose the underlying etiology of the illness.

The most difficult task is to assess the seriously ill in pre-hospital settings and emergency departments. Acute illnesses and including trauma result in alteration in nearly all physiological systems (altered vital parameters, immunity response, coagulation system, metabolism of glucose, fat, and protein, and psychological response). Early identification of altered physiological parameters in acutely ill patients will make it easier to manage with simpler interventions and prevent further deterioration. In acute illness, bodily physiological parameters react early (activation of sympathetic nervous system), and assessment of these parameters (magnitude of sympathetic responses) give an idea of severity of illness. Children and young adults may not exhibit signs and symptoms of acute illness at initial stage because of their greater tendency to compensate. Severely injured and elderly patients are also difficult to assess for severity of illness. Longer the interval between appropriate interventions and onset of acute illness (beyond certain period) poorer will the outcome.

The routine systematic approach of taking full history, conducting complete physical examination and investigation, making correct diagnosis and planning treatment cannot be followed in emergency situation. **"Time is essence"**. In assessing serious patients, all the above steps should be carried simultaneously (Fig. 2.1). At initial encounter, a best guess diagnosis should be made and patient should be reassessed after each intervention. In acute illness should restrict ourselves only

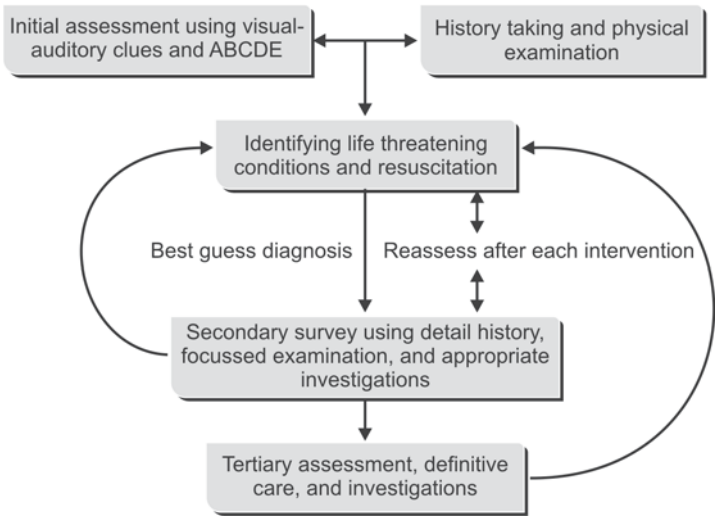


Fig. 2.1: Outlines of approach to seriously ill

to the information required for immediate intervention rather eliciting detailed history. Background health information/status is also necessary in many situations.

RECOGNIZING AT RISK

Tables 2.1 and 2.2 depicts list of important symptoms and signs and vital parameters which indicate serious illness in adults.

Approach to Assess the Seriously Ill Patient

1. **Primary survey** or initial assessment for identifying life threatening problems and prioritizing for interventions.
2. **Secondary survey** for identifying emergency conditions, appropriate interventions to manage and relevant investigations.
3. **Tertiary survey** for definitive care and detailed investigations.

Primary Survey Using ABCDE Approach

Initial assessment is done within few minutes to find out main physiological abnormalities, severity of illness, time available

Table 2.1: Features indicating severe illness

Systems	*Clinical features*
Cardiovascular system	Tachycardia, bradycardia, acute chest pain, hypotension, cold extremities, altered consciousness level
Respiratory system	Tachypnea, increased work of breathing, bradypnea, oxygen saturation < 94% in room air, cyanosis
Nervous system	Acute deterioration in consciousness level, agitation, aggressive behavior, seizures
Renal	Decreased urine output < 0.5 ml/kg/hr over a period of 6 hours
Gastrointestinal system	Hematemesis (bleeding from upper gut), severe jaundice, melaena (black color stool)
Metabolic	Metabolic acidosis, hypoglycemia (low blood sugar), electrolyte abnormalities
Miscellaneous	Sweating, massive bleeding, severe anemia, erythema

Table 2.2: Signs of vital importance

Parameter	*Value*
Blood pressure	Systolic < 90 mmHg and MAP < 65 mmHg
Heart rate	< 50 or > 150/min
Respiratory rate	< 8 or > 30/min
Conscious level	Glasgow Coma Scale < 13/15
Urine output	< 0.5 ml/kg/hr Metabolic acidosis is marker of serious illness

for investigations and initial treatment. The main components of primary assessment are;

A. Airway
B. Work of breathing
C. Circulation to skin
D. Level of consciousness
E. Exposure/environment.

Alteration or abnormality in any one of these components need immediate intervention. If no pulse is detected, immediately start chest compression and ventilation (cardiopulmonary resuscitation). Patient's history gives clue to diagnosis. Thus obtain simultaneously brief of current and past history from eye witness, care taker, family members, or paramedics and try to know main symptoms. Also elicit any history of trauma, intervention done, ingestion of drug or poison or toxin, and sudden alteration in mental status. Further detailed history may be taken by the doctor for further assessment and management.

A. *Assessment of airway*: Patent airway is of vital importance. No patent airway no life. Follow sequence of look, listen, and feel for assessment of airway problems. Open the airway using head tilt-chin lift maneuver in unconscious patient and look for patency of airway, listen for abnormal breath sounds, and feel for airflow keeping your face close to patient mouth and nose facing the patient's chest.
   - *Look*: Look for causes of airway obstruction (trauma, blood, vomitus, foreign body, denture, and infection), cyanosis, abnormal respiratory rate and pattern (increased rate is important marker of severity of illness), increased work of breathing (subcostal and intercostal retractions), and altered level of consciousness.
   - *Listen*: Listen for noisy breathing (stridor, grunting, wheezing, and gurgling).
   - *Feel*: Feel of decreased or absence of airflow by keeping your face near to patient mouth and nose while opening the airway using head tilt-chin lift maneuver.

B. *Assessment of breathing*: Once airway has been assessed and maintained either using simple maneuvers like suctioning, removal of foreign body by finger sweep or head tilt-chin lift or jaw thrust maneuver (in trauma victim) or by using airway adjuncts (oropharyngeal or nasopharyngeal airways), assess for efforts, efficacy and effects of breathing. **Tachypnea is indicator of serious illness**. Count the respiratory rate and document it. Respiratory rate is also increased in pain and fever. If no breathing effort is seen, give two effective rescue breaths for one second each (blowing air into patient

mouth closing nose with thumb and index finger) making tight seal around lips. The risk of disease transmission is very low with mouth-to-mouth breathing. One can also use pocket mask for giving rescue breaths. Breathing may be abnormal in neuromuscular disorders, pulmonary disorders, and extrapulmonary disorders.

- *Look*: Look for cyanosis (bluish discoloration of body), accessory muscles, altered respiratory rate pattern (RR is increased in respiratory illnesses, cardiac diseases, pain, anxiety, and fever) and pattern (rapid, shallow, periodic, gasping, and apnoeic), oxygen saturation with pulse oxymeter (SpO_2), agitation, confusion and level of consciousness.
- *Listen*: Listen for noisy breathing like grunt (expiration against partially closed glottis), wheeze (audible sounds without the aid of stethoscope), stridor (inspiratory sounds), and inability to talk.
- *Feel*: Palpate chest for crepitus, bilateral movements, and position of trachea.

C. *Assessment of circulation*: Inadequate perfusion to body organs can lead to tachycardia and altered mental status. Look for evidence of poor circulation, listen heart sounds, and feel pulses. Cardiovascular disturbances can be primary or secondary to other disorders such as sepsis, hypoxia, or drugs induced. Normal central pulses (carotid and femoral) and weak peripheral pulses indicate compensated shock while weak central pulse as well as peripheral pulses are indicative of hypotensive shock and needs immediate intervention. Fall in blood pressure is late sign of shock. Arrhythmias (abnormal heart rhythm) can also be picked up by palpating the pulse.

- *Look*: Look for evidence of external bleeding, skin mottling, pallor, jugular venous pressure (distended neck veins seen in tension pneumothorax, cardiac tamponade) and dyspnea (difficulty in respiration).
- *Listen*: Abnormal heart sounds heard with the help of stethoscope.
- *Feel*: Central (carotid and femoral) and peripheral pulses (radial and brachial) and temperature.

D. *Disability or neurological assessment*: Assess level of consciousness using Glasgow Coma Scale or AVPU scale, pupil size and reaction to light and posture.

In addition to ABC's and neurological assessment, a rapid external examination is carried out. Look for pallor, jaundice, excessive sweating, rash, bleeding spots, edema, and cyanosis. Also conduct abdominal examination for evidence of tenderness, rigidity, distension and any palpable mass.

Categorization of Patients after Initial Assessment

1. *Stable*: These patients need minimal monitoring and have no abnormality in appearance (level of consciousness), work of breathing and circulation to skin
2. Stable with risk of deterioration
3. Respiratory distress/failure
4. Cardiovascular compromise
5. Neurological compromise
6. Cardiopulmonary failure/arrest.

CHAPTER 3

Assessment of Seriously Ill Children

Children have dynamic physiology and their psychomotor skills and social skills depend on the developmental stage. Therefore, appearance and expected behavior to illness also vary with age. Despite of having similar genetic makeup, their expressions are different from adults. Children also have certain anatomical and physiological differences from adults. Moreover children depend on care-givers for their needs. It is important to know weight and height in different age groups. Certain important differences between children and adults with treatment considerations are given in Table 3.1.

1. Age-wise categorization
   a. Newborn: From birth to 28 days
   b. Infant: Up to one year
   c. Toddler: 1-3 years
   d. Preschool: 3-6 years
   e. School age child: 6-12 years
   f. Adolescent: 12-18 years
2. Calculation of weight
   1-6 years = Age × 2 + 8
   7-12 years = Age × 7 – 5/2
3. Calculation of height (2-12 years)
   Age in years × 6 + 77 = cm

Initial assessment helps to evaluate and stabilize the seriously ill child. It also gives clue, to categorize the severity of illness, understand physiological abnormalities and best therapeutic interventions needed.

Assess the child using systematic approach. Categorize the severity and type of illness (respiratory and circulatory), deciding actions, and act accordingly (starting CPR, giving oxygen, attach

pulse oximeter or vital sign monitor, providing appropriate treatment, and arranging transport). Reassess the child after each intervention. There are four components of pediatric assessment (We will discuss only general and primary assessment).

Table 3.1: Important differences between children and adults

Differences	*Treatment considerations*
Body weight	Weight increases with increasing age. Medicine and fluid are used on the basis of weight of the child
Anterior fontanel is open up to 6 month of age	Helps in assessment of severity of dehydration
Activity	Level of activity depends on age. Persistence of neonatal reflexes beyond certain age are abnormal
Body surface area	Body surface area to weight ratio decreases with increasing age Larger body surface area makes them more prone to hypothermia and dehydration
Small upper and lower airway	Equipments requirement are different (use straight blade laryngoscope for intubation up to 20 kg and uncuffed endotracheal tubes in neonates)
Poorly developed tracheal cartilages and muscles	Increased chance of airway obstruction during flexion and hyperextension of neck
Soft ribs cage	Less chance of ribs fracture, more chance of lung injury
Children have less total circulating blood volume	More prone to hypotension with small blood loss
Small stomach capacity	Chance of aspiration high
High metabolic rate	More chance of dehydration and hypoglycemia

1. General assessment
2. Primary assessment
3. Secondary assessment
4. Tertiary assessment

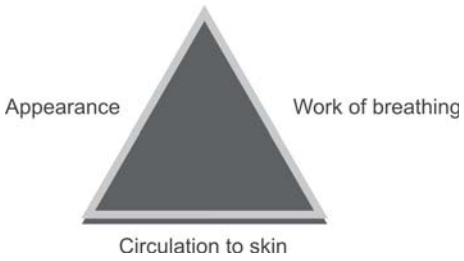


Fig. 3.1: Pediatric assessment triangle

Quick general assessment can be done using pediatric assessment triangle (Fig. 3.1:PAT). PAT is rapid way to assess physiological abnormalities by visual and auditory clues within 30-60 seconds. No equipment or investigation is required at this stage of assessment. The three components of PAT (appearance, work of breathing, and circulation to skin) are interdependent and reflect child's physiological status. PAT also helps us to define severity of problems and urgency of treatment of life threatening problems. Three components of the PAT represents general status of child, oxygenation and ventilation status, perfusion level, and brain functions.

Components of PAT

1. *Appearance*: It reflects the adequacy of ventilation, oxygenation, brain perfusion, homeostasis, and brain functions. Various components of appearance which describe child's disability are given below. Certain conditions like blunt trauma and poisonings (iron and paracetamol) may mislead in general appearance assessment. Remember that appearance does not reflect etiology of illness/injury.

   Components of appearance:
   a. Tone
   b. Interactiveness
   c. Consolability
   d. Look for gaze
   e. Speech and cry
2. *Work of breathing*: It primarily reflects oxygenation and ventilation status of the child. Look for visual and auditory

clue of abnormal respiration, pattern of breathing and work of breathing. Visual and auditory clues for increased work of breathing are; *abnormal sounds (snoring, stridor, wheeze, muffled speech), head bobbing, abnormal position (sniffing, tripod), retractions, nasal flaring, and tachypnea*.

3. *Circulation*: Assess the adequacy of cardiac output and perfusion of vital organs. Pallor, mottling, abnormal behavior, tachypnea and cyanosis are features of inadequate circulation. Observe exposed part of body for any injury and evidence of skin bleed.

Three components when combined give an idea of likely physiological abnormalities, severity of illness, and detect life threatening conditions (Tables 3.2 and 3.3). This also gives an idea that how quickly one should intervene and what type of general and specific treatments to be instituted.

After initial assessment and appropriate interventions done to stabilize the child, proceed for secondary assessment.

Table 3.2: Categorization of severity of illness using PAT

Appearance	***Work of breathing***	***Circulation***	***Physiological status***
Abnormal	Normal	Normal	Primary brain dysfunction
Normal	Abnormal	Normal	Respiratory distress
Abnormal	Abnormal	Normal	Respiratory failure
Normal	Normal	Abnormal	Compensated shock
Abnormal	Normal	Abnormal	Decompensated shock
Abnormal	Abnormal	Abnormal	Cardiorespiratory failure

Table 3.3: Life threatening conditions requiring immediate attention

1. Complete or partial airway obstruction
2. Apnea, bradypnea, tachypnea, increased work of breathing
3. Signs of poor perfusion, symptomatic bradycardia, hypotension, tachycardia
4. Unresponsiveness, decreased response or abnormal motor response to pain
5. Hypothermia, bleeding consistent with septic shock, acute abdominal distension

SUMMARY (FIG. 3.2)

A. Pediatric assessment triangle using visual and auditory clues help to identify life threatening illness in pediatric patients.
B. Remembering certain normal age specific physiological parameters (Tables 3.4 to 3.6) are of importance to differentiate between normal and diseased.
C. Table 3.7 gives list of vital signs of importance in prehospital setting.

Table 3.4: Normal respiratory rate in children

Age	*Breaths/min*
Infant (< 1 year)	30-60
Toddler (1-3 years)	24-40
Preschool (4-5 years)	22-34
School age (6-12 years)	18-30
Adolescent (13-18 years)	12-16

Table 3.5: Normal heart rate in children

Age	*Awake*	*Mean*	*Sleeping*
Newborn to 3 months	85-205	140	80-160
3 months to 2 years	100-190	130	75-160
2 years to 10 years	60-140	80	60-90
> 10 years	60-100	75	50-90

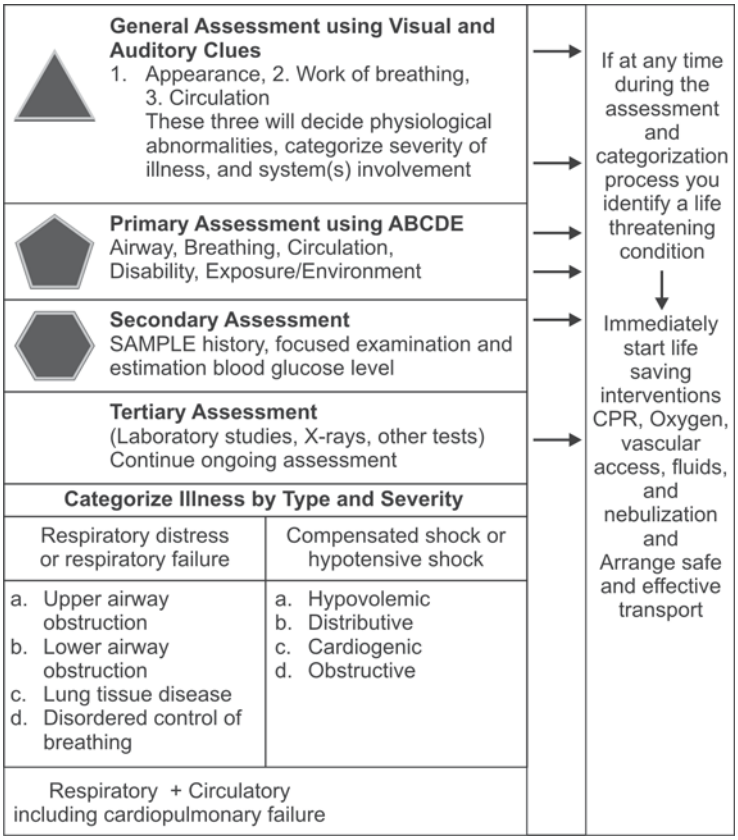
Table 3.6: Normal blood pressure in children

Age	*SBP (mmHg)*		*DBP (mmHg)*	
	Female	*Male*	*Female*	*Male*
Neonate (1st day)	60-76	60-74	31-45	30-44
Neonate (4th day)	67-83	68-84	37-53	35-53
Infant (1 month)	73-91	74-94	36-56	37-55
Infant (3 months)	78-100	81-103	44-64	45-65
Infant (6 months)	82-102	87-105	46-66	48-68
Infant (1 year)	68-104	67-103	22-60	20-58
Child (2 years)	71-105	70-106	27-65	25-63
Child (7 years)	79-113	79-115	49-77	38-77
Adolescent (15 years)	93-127	95-131	47-85	45-85

Mean Arterial Blood Pressure = 55 + (age in years × 1.5) mmHg

Table 3.7: Signs of vital importance in critical illness

1.	Respiratory rate > 60/min up to 2 months, > 50/min up to 1 year, and > 40/min after one year and rate above 60/min is always abnormal
2.	Saturation SpO_2 < 94% in room air
3.	Capillary refill time > 3 sec
4.	Heart rate: Infant > 200/min and < 80/min, child > 180/min and < 60/min
5.	Blood pressure: < 70 + age × 2
6.	Urine output < 1 ml/kg/hr
7.	Altered mental status
8.	Unresponsive to painful stimulus
9.	Temperature < 36.5c
10.	Metabolic acidosis



Modified from pediatric advanced life support manual

Fig. 3.2: Summary of assessment of seriously ill children

CHAPTER 4

Assessment of Seriously Injured

Trauma contributes huge burden in the developing countries and is leading cause of morbidity and mortality in India. As per WHO report approximately 16000 people die per day due all types of trauma. Developing countries are not well equipped with trauma care centers and trained man-power. It is essential to understand that if these victims are handled within **"Golden period"** then the outcome will better. At initial contact if we can prioritize the tasks in these patients we can save many lives. Most of deaths in trauma occur due to massive bleeding, obstruction of airway leading to respiratory failure and injury to vital organs like brain. R Adams Cowley described the term **"Golden hour"** of trauma which is presently known as **"Golden period"** defines time between injury and definitive care. Interventions like control of bleeding and management of airway are done during this period than the outcome will improve. Some patients may have even less than one hour to receive care (bullet injury or penetrating injury to heart). It is the duty of prehospital life support provider to resuscitate and transport these victims to the nearest trauma center or nearby hospital at the earliest.

Children differ anatomically, physiologically, developmentally and psychologically from adults. Few of the important reasons which make children more vulnerable to severe traumatic injuries are;

1. Small children cannot escape from accident scene site because of poorly developed cognitive skills.
2. Large head size makes child more prone to head injury (shift in center of gravity).
3. Large occiput may cause airway obstruction during transport.

4. Close proximity of pediatric airway to earth surface and higher respiratory rate make children prone to toxic gas poisoning.
5. Highly compliant chest wall predisposes to lung contusion.
6. Injuries without fracture are common due to thin bone and thick periosteum.
7. Impact of traumatic energy transmission is high in children because of their small size.
8. Intracranial bleed can also lead to hypotensive shock in children which is rarely in adults.
9. Spinal cord injuries cannot be assessed easily in children due to flat facet joints and elastic cervical ligaments. Children can have spinal cord injury even without any radiological abnormality (SCIWORA).
10. Liver and spleen are more prone to traumatic injuries since they are not covered with ribs.

Donald D Trunkey described trimodal distribution of death due to injury:

1. Within seconds to minute (50% deaths) mainly due brain lacerations, brain stem injury, cardiac trauma, aortic injury and high spinal cord injury.
2. From minutes to hours from subdural hemorrhage, tension pneumothorax, hemothorax, liver and spleen injury, and pelvic fractures (30%).
3. Days to weeks as a result of sepsis and multiorgan failure. Reaching to accident, performing initial assessment, doing critical interventions, and transporting should not exceed the **"platinum ten minutes"**. This is not always possible in developing countries due to many reasons. "Scoop and run" situation exists at many places. It is essential to assess the injured victim in a time frame through a structured approach and act accordingly. As a paramedic or PHLS service provider during general or global assessment if you detect patients with decreased level of consciousness, compromised airway, large flail chest, tension pneumothorax, and severe head injury, you should follow the approach "load and go". Transport immediately to nearest appropriate health facility and do not wait for more invasive intervention or treatment

of minor injuries. Initial trauma assessment should be global and management include both accident scene handling and victim care.

4. *Scene assessment*: Make a quick assessment of scene and ascertain whether if it is safe to proceed.
   a. Establishing the priorities of management
      i. *Scene safety*: Stabilization of vehicle, removal of victims from fire, toxic gases, and electric wire (spread of oil due to accidents lead to increase chance of fire), and traffic safety at scene site.
      ii. *Self and bystander's protection*: Use universal precautions (wear gloves, gown, face mask, and goggles for eye protection) for self and ensure bystander's safety.
      iii. Find out number of casualties and need for further help.
      iv. Carry all equipments necessary to provide initial care {personal protective equipments, long spine board, straps, head and spine immobilization devices, airway management equipments and oxygen, decompression needle, and trauma kit (dressing material, BP apparatus, IV set)}.
      v. Provide care to those who have more chance of survival. Victims who are unconscious with no respiration and pulse, may not be priority of management.
   b. It is also important to understand the mechanism of injury and kinematics involved in producing injury (head protection, restrains worn or not, position of victims at the time of injury, speed of impact, damage to vehicle, injury to accompanying victims, history of drowning or fall from height, etc).
   c. Categorization of patients on the basis of need of care
      i. *Immediate*: Injuries are critical but have better outcome with minimal help/equipments.
      ii. *Delayed*: Sustained injuries but not life threatening may be dealt in hospital.
      iii. *Minor*: Also called walking wounded, may not need immediate care.

iv. *Expectant*: Serious injuries with minimum chance of survival.
v. *Dead*: Unresponsive, unconscious, not breathing and pulseless.

5. Victim's Assessment
   a. *Primary survey*: Follow ABCDE's approach of initial assessment
   b. *Resuscitation*: Start immediate resuscitation in patients who are unconscious, having respiratory distress and hypotensive shock, massive hemorrhage, polytrauma, and head injury.
   c. *Secondary survey*: History taking allergy, medication, past history, last meal taken, event leading to present illness and head to toe examination and carrying out relevant investigations.
   d. *Emergency management*: Management of emergencies detected during primary and secondary surveys.
   e. *Tertiary survey and definitive care*: This is done in the hospital settings after initial stabilization and managing serious conditions.
   f. Rapid transportation to appropriate health care facility.

PRIMARY SURVEY

Primary survey is done on the pattern discussed in previous chapters with few additional points mentioned below.

Components of Primary Survey or Initial Assessment

A. Airway with inline cervical spine immobilization
B. Breathing including ventilation and oxygenation
C. Circulation with external hemorrhage control
D. Disability/Neurological assessment
E. Exposure/Environment/Examination/Evaluation and hypothermia prevention
F. Rapid transportation to appropriate health center

Airway and Cervical Spine Immobilization

Assessment of airway follows the same sequence as described in Chapter 2. If the child is crying or adult is able to communicate,

it means airway is patent. Check the patency of airway (rule out foreign body, mandibular and laryngeal injury) using jaw thrust or trauma chin lift maneuver. Head tilt-chin lift technique is not recommended in trauma victims. This may further aggravate cervical spinal cord injury. If patency of airway cannot be established by simple maneuver, active intervention using airway adjuncts (Guedel's airway or nasopharyngeal airway) will be required depending upon the situation (see chapter on airway and cervical spine immobilization). Visible foreign body in the mouth should be removed by finger sweep technique. Apply manual in line stabilization and hard cervical collar (age appropriate) to prevent further cervical injury. Depending on the position of victim at accident site, you should manage the head and cervical spine (refer Chapter 8). Try to bring head in neutral position. Inline cervical spine stabilization is contraindicated in patients with neck muscle spasm, resistance to move head, compromised airway, increase in pain during movements, and appearance of new neurological signs. Compromised airway needs immediate rapid sequence intubation (RSI) keeping "inline manual head and neck stabilization". If patient is not responsive to voice and not able to maintain airway by simple methods (ruled out history of drug overdose) intubate or insert laryngeal mask airway to secure airway. Patient with decreased level of consciousness and compromised airway should be shifted immediately to the hospital (load-and-go). Different techniques to secure airway have been discussed in Chapter 8. Do not move the patient until airway and cervical spine have been secured and stabilized.

Breathing (Ventilation and Oxygenation)

Once the airway is secured with inline cervical spine stabilization, and extensive external bleeding controlled then proceed to assess breathing. Assess the efforts, efficacy, and effects of breathing. Follow the sequence of look, listen, and feel as discussed earlier. If the victim is not breathing, immediately insert an appropriate size oropharyngeal airway in mouth and start ventilating with self-inflating bag-mask attached with supplementary oxygen. Even if the respiratory rate is slow

(< 10/min) or very fast, start ventilating with self-inflating bag-mask. Look and palpate for any sign of external chest injury (fractured ribs, crepitus), tracheal position, jugular venous distension and abnormal chest movements. Tension pneumothorax (air in the pleural cavity) and flail chest (pleural space open to atmosphere along with more than three fractured ribs) need immediate treatment. Deliver high flow oxygen using (flow of oxygen more than patient's inspiratory efforts) non-rebreathing mask to all seriously ill patients.

Circulation and External Bleeding Control

Hemorrhage is most important cause of hypovolemic shock (when blood flow is inadequate to meet the oxygen demand of the body or imbalance between need and utilization) and mortality in trauma. Hypotension (low blood pressure for age) is late feature of shock. Control of external hemorrhage can be achieved by means of manual compression, applying tourniquets or blood pressure cuffs. Removing weapon from wound site in prehospital settings may increase the risk of bleeding. Arterial bleeding is characterized by spurting of blood and is difficult to control.

Rapid assessment of pulse (rate and volume), capillary refill time, skin color, peripheral temperature, level of consciousness and blood pressure (Table 4.1) give good clue of the circulatory status of the patient.

1. Pulse:
   a. Tachycardia is early marker of shock and bradycardia is poor prognostic sign
   b. Poor volume indicates shock
2. Color: Normal color of skin is pink
3. Capillary refill time: Press nail beds for few seconds and see return of blood
   a. Normal CRT 2 seconds
   b. Abnormal CRT > 3 seconds
4. Temperature: Periphery are cold in shock
5. Systolic blood pressure < 90 mmHg in adults and less than (70 + age x 2) in children indicate hypotension
6. GCS: Less than 13/15 needs assessment

Table 4.1: Estimation of SBP on the basis of pulse volume

Type of pulse	*Estimated systolic blood pressure*
Radial	80-90 mmHg
Brachial	70-80 mmHg
Femoral	70-80 mmHg
Carotid	60-70 mmHg

Loss of consciousness in hemorrhagic shock means half of the blood volume has been lost. Tension pneumothorax, cardiac tamponade and myocardial injuries are important causes of non-hemorrhagic hypovolemic shock in trauma victim. Distended neck veins, decreased chest movements, muffled heart sounds and pulsus paradoxus (fall of systolic blood pressure more than 10 mmHg during inspiration) are indicative of above conditions. Obtain vascular access (intravenous or intraosseous) and infuse crystalloid solution in patients with shock. Either ringer lactate or normal saline is infused 20 ml/kg over 5-10 min in children and 2-3 liter (50 ml/kg) in adults. Reassess the patient after each intervention. Uncrossmatched type specific or O-negative or O-positive RBC may be transfused in patients who are still hypotensive after two fluid boluses. Age specific parameters are important to know while dealing such victims. Suspect blunt cardiac injury if person is involved in high-speed, frontal impact accidents and who has unexplained hypotension and arrhythmia.

Disability/Neurological

A brief and rapid neurological assessment is performed including level of consciousness using Glasgow coma scale (Table 4.2) or AVPU scale (Table 4.3), pupillary size and reaction, lateralizing signs (abnormal posturing), and weakness of limbs. Besides direct brain injury, decreased level of consciousness may also result due to cerebral hypoxia or poor circulation. Abnormal appearance or level of consciousness combined with respiratory distress or features of shock indicate the need for aggressive resuscitation.

Table 4.2: Glasgow coma scale

Adult and child	*Infant (12 months)*	*Score*
	Best eye response	
Spontaneous	Spontaneous	4
To command	To voice	3
To pain	To pain	2
None	None	1
	Best verbal response	
Oriented	Coos and babbles	5
Confused	Irritable cry	4
Inappropriate	Cries to pain	3
Incomprehensible	Moans to pain	2
None	None	1
	Best motor response	
Obeys command	Spontaneous movements	6
Localizes pain	Withdraws to touch	5
Withdraws	Withdraws to pain	4
Flexion to pain	Flexion to pain	3
Extension to pain	Extension to pain	2
None	None	1

Normal GCS 15/15 (a score of 13/15 needs attention)

Table 4.3: AVPU scale

A	Alert	Awake, alert, responsive to external stimulus. Age specific response is assessed
V	Voice	Child responds to voice
P	Pain	Response to painful stimulus
U	Unresponsive	No response to any stimulus

Exposure/Environment

It is essential to uncover the patient for proper examination (hypothermia is a major risk in children). It is also important to cover the child with blanket to prevent hypothermia. Always use warm intravenous fluids during resuscitation in trauma victims.

Life threatening situations, i.e. tension pneumothorax, flail chest, acute respiratory failure, cardiac tamponade, myocardial

injury, hypotensive shock, cardiac arrest, ventricular fibrillation, intracranial bleeding, herniation syndromes (abnormal posturing and pupillary reaction), open abdominal injury, and large blood vessel injuries should be managed during initial assessment. Arrange for transport and appropriate surgical interventions. Continue to monitor vital signs including pulse oximetry and urine output.

General Impression

General impression provides information regarding kind of intervention needed, i.e. basic life support, advanced life support, need for additional resources, and transportation.

Transport Considerations

1. Arrange transport after initial resuscitation to nearby hospital or trauma center (load and go).
2. Inform the receiving hospital about patient's details, mechanism and type of injury, kind of intervention done, help needed, and number of casualties.
3. Lift the patient as a whole using logroll method. Tie the patient on long backboard with straps (head, chest, pelvis and legs).
4. Continue to monitor vital signs, provide essential care and record events.

Secondary Survey (Indicated only in not load-and-go Situations)

After completing primary survey and treating life threatening problems and stabilizing the patient, secondary survey is carried out. Throughout the course of management continue to monitor vital signs including level of consciousness and pulse oximetry. Secondary survey includes detailed focussed history as discussed earlier (including details of mechanism of injury, speed of impact, weight of victim, contact area, density, associated persons injuries, damage to vehicle, history of any drug allergy, previous medical illness or trauma, any medication received, tetanus immunization) and head to toe examination. Recognizing the

mechanism of injury will help in long-term management of patient (Table 4.4).

Table 4.4: Injuries based on mechanism of impact

Mechanism of injury	*Type of injury*
Frontal impact	Cervical spine, flail chest, myocardial contusion, ruptured liver and spleen, fracture/dislocation of hip and knee
Rear impact	Cervical spine, head, thoracic and abdominal injury, fracture of lower extremities
Lateral impact	Cervical spine, flail chest, pulmonary contusion, aortic injury, head injury liver/spleen injury, pelvis or acetabulum
Rotational impact	Combination of frontal and lateral impact injury
Rollover	Crushed/impact injury

Detailed Examination

a. *Head and face*: Face is examined for open wounds, fractures, deformity, cerebrospinal fluid leak (nose and ear), conjunctival hemorrhage, pupillary reaction, eye movements and ears.
b. *Neck*: Neck is examined for cervical spine injury, pain, surgical emphysema (crepitus), jugular vein distension, tracheal displacement, and any swelling that may compromise airway.
c. *Spine*: Pain, crepitus, paralysis (weakness of limbs), and abnormal sensations are indicators of spinal injury in conscious patients.
d. *Chest and thorax*: Chest is examined to rule out life threatening conditions like; tension pneumothorax, hemothorax, and flail chest. Look for any chest deformity, stability of ribs, open wounds and any other abnormal respiratory movements (retractions). Assess for any crepitus, and abnormal breath sounds.
e. *Abdomen*: Inspect for contusions, open wounds, abdominal movements, tenderness and rigidity, and genitalia. Blood from meatus or scrotal hematoma are contraindications to catheterize the urinary bladder.

f. *Pelvis*: Pelvic fracture is an important cause of internal bleeding (30% blood volume may be lost) in vehicular accidents and death. See for any ecchymosis, swelling and deformity (Fig. 4.1). Palpate the pelvic region by first compressing the iliac wing laterally and inwardly. If no crepitus or pain is observed exert pressure downward on iliac crest again and notice for crepitus pain. Patient with pelvis fractures should not be logrolled except when alternative method will result in life threatening delay in evacuation.

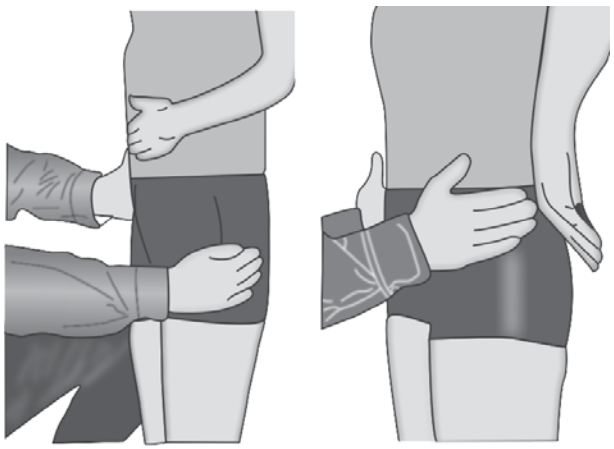


Fig. 4.1: Assessment of pelvic injury

g. *Examination of extremities*: Special attention should be focussed on dislocation of hip, fracture femur and vascular injuries (palpate distal pulse, bleeding). Splint the limb if you are not sure of fracture.
h. *Neurological examination*: Observe pupils (size, reaction to light, and symmetry), sensory loss, and abnormal posture or weakness.
i. *History and vital signs*: Evaluate history and continue to monitor heart rate, respiratory rate, blood pressure, color, oxygen saturation, and temperature every 5-10 minutes during transport or otherwise.

Tertiary Survey and Definitive Care

Always perform head to toe examination within 24 hours and carry out appropriate investigations. Definitive treatment is a team approach and patient must be referred or transferred at appropriate level facility required. Always keep record of all interventions and monitored data.

Attention

1. It is important to consult the surgeon early in trauma victims.
2. You can seek the help of experts on telephone while handling such patients.
3. Transfer to higher center should not be delayed in view of radiological investigation.
4. Early intubation is indicated in patients with smoke, inhalational injury, facial burns, and facial injury.
5. Identify preventable cause of secondary injury (hypoxia and bleeding).

Indicators of Severity of Trauma

1. Mechanism of injury
   a. Death of other occupant in vehicle
   b. Eviction from vehicle
   c. Steer deformity
   d. Pedestrian or cyclist
   e. Side impact
   f. Compression or entrapment
   g. Crush injury
   h. High voltage current
   i. Rollover
   j. Severe vehicle deformity
2. Injury
   a. High speed injury
   b. Fall from height
   c. All penetrating injuries except hand and feet
3. Extreme of ages
4. Physiological abnormalities

   a. Respiratory rate < 10 and > 30/min or RR > 50/min in children
   b. Glasgow coma scale < 13
   c. Systolic blood pressure < 90 mmHg in adults and < 70 + age × 2 in children
   d. Pulse < 60/min with poor perfusion and > 150-180/min
   e. Absent radial pulses
5. Anatomical
   a. Amputation
   b. Flail chest
   c. Head injury
   d. Facial injury compromising airway
   e. Neurological deficit
   f. Second degree burn (> 15%) or third degree burn (> 10%)
6. Others
   a. Tension pneumothorax
   b. Open pneumothorax
   c. Hemothorax
   d. Cardiac tamponade

Death

Suspect person dead if patient is;
1. Unresponsive
2. Absent respiration
3. Pulseless
4. Fixed pupils
5. Plus any of the following(s) is present:
   a. Injury severe enough to cause death
   b. Rigor mortis
   e. Tissue decomposition.

CHAPTER 5

Monitoring

Monitoring of seriously ill is an essential component of management. Acute illnesses result into predictable physiological alteration in the human body. These physiological changes/alterations can be monitored clinically as well as using various mechanical devices. Monitoring of parameters give us clue to diagnosis of acute deterioration in clinical condition, progression or severity of illness, intervention required, response to treatment, and outcome accordingly. Monitoring can be both invasive as well noninvasive. In prehospital settings and during transport mainly noninvasive monitoring is done by prehospital life support provider.

TYPES OF MONITORING

a. Clinical monitoring
b. Hemodynamic monitoring
c. Biochemical monitoring
d. Microbiological monitoring
e. Radiological monitoring

Prehospital life support provider primarily depends on clinical and basic hemodynamic parameters for assessment. It is also essential to document all the events and parameters on file or record book.

Clinical Monitoring

Observe organ system on three points: Efforts, efficacy, and effects.

1. *Respiratory system:* Respiratory rate, pattern of breathing, recession, inspiratory and expiratory noises, accessory muscles, degree of chest expansion, oxygen saturation, cyanosis, mental status, heart rate.

2. *Cardiovascular system*: Heart rate, pulse volume, capillary refill time, blood pressure, respiratory rate, skin perfusion, mental status, and urine output.
3. *Neurological*: GCS or AVPU scale, pupils, and body posture.
4. *Exposure*: Temperature, bleed.

a. *Pulse rate*: Palpate the radial, brachial, and carotid pulses to assess rate and volume. Also know age appropriate heart rate (Chapter 3).
   i. Tachycardia: Increased pulse rate is seen in conditions like fever, shock, pain, respiratory distress.
   ii. Bradycardia: Usually represents terminal sign of illness and commonly seen in hypoxia and hypovolemia.
   iii. Regular or irregular pulse rate indicates abnormal rhythm.
b. *Pulse volume*: Assessment of volume is done to evaluate fluid status.
   i. Peripheral pulse volume (radial, brachial, posterior tibialis): Thready pulse indicates loss of body fluids. Poor volume combined with higher heart rate indicates early shock.
   ii. Central pulse (carotid and femoral): Low volume indicates that patient is in decompensated shock and needs immediate resuscitation.
c. *Capillary refill time (CRT)*: CRT gives good assessment about patient's hydration status. CRT can be measured over sternum/sole or nail beds. CRT above 3 seconds is always abnormal. Press at nail bed or on sternum for few seconds and release. Look for return of blood in capillaries.
d. *Skin*: Normally skin is pink and warm. Pale and mottled skin due to vasoconstriction is seen in shock and hypothermia.
e. *Blood pressure*: Systolic blood pressure less than 90 mmHg in adults and (< 70 + age × 2) in children above one year age is always abnormal and indicates hypotension. Blood pressure can be monitored either by blood pressure apparatus (sphygmomanometer) or by monitoring devices.
f. *Temperature*: Fall in peripheral and core temperature (rectal) and increase difference between two temperatures is

suggestive of shock. Temperature can be recorded by thermometer or monitoring device.

g. *Respiratory rate*: Age appropriate respiratory rates are given in Table 3.4. Respiratory rate of more than 50/min in children and more than 25/min in adults needs immediate attention. Bradypnea indicates terminal illness and apnea is the complete cessation of respiration and requires immediate intervention.
h. *Work of breathing*: Increased work of breathing (chest retractions, use of accessory muscles, nasal flaring) indicates air hunger, partial airway obstruction, pulmonary diseases, shock, and increased fluid overload in acute care setting.
i. *Respiratory efforts*: Poor respiratory efforts are seen head injury, shock states, respiratory failure, drug overdose, and muscle disorders.
j. *Chest rise*: Adequate chest rise signifies good respiratory efforts and tidal volume.
k. *Cyanosis (peripheral and central)*: Bluish discoloration of nails and mucosa of mouth is seen in late stage of shock, cyanotic congenital heart diseases, abnormal hemoglobin and respiratory failure.
l. *Breath sounds*: Snoring, gurgling, stridor indicate upper airway diseases and wheezing and grunting indicate lower airway diseases.
m. *Level of consciousness*: Acute decrease in level of consciousness {(Glasgow coma scale (<13/15)} indicates abnormal brain perfusion, oxygenation or worsening of brain injury (mild brain injury GCS 13-15, moderate 9-12, and severe 3-8). Sudden loss of consciousness, pupillary dilatation and convulsions indicate acute hypoxic insult to brain.
n. *Pupil*: Look for size, symmetry and reaction to light.
o. *Urine output*: Decrease in renal perfusion will result in decrease urine output (oliguria is defined as urine output < 0.5 ml/kg/hr in adults, < 1 ml/kg/hr in children, and < 2 ml/kg/hr in neonates).
p. *Pulse oximetry*: Oxygen saturation < 94% in room air is always abnormal and need supplementary oxygen therapy. This can be monitored either by pulse oximeter or multipara monitors.

Hemodynamic Monitoring (Invasive and Noninvasive)

a. *Heart rate*: It is displayed on monitor screen (both ECG and pulse oximeter lead will display heart rate).
b. *Blood pressure*: Noninvasive and invasive blood pressure can be monitored as per requirement.
c. *ECG*: Attach ECG lead and record electrical changes in heart. Look for abnormal rhythms.
d. *Respiratory rate*: Respiratory rate is also displayed on screen.
e. *Temperature*: Temperature is monitored by attaching probe on skin and or putting probe into rectum.
f. *Oxygen saturation*: Saturation < 94% needs attention.
g. *Central venous pressure*: Done in advanced settings.

Monitoring of the Patient on Ventilator

Monitor and record the following parameters in ventilated patients during transport.

a. Mode of ventilation
b. Fraction of oxygen concentration (FiO_2)
c. Total respiratory rate (set + delivered)
d. Peak inspiratory pressure (PIP)
e. Peak end expiratory pressure (PEEP)
f. Tidal volume
g. Oxygen saturation
h. Alarms (power, oxygen, discontinuation)

Transport Considerations

a. Always attach monitor
b. Record all vital parameters including oxygen saturation
c. Intervene as required
d. Monitor blood glucose
e. Monitor GCS
f. Monitor ventilator parameters.

CHAPTER 6

Basic Life Support Skills

Functional outcome of seriously ill patients depends on timely intervention. Early resuscitation and prompt defibrillation during cardiac arrest (within 1-2 minutes) can increase chance of survival by more than 60%. Outcome of a patient also depends on time of help between initiation effective cardiopulmonary resuscitation (CPR) and cardiac arrest. Chance of survival is reduced by 7-10% for every minute delay in CPR. Basic life support (BLS) skills forms the basis of acute care management in all age groups and settings.

Basic life support (BLS) skills refer to life saving procedures that focuses on patient's airway, breathing and circulation. BLS skills include opening of the airway by simple measures, providing effective rescue breathing, chest compression, management of obstructed airway, and use of automated external defibrillator (AED).

Components of BLS

1. Airway
2. Breathing
3. Circulation
4. Defibrillation

Note: Drugs are not part of basic life support skills.

CPR may be required both prehospital and in-hospital settings. Initiate immediately chest compression and ventilation in patients who have no signs of circulation, i.e. no pulse or pulse rate less than 60/min with poor perfusion in children. Perform CPR on hard surface in supine position.

REVERSIBLE CAUSES OF CARDIAC ARREST

a. Hypoxia
b. Hypovolemia
c. Tension pneumothorax
d. Poisoning
e. Electrolyte disturbances
f. Cardiac tamponade
g. Acute myocardial infarction
h. Respiratory arrest in children

Always start CPR in a patient who is unresponsive or having no respiration or pulseless. Sequence of CPR includes;

1. *Ensure scene and self-safety*: Before you proceed with CPR, ensure that patient/bystanders and you are safe. Remove the patient from site of danger.
2. *Assess responsiveness*: The initial steps include assessing responsiveness, patency of airway, breathing efforts, and circulation. Patient may be unresponsive when in sleep, drugs overdose, and hysterical state. Check responsiveness by either shaking or shouting "are you alrights ?" (Figs 6.1 and 6.2). Do not shake patient with head and cervical spine injury.

Fig. 6.1: Assessing responsiveness in adult

Fig. 6.2: Assessing responsiveness in infant

3. If victim is unresponsive but breathing, keep him/her in recovery position as shown in (Fig. 6.3).
   a. Left lateral position of recovery position helps to prevent aspiration of gastric contents and puts esophagus above the stomach to prevent aspiration.
   b. Head, neck, and body should be aligned to avoid twisting and spinal injury.
   c. Call for further help (Fig. 6.4). Phone first in adults and phone fast in children.
   d. If the patient is child, you first do CPR for 2 minutes and then call for help.
   e. If you see a child who has suddenly collapsed in your presence, call for help first and then initiate CPR.
   f. If patient is unresponsive and not breathing keep him/her in supine position.

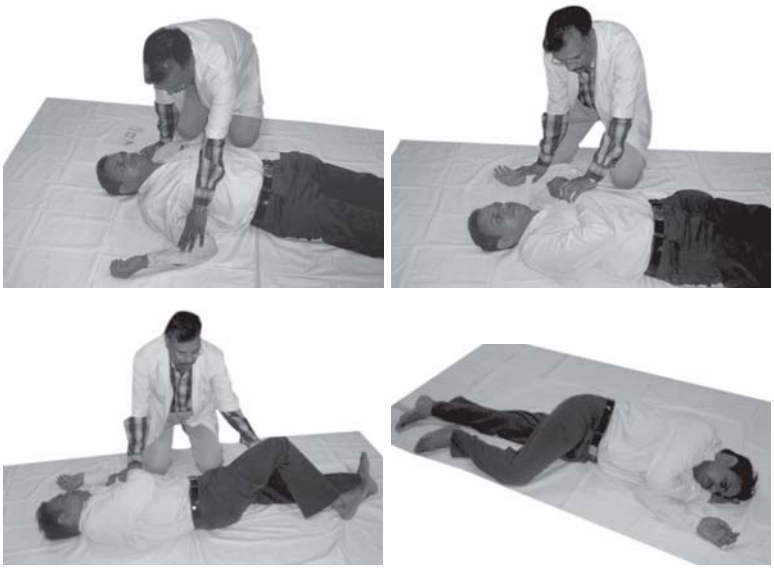
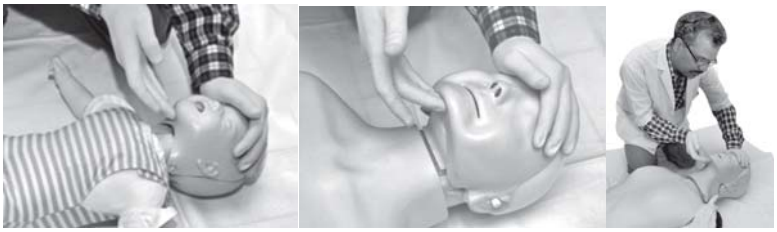


Fig. 6.3: Recovery position (only in adults)

Fig. 6.4: Call for help

4. *Assess patency of airway*: Fall of tongue and loose denture are two most important causes of airway obstruction in unconscious patient.
   a. To open the airway use head tilt-chin lift method (Fig. 6.5): This method is used in unconscious patients. Place one hand on forehead barring thumb and index finger and push the head back with palm. Place other hand (two fingers and not the thumb) on the bony part of lower jaw (chin) and lift jaw to bring the chin forward. It will bring tongue forward and away from back of throat.
   b. In a suspected trauma victim jaw thrust (Fig. 6.6) is the recommended technique for assessing the airway (place both hands on each side of victim's head, resting your elbows on the surface and place your fingers on patient's lower jaw and lift with both hands, displacing jaw forward) and retract lower lips with thumbs.
   c. If the patient is victim of trauma is lying prone or in lateral position, **logroll** to supine position to perform the skills.
   d. If the patient is not able to maintain airway by simple maneuver, use oropharyngeal or nasopharyngeal airways (see Chapter on Airway and Cervical Spine).



Infant Child Adult

Fig. 6.5: Head tilt-chin lift

Infant Child Adult

Fig. 6.6: Jaw thrust maneuver

5. *Check for breathing (Fig. 6.7)*: Check for adequacy of breathing taking not more than 5-10 seconds. Bring your face close to victim's mouth facing towards victim's chest.
   a. Look for visible chest movements.
   b. Listen breath sounds.
   c. Feel for air on your cheek. Agonal breaths (infrequent and irregular breaths) are not the breathing movements.

Adult Child

Fig. 6.7: Check for breathing (look, listen, and feel)

6. *Victim is unresponsive and not breathing*: Lone rescuer should give five cycles of CPR before calling for help in children. Call for help (phone first) and start CPR in adults.
7. *Victim is not breathing*: Give two effective rescue breaths, making chest to rise.
   a. Keep the airway open using head tilt-chin lift (except in trauma victim where jaw thrust technique is used).
   b. Remove the visible foreign objects by finger sweep method.
   c. Pinch the soft part of nose with index finger and thumb to prevent air escape.
   d. Take a regular breath (no deep breath) and seal your lips around victim's mouth, creating good air tight seal (Fig. 6.8). Pocket face mask may also be used to deliver breaths (Fig. 6.9). Risk of disease transmission is very low during mouth-to-mouth breathing.
   e. In infant, seal is made around nose and mouth (Fig. 6.10).

Fig. 6.8: Rescue breath mouth-to-mouth

Fig. 6.9: Rescue breath using face mask

Fig. 6.10: Mouth-to-mouth breathing

f. Give breath for one second (use barrier devices, if available).
g. Watch for adequate chest rise.
h. If there is no chest rise, look for foreign body or improperly opened airway.
i. When alone, stand on victim's right side to deliver breaths and chest compression.

8. *Check for signs of circulation (Figs 6.11 and 6.12)*: After giving two rescue breaths you should assess circulation (carotid pulse in adult and child and brachial pulse in infant) for at least 5 seconds and not more than 10 seconds.

1. No sign of circulation or no pulse in adults
2. No pulse or pulse < 60/min with poor perfusion in children
3. Not sure of pulse.

a. Locate the Adam's apple and slide your finger between Adam's apple and neck muscles. Feel the artery with two fingers (signs of circulation also include any movement, coughing, or normal breath).

Fig. 6.11: Checking for carotid pulse in adult

Fig. 6.12: Checking brachial pulse in an infant

b. If signs of circulation are present, continue to give breaths every 5-6 seconds (10-12 breaths/min) in adults and every 3-5 seconds (12-20 breaths/min) in children.
c. Maintain head tilt-chin lift during assessment of circulation.
d. Start chest compression, if;
   1. Absent pulse in adults and children
   2. Heart rate < 60/min with poor perfusion in children.

9. *Chest compression*: Chest compression requires a smooth application of pressure over lower-half of sternum. External pressure applied to the sternum increases pressure in chest (intrathoracic pressure) and moves blood into the circulation. Push hard, push fast. Compression should be sharp. Proper hands placement on patient's chest is necessary to avoid internal injury such as bruising of the heart and laceration of the liver. Blood flow in the carotid arteries as a result of external chest compressions is only one-fourth to one-third of the normal flow, but it is adequate until advanced life support is available.
   a. Place the victim on flat surface in supine position.
   b. Locate the site on sternum by drawing a line between the nipples (Fig. 6.13).
   c. Place your fingers below the intermammary line (one finger below) in infants.
   d. Place heel of one hand on the sternum and heel of second hand on back of first hand keeping fingers interlacing, pointing away, and not touching the rib cage (Fig. 6.14). Use two fingers or two thumbs technique in infants (Fig. 6.15).

Adult Infant

Fig. 6.13: Locating space for chest compression

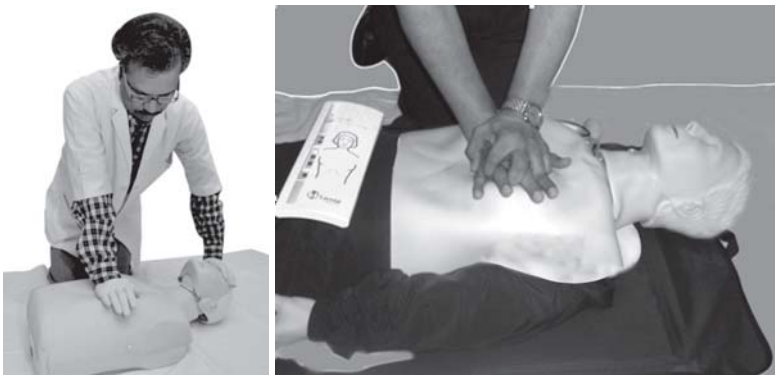


Fig. 6.14: Chest compression

Fig. 6.15: Chest compression infant

e. Lean forward so that shoulders are in line with hands. Keep arm straight with elbow locked and push sternum downward [(1/3rd of anteroposterior diameter in children) and (1½ 2 to 2 inches in adults) (Fig. 6.16)].
f. The pressure and release phase of each compression should be of equal duration. Allow complete recoil of chest.
g. Push hard, push fast.
h. Heel should remain in contact while doing compression and release.
i. The ratio of chest compression to ventilation is 30:2 for single rescuer in adults and children.
j. For two rescuers the ratio is 15:2 (100 compressions per minute) in children.
k. Perform 5 cycles of CPR in 2 minutes (< 23 seconds for 30 compression).
l. Reassess the hand position and pulse after each cycle of CPR.

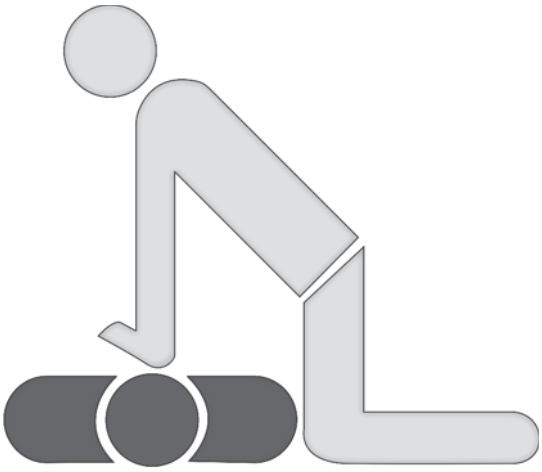


Fig. 6.16: Shoulder in line with hand

10. *Automated external defibrillator (AED) / manual defibrillator*:

Defibrillator stuns the heart and briefly stops electrical activity. If the heart is viable, it will resume its activity. CPR is needed after successful defibrillation.

Defibrillation is indicated in following situations;

a. Unresponsive
b. Not breathing
c. No pulse
d. *Contraindication*: Asystole and pulseless electrical activity.
    1. Attach the AED on patient and analyze the rhythm (Fig. 6.17).
    2. If rhythm is shockable (monitor will display), i.e. ventricular fibrillation or pulseless ventricular tachycardia, give shock (detail in Chapter on Procedures).
    3. Rhythm is not shockable resume CPR for 5 cycles and check rhythm after every 5 cycles of CPR until advanced support arises or patient is transferred to advanced center.

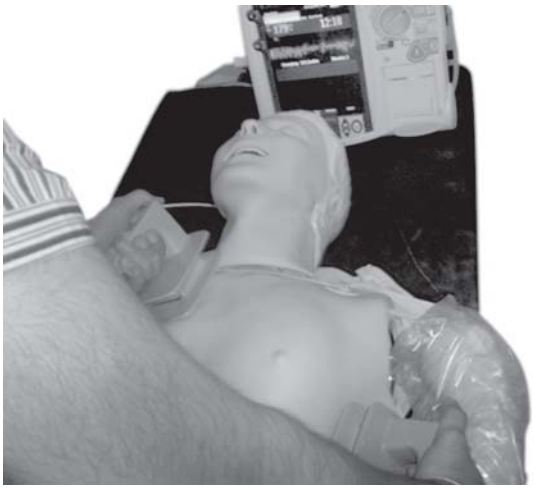


Fig. 6.17: Application of paddles

11. *Suspected foreign body in the airway*: If child or adult is choking suspect foreign body, may be partially or completely obstructing the airway.
    a. In case of partial obstruction, patient continues to breathe and remain conscious
    b. Patient with severe airway obstruction may remain conscious but unable to move enough air to cough or may become unconscious.

Procedure

a. Patient with obstructed airway is coughing and conscious encourage coughing and stay with the victim and observe. If symptom of mild obstruction persists transfer the patient to higher center.
b. If features of severe airway obstruction are present (poor cough, high pitched sound, increase respiratory difficulty, cyanosis, and clutching of neck with thumb and finger) but conscious, immediately start Heimlich maneuver. Use abdominal thrust in patients above one year of age (Fig. 6.18).

I. Stand or kneel behind the patient.
II. Wrap your arms around patient waist.
III. Place thumb side of fist on abdomen just above the umbilicus and below breastbone and press the fist with other hand towards abdomen and upward.
IV. Repeat the action until foreign body is expelled or patient becomes unconscious.
V. Instead of abdominal thrusts, chest thrusts are indicated in obese and pregnant patients.
VI. Victim becomes unresponsive open the airway, remove visible objects, and start CPR. Look for foreign body in mouth after each cycle of CPR.

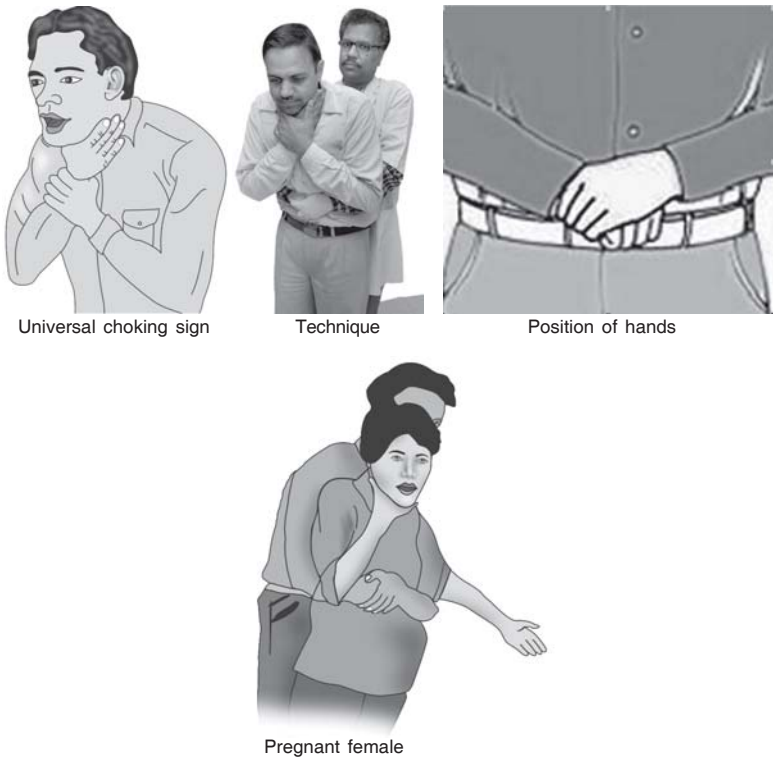


Fig. 6.18: Heimlich maneuver

c. Infant is below one year and choking follows the steps as under (Fig. 6.19).

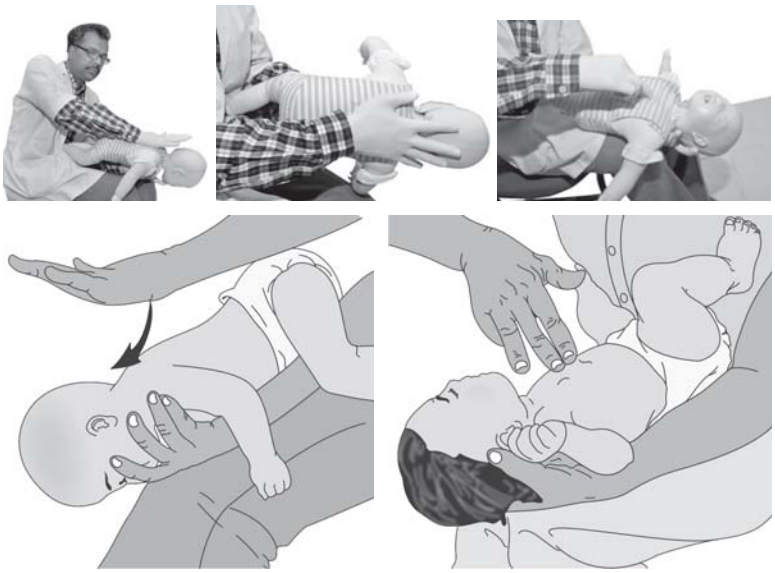


Fig. 6.19: Heimlich maneuver—infant

I. Sit with infant in your lap.
II. Hold the infant facedown with head slightly lower than chest, resting on forearm.
III. Support head and jaw with your hand.
IV. Give five back slaps in the middle of the back between infant's shoulders.
V. After five slaps turn the infant in prone position supporting back and head.
VI. Provide quick five downward chest thrusts.
VII. Repeat the sequence till foreign body is expelled or infant becomes unconscious.
VIII. Put child on flat surface, open the mouth and look for foreign body and remove, if visible. Start CPR and after each cycle look for foreign body in mouth.

Removal of foreign body from mouth (Fig. 6.20):

a. Open the mouth using head-tilt chin lift or trauma jaw thrust or trauma chin lift technique.
b. Remove foreign body with sweep and hook method.

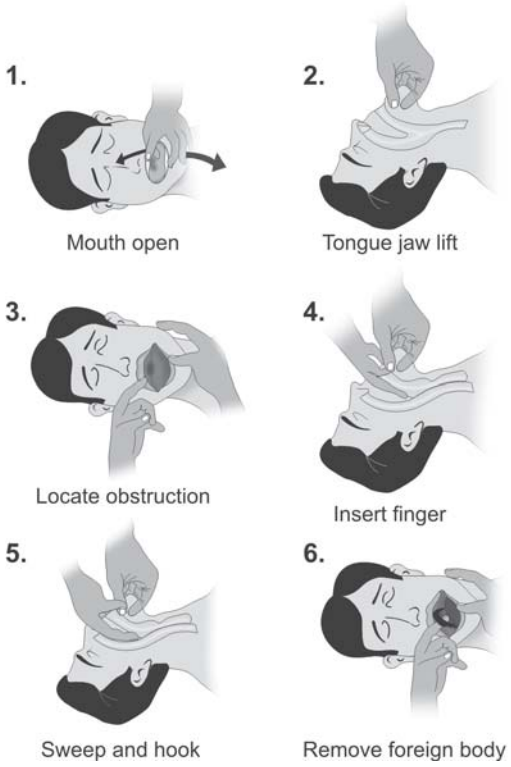


Fig. 6.20: Foreign body removal

SUMMARY

1. Determine responsiveness (gently shake if not injured or shout loudly).
2. Call out for help (if sudden collapse > 1 year, and adult, ask defibrillator and apply AED).

3. Position the victim supine on firm surface.
4. Assess the airway (use head-tilt and chin left).
5. Assess breathing (look, listen, and feel for breaths).
6. If not breathing give two effective breaths of one second each and watch for chest rise.
7. Check pulse (brachial artery in less than 1 year and carotid in above 1 year).
8. Perform chest compression if heart rate < 60/min with signs of poor perfusion in children and no pulse in adults.
9. Compression: Ventilation ratio 30:2.
10. Apply AED and assess rhythm.
11. Differences in infant, child, and adult CPR are given in Table 6.1.

Table 6.1: Summary of CPR in infants, children, and adults

Rescuer action	***Infant < 1 yr***	***Child 1 yr to puberty***	***Adult***
Assess responsiveness	Scene safety Tap bottom of feet or rub back	Scene safety Shake or speak loudly	Scene tap safety Shake or speak loudly
Activate EMS	5 cycles of CPR	5 cycles of CPR	Leave to call
Open airway	Head tilt. Chin lift (jaw thrust if trauma)	Head tilt. Chin lift (jaw thrust if trauma)	Head tilt. Chin lift (jaw thrust if trauma)
Check breathing	Look, listen, feel For air movements and chest rise	Look, listen, feel	Look, listen, feel
Rescue mask breaths	2 effective breaths of one second each that make chest rise	2 effective breaths of one second each that make chest rise	2 effective breaths of one second each that make chest rise
Check pulse no more than 10 seconds	Brachial (no pulse or < 60/min with poor perfusion start CPR)	Carotid (no pulse or < 60/min with poor perfusion start CPR)	Carotid (no pulse start CPR)

Contd...

Contd...

Chest compression (location)	Just below nipple line on breastbone	Center of breastbone between nipple	Center of breastbone between nipple
Compression (hard, fast, complete recoil, and no interruption)	1. One rescuer two fingers 2. Two rescuer two thumbs	One or two hands	Two hands
Compression rate and depth	30:2 (two rescuer 15:2) 1/3rd -½ of AP diameter	30:2 (two rescuer 15:2) 1/3rd -½ of AP diameter	30:2 ..... 4-5 cm Newborn 3:1

CHAPTER 7

Neonatal Resuscitation

Birth is the riskiest event of the life. Failure to postnatal adaptation can result into physiological instability, end organ damage, and death or disability. Stress of labor, transition to extrauterine environment and physiological challenges must be overcome successfully. Nearly 10% of neonates require some assistance during delivery.

The steps of resuscitation are same as of adults except that newborn needs special emphasis on temperature regulation. Below given is the flow diagram of neonatal resuscitation procedure (Fig. 7.1) which begins with the birth of the child. This diagram has been divided into three blocks of 30 seconds each. Block **A** concentrates on airway and temperature, Block **B** focuses on breathing and oxygenation, and Block **C** deals with circulation and drugs.

Neonates who require resuscitation can be identified by the following characteristics:

1. Meconium stained amniotic fluid (yes/no)
2. Preterm (yes/no)
3. Baby not crying at birth(yes/no)
4. No respiration at birth (yes/no).

A. If baby is born full-term, crying and pink colored needs only routine care.

- The baby can be dried with prewarmed dry towel and kept directly on mother's chest and/or abdomen.
- The baby should be covered with dry clothe to maintain the body temperature.
- The baby should be continuously observed for breathing, activity, and color.

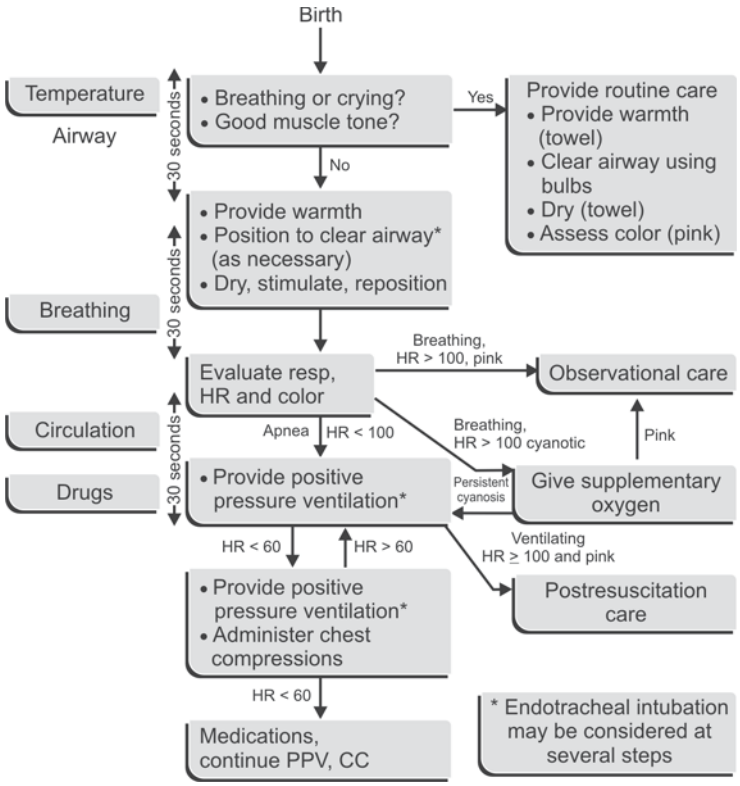


Fig. 7.1: Neonatal resuscitation flow chart

B. If the baby is born preterm, has no cry at birth, no respiration, and blue at birth, following actions/interventions will be required;

- Initial steps of stabilization include (providing warmth, position of the baby, clearing airway, drying, stimulation, reposition to keep the airway patent)
- Ventilation
- Chest compression and administration of drugs

Intervention at any stage depends on the three vital signs namely *respiration, heart rate and color*. Approximately 30 sec is allotted to complete each step and to decide for further action.

INITIAL STEPS OF STABILIZATION AT BIRTH

1. Providing warmth (place the child under radiant warmer or cover with prewarmed dry towel or blanket or keep on mother's abdomen).
2. Place the head in sniffing position to open the airway (Fig. 7.2).

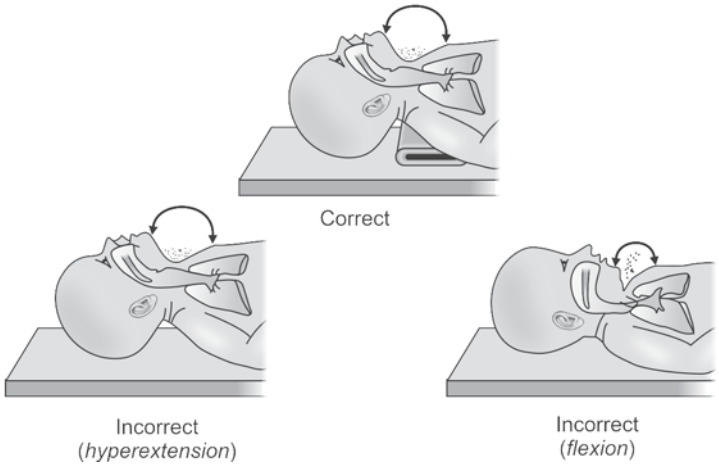


Fig. 7.2: Correct position of airway is essential

3. Clear the airway
   a. Clear the airway (mouth and nose) with cloth/bulb syringe or suction catheter (keep suction pressure less than 100 mmHg).
   b. Suction mouth first followed by nose.
4. Stimulate the child with gentle stroking at sole or rubbing at back and reposition the baby to keep airway patent (Fig. 7.3).

Continue to Evaluate

1. Respiratory efforts
2. Heart rate
3. Color

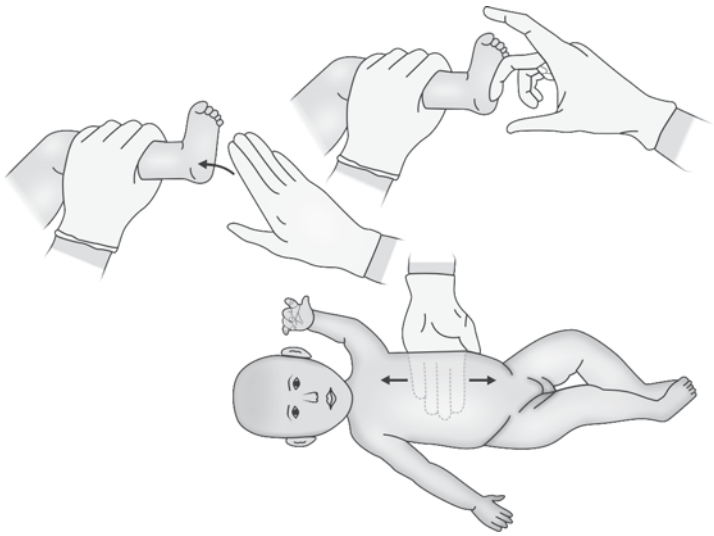


Fig. 7.3: Stimulate to cry

Positive Pressure Ventilation

1. If the baby cyanotic and heart rate is above 100/min, start with supplementary oxygen therapy using simple face mask or oxygen tubing (Fig. 7.4).

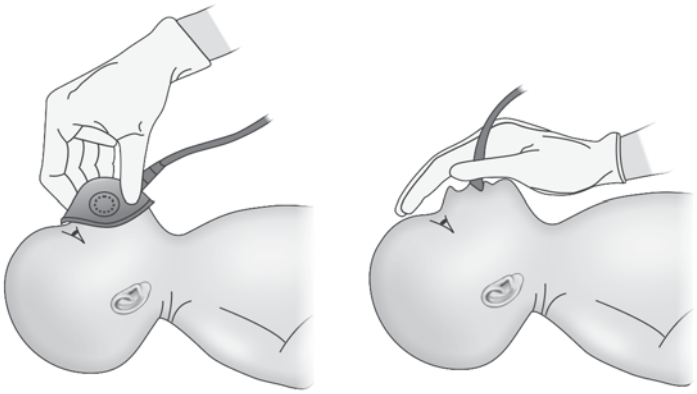


Fig. 7.4: Methods of oxygen delivery during resuscitation

2. If the baby is cyanotic after 90 seconds of oxygen therapy or heart rate is less than 100/min, initiate positive pressure ventilation with bag-mask (Fig. 7.5).

Fig. 7.5: Self-inflating bag-mask

3. If the baby is apnoeic or gasping or heart rate is less than 100/min after initial steps of resuscitation, start positive pressure ventilation.
4. Several devices are used to provide positive pressure ventilation;
   a. *Self-inflating bag*: This is most commonly used device for providing positive pressure ventilation. The rate of ventilation should be 40-60/min. The primary measurement of successful ventilation is improvement in heart rate. Oxygen source is not essential for self-inflating bag in emergency setup.
   b. *Flow inflating bag (Fig. 7.6)*: This device is primarily used by anesthesiologist and is not popular with primary care physicians. This device cannot be used without oxygen source.

Fig. 7.6: Flow inflating bag

c. *Laryngeal mask airway (Fig. 7.7)*: Neonatal LMA of size 1 can be used in full term neonates. This device can be used by inexperienced provider or failed to intubate situation.

Fig. 7.7: Positive pressure ventilation using LMA

When to Stop PPV

a. Heart rate > 100/min
b. Improvement in color
c. Spontaneous breathing efforts
d. Good muscle tone

If Baby is not Improving, Suspect

a. Improper seal
b. Blocked airway
c. Full stomach
d. Not enough pressure
e. Equipment failure
f. Oxygen failure

Chest Compression

Indications

a. Heart rate less than 60/min after 30 seconds of PPV and oxygen supplementation.
b. Apnoeic at birth
    1. Site of compression: Lower-third of sternum
    2. Depth of compression: One-third of anteroposterior diameter of chest.
    3. Technique (Figs 7.8 and 7.9)
        a. Compression with two thumbs with finger encircling the chest and supporting the back. This technique generates higher peak systolic and coronary perfusion pressure than the two fingers technique.
        b. Two finger techniques: Two fingers are placed one finger below the intermammary line and second hand can be used to keep the airway open.
        c. Compression: Relaxation ratio 3:1.
        d. Compression phase should be shorter than relaxation phase.
        e. Do not remove thumbs or fingers during relaxing phase.
        f. Allow complete re-expansion.
        g. Activity should be coordinated.

Fig. 7.8: Two finger technique

Fig. 7.9: Two thumb technique

4. Compression: Ventilation ratio should be 3:1 with 90 compressions and 30 ventilations in one minute.
5. Monitor respiratory efforts, heart rate and color.
6. When to stop chest compression
   a. Heart rate > 60/min
   b. Spontaneous breaths.

Indications for Endotracheal Intubation

a. Need for chest compression
b. Apnoeic baby with no heart
c. Meconium stained liquor (not vigorous)
d. Endotracheal administration of drugs
e. Special resuscitation situations (diaphragmatic hernia)

Transport Considerations

1. Transfer the neonates
   a. Who has not cried or cried after 5 minutes of birth
   b. Apnoeic at birth
   c. Heart rate less than 100/min
   d. Any neonate with birth weight less than 1.8 kg
   e. Gestational age less than 34 weeks
   f. Baby with convulsion
   g. Limp baby
   h. Baby with obvious congenital malformation.
2. Continue to monitor vitals (heart rate, respiration, and color).
3. Measure blood glucose with glucometer. If blood glucose is less than 45 mg/dl, give 5 ml/kg of 10% dextrose.
4. Maintain airway and give oxygen with self-inflating bag or simple face mask or head box.
5. Obtain intravenous access.
6. Maintain body temperature (keep baby covered with warm blankets).
7. Keep environmental temperature about 28°C.
8. If convulsions are present, give intravenous or intraosseous midazolam 0.1 mg/kg.
9. Maintain record of events.

CHAPTER 8

Airway and Cervical Spine

APPLIED ANATOMY OF AIRWAY

Primary function of respiratory system is oxygenation and ventilation. The organs of respiratory system include nose, paranasal sinuses, pharynx, larynx, trachea, bronchi, bronchioles, alveoli, pleura, and muscles of respiration. Nose is the entry point to respiratory system. The main function of nose is humidification and filtration of inspired air. During supplementary oxygen therapy nasal cavity acts as reservoir to increase oxygen concentration. Nose opens into pharynx which has three parts; oropharynx, nasopharynx, and laryngopharynx. The larynx and trachea is situated anterior to esophagus. Larynx is anteriorly and highly placed in children. Larynx also has three parts; supraglottic, glottic, and subglottic space. The glottis is narrowest in adults while subglottis is narrowest in children. Larynx is followed by trachea which divides into two main bronchi and further into bronchioles. Bronchioles are connected to alveoli (the area of gas diffusion). The two lungs are covered by thin membrane called pleura.

Difference between Children and Adult Airway (Fig. 8.1)

a. Infants are obligatory nasal breather up to six months of age and nasal block in this age group can lead to respiratory distress.
b. Tongue is large in children as compare to adults and is an important cause of airway obstruction in unconscious children.
c. Epiglottis is large omega shaped.
d. The tracheal cartilages and muscles are poorly developed in children making more prone to airway obstruction during neck flexion and hyperextension.
e. Airway is funnel shaped in children.

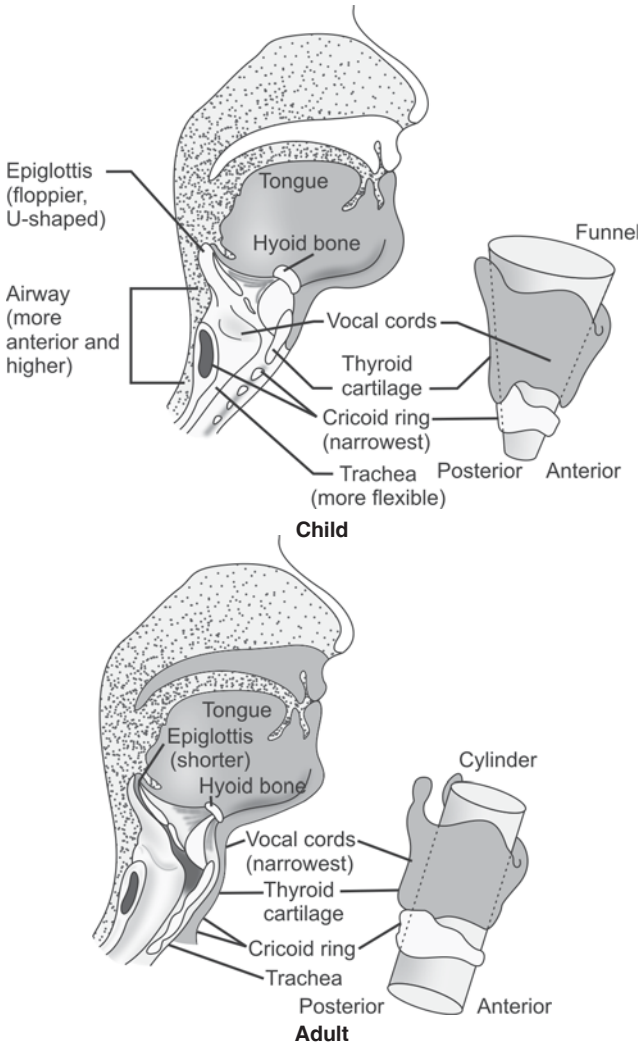


Fig. 8.1: Difference between pediatric and adult airway

f. Larynx is highly placed and reason for using straight blade in children.
g. Horizontally positioned ribs make ineffective respiration.
h. Highly compliant chest wall give protection from rib fractures during trauma.
i. Chest muscles are poorly developed in children.

Patent airway is the top priority in management of in any sick/injured patient. Evaluation of airway has been discussed in Chapter 2 and 3. In this chapter we will discuss how to maintain the airway patent.

Features of Airway Obstruction

a. Inspiratory sounds
b. Marked respiratory distress
c. Agitation
d. Poor air movements
e. Cyanosis

Airway can be maintained by simple measures like suctioning of secretions, removal of visible foreign body by finger sweep, and using head tilt-chin lift or jaw thrust maneuver. Jaw thrust is maneuver used in trauma victims. If simple maneuvers fail to keep airway patent, one can use airway adjuncts like oropharyngeal or nasopharyngeal airways. Advanced airways like laryngeal mask airway (LMA), double lumen tube, endotracheal tube or surgical airway may also be required. As a Prehospital Life Support provider you can use LMA.

METHODS OF MAINTAINING AIRWAY PATENT

1. Suctioning
2. Finger sweep to remove visible foreign body
3. Head tilt-chin lift
4. Jaw thrust
5. Trauma chin lift
6. Oropharyngeal airway (OPA)
7. Nasopharyngeal airway (NPA)
8. Laryngeal mask airway (LMA)
9. Manual resuscitator
10. Position of comfort
11. Endotracheal intubation
12. Surgical airway

Use assisted ventilation in patients who are unresponsive, not breathing or respiratory rate is slow (less than 10/min or more than 30/min in adults and < 12/min or > 50/min in children), gasping, maxillo-facial trauma, suspected inhalational injury, and depressed level of consciousness.

1. Suctioning

Secretions (blood and vomitus) may obstruct the airway in semiconscious or unconscious or trauma patients who have depressed protective reflexes and can be important cause of respiratory distress and airway obstruction.

Procedure

Select appropriate size catheter

a. Measure the length of catheter (Fig. 8.2) before suctioning (tip of nose to ear lobule).
b. Preoxygenate before suctioning.
c. Switch on the suction machine (manual suction machine can be used in emergency situation).
d. Attach catheter to adapter.
e. Insert the catheter into mouth beyond the tongue.
f. Apply the suction by occluding the side hole while withdrawing the catheter with rotating action.
g. Do not try suctioning more than 10 seconds. Monitor heart rate while suctioning. Stop suctioning if patient develops bradycardia and give high flow oxygen.

Fig. 8.2: Selection of length suction catheter

h. Oxygenate the patient after suctioning.
i. Monitor heart rate, oxygen saturation and clinical condition of the patient.

2. Trauma Jaw Thrust (Fig. 8.3)

This maneuver is done in unconscious trauma patient. Head and cervical spine are maintained in line. Provider can stand either on above the head or on bedside. Keep your hand on either side of face and fingers pointing towards feet. Push the mandible forward placing thumbs on cheekbone and index and middle finger on mandible and pushing it forward.

Fig. 8.3: Jaw thrust

3. Trauma Chin Lift (Fig. 8.4)

Chin lift technique is used to relieve anatomical airway obstruction in patients who are breathing spontaneously. Two providers are required. One will provider will hold head and cervical spine manually inline while second provider will grasp the chin and incisors to pull mandible forward.

4. Oropharyngeal Airways

There are different types of oropharyngeal airways (Guedel's, Berman, and Patil-Syracuse endoscopic) used to maintain the airway open in semiconscious or unconscious patients. Guedel's airway is the most common type used in all the age groups.

Fig. 8.4: Trauma chin lift

Indications

a. Unconscious patient (absent gag reflex)
b. Status epilepticus patients to avoid further injury
c. Bag-mask ventilation.

Procedure

1. *Selection of size*: Various sizes (Fig. 8.5) of Guedel's airway in different color coding (Table 8.1) are available in the market. Measure the length of airway device from corner of mouth to the angle of mandible. Inappropriate size selection can lead to airway obstruction.

Fig. 8.5: Guedel's airway

Table 8.1: Determining size on the basis of color code

Size	*Color*
000	Violet
00	Blue
0	Black
1	White
2	Green
3	Orange
4	Red
5	Yellow

2. *Equipments*:
   a. Guedel's airway
   b. Tongue depressor
   c. Suction catheter
   d. Suction machine (manual or electronic)
   e. Self-inflating bag-mask.
3. *Technique of insertion*:
   a. Select the appropriate size Guedel's airway (Table 8.2 and Fig. 8.6).
   b. One provider will stabilize the cervical spine and other will insert the OPA.
   c. Clear mouth of secretions.
   d. Open the mouth with left hand and separate the teeth with thumb against the lower teeth and index or third finger against the upper teeth/gum or insert the tongue depressor to displace the tongue (Fig. 8.7).

Table 8.2: Selection of OPA (weight and age)

Age	*Weight (kg)*	*Airway choice*
Premature	1-2.5	00
Neonate	3-5	0
6 months	6-9	1
1-2 years	10-13	2
4-6 years	15-20	3
8-10 years	25-32	4/5
12 years	35-45	5
Adult	50-90	6

Fig. 8.6: Choosing appropriate size

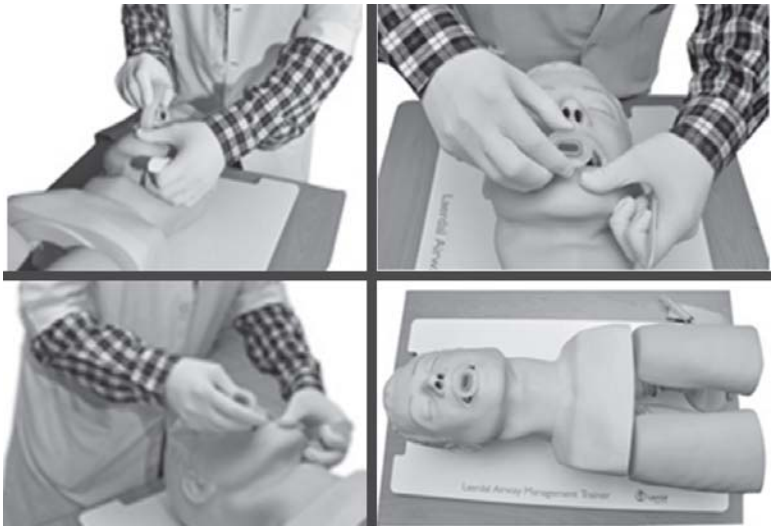


Fig. 8.7: Steps of insertion OPA

e. Insert the tip of airway facing hard palate and rotate to 180 degree to rest at base of tongue. This technique is less preferred in children.
f. The flange end should lie outside the lips and bite portion between teeth and lips.

Tongue jaw lift insertion method: One provider will held the head and cervical spine inline and second provider will open the mouth using chin lift and insert the OPA as above.

Tongue blade insertion method: Press the tongue with tongue depressor and airway is inserted directly concave surface facing the tongue (Figs 8.8 and 14.11). In trauma victim one provider will immobilize the cervical spine and second provider will insert the OPA.

a. Properly placed airway will relieve obstruction immediately.
b. Clinically you will see decrease in work of breathing and improved oxygen saturation.
c. In trauma victims OPA can be inserted on ground as shown in (Fig. 8.9).

Fig. 8.8: Tongue blade insertion method

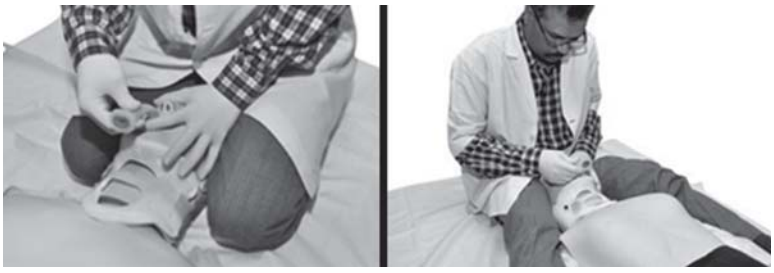


Fig. 8.9: Insertion of OPA in trauma victim (single provider)

5. Nasopharyngeal Airway (NPA)

NPAs are made up of rubber or plastic. NPA resembles to endotracheal tube in shape. NPA are available in different sizes. This is used in semiconscious/old age with loose denture and difficult to open mouth patients. Endotracheal tubes of appropriate size after cutting distal end can also be used.

1. Selection of size (Fig. 8.10): The diameter should be either of patient's little finger or nostril.

Fig. 8.10: Nasopharyngeal airway

2. Depth of insertion (Fig. 8.11): Measure length from nostril to ear lobule.
3. Method:
   a. Occlude each nostril to check patency and select the patent side.
   b. Suction nose.
   c. Select nostril with large size and put vasoconstrictor nasal drops in the nose, if available.
   d. One provider will hold the head and neck to stabilize the cervical spine and open the airway with jaw thrust method.
   e. Lubricate the tube with jelly and insert it from anterior to posteriorly keeping the bevel end towards nasal septum.

f. Keep pharyngeal end just below the base of tongue (Fig. 8.12).
g. If properly placed will alleviate the obstruction and improve oxygenation.

Fig. 8.11: Depth of insertion NPA

Fig. 8.12: Correct position of NPA

6. Manual Resuscitator (Self and Flow Inflating Bags)

There are two types of manual resuscitator which are commonly available. These are used for providing assisted ventilation directly or with LMA or endotracheal tube. Ambu bag are commonly used even without oxygen source. Different sizes of self-inflating bag or ambu bags are available but commonly 500 ml and 1000 ml capacity bags are used for children and adults. Commonly available resuscitators are;

1. Self-inflating bag (commonly known as ambu bag)
2. Flow inflating or anesthesia bag (known as Bain's circuit for adults and JR circuit for children).

Indications

a. Respiratory distress (commonly known as bradypnea or tachypnea)
b. Patient not able to maintain airway
c. Semi or unconscious patients
d. LMA or endotracheal tube *in situ*.

Equipments Required for Assisted Ventilation with Bag

a. Flow or self-inflating bag
b. Different sizes transparent face mask
c. Oropharyngeal or nasopharyngeal airway
d. LMA
e. Oxygen source
f. Vital sign monitor or pulse oximeter
g. 5 ml syringe.

Procedure

a. Decide indication of assisted ventilation.
b. Position yourself above patient's head.
c. Choose appropriate capacity ambu bag (children 500 ml and adult 1000 ml).
d. Select appropriate size OPA or NPA or LMA and insert as per indication.
e. Select appropriate size mask (covering nasal bridge and depression on chin).

f. Keep the airway open and place face mask pressing the edge with thumb and index finger (E-C clamp) of nondominating hand and use remaining fingers to lift the angle of mandible (Fig. 8.13). If you are two rescuers than one can hold mask with both hand (Fig. 8.14).
g. Attach oxygen with ambu bag, if available (5-10 L/min in children and 10-15 L/min in adults).
h. Attach pulse oximeter.
i. Keep mask on face making good seal.

Fig. 8.13: Single rescuer (E-C)

Fig. 8.14: Two rescuer (E-C)

j. Squeeze the bag to give breaths for one second each and look for chest rise.
k. Flow inflating or anesthesia bag requires oxygen source. Attach oxygen at one end and another end is attached to mask, LMA, or endotracheal tube. The air is exhaled from another port.

7. Laryngeal Mask Airway (LMA)

LMA is another alternative airway device used in seriously ill or unconscious patients including neonates for keeping airway patent. This device is made up of silicone and can be reused. Presently eight sizes of disposable LMA's are also available in the market. This device can be used by paramedics and does not require any specialization.

Equipment for LMA Insertion

a. Appropriate size LMA (Fig. 8.15)
b. Syringe with appropriate volume for LMA cuff inflation
c. Water soluble lubricant jelly
d. Ventilation equipment (Self or flow inflating bag, ventilator)
e. Stethoscope for auscultation of breath sounds
f. Tape or other device(s) to secure LMA.

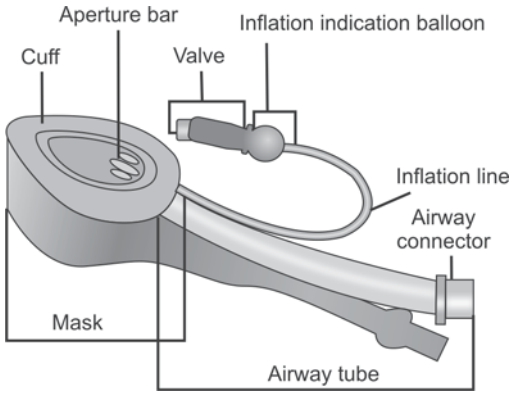


Fig. 8.15: Parts of LMA

Preparation

a. Step 1: Size selection
b. Step 2: Examination of the LMA for any damage
c. Step 3: Check deflation and inflation of the cuff
d. Step 4: Lubrication of the LMA
e. Step 5: Position the airway

Step1: *Selection of size*

a. Verify that the size of the LMA is correct for the patient and if in doubt one larger size is selected. Alternatively size may be selected by matching widest part of LMA with width of second and fourth finger of the child.
b. Recommended size guidelines:
   - Size 1: Under 5 kg
   - Size 1.5: 5 to 10 kg
   - Size 2: 10 to 20 kg
   - Size 2.5: 20 to 30 kg
   - Size 3: 30 kg to small adult
   - Size 4: Adult 50-70 kg
   - Size 5: Large adult 70-100 kg /poor seal with size 4
   - Size 6: Adult over 100 kg

Step 2: *Examination of LMA*

a. Visually inspect the LMA cuff for tear or other abnormalities.

Step 3: Inspect the tube to ensure that it is free of blockage or loose particles.

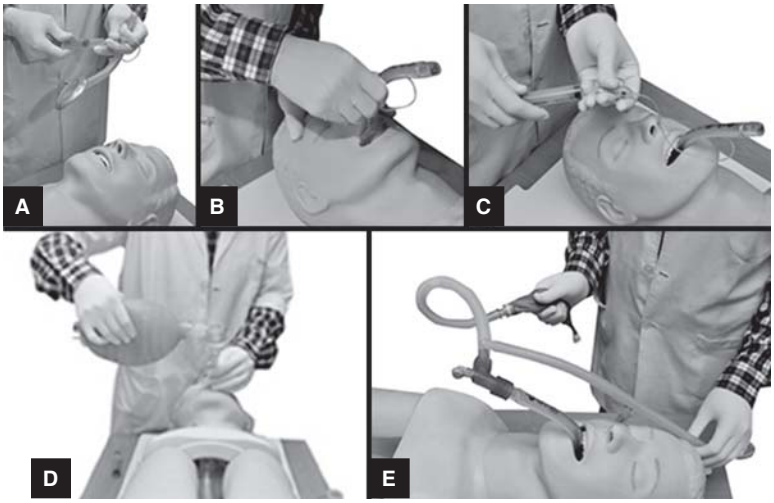
a. Deflate the cuff to ensure that it will maintain a vacuum and wrinkle free.
b. Inflate the cuff to ensure that it does not leak.
c. Slowly deflate the cuff to form a smooth flat wedge shape which will pass easily around the back of the tongue and behind the epiglottis.

Step 4: Use a water soluble lubricant to lubricate the LMA

a. Only lubricate the LMA just prior to insertion.
b. Lubricate the back of the mask thoroughly.

Step 5: (Figs 8.16A to E)

a. The tube is grasped like a pen, with index finger pressing the point where tube joins the cuff. The aperture should face the tongue. Another method of insertion is like oropharyngeal



Figs 8.16A to E: LMA attached with flow inflating bag: (A) Check and deflate, (B) Pen technique, (C) Injecting air, (D) Attached with ambu-bag, and (E) Attached with flow inflating bag

airway. Thumb insertion technique is used in patients when access from head size is not possible.

b. Gently advance the LMA in midline or slightly diagonal with one single movement, applying continuous pressure against the palate-pharyngeal curvature with the index finger. Head should be in sniffing position in nontrauma patients. Jaw may be pulled down in trauma patients.
c. The vector of the force applied must be directed cranially and not caudally.
d. Continue pushing the LMA against the soft palate so that the cuff passes along the posterior pharyngeal wall and the tip locates itself in the hypopharynx.
e. Inflate the cuff: During inflation the maximum air in cuff should not exceed:
   - Size 1: 4 ml
   - Size 1.5: 7 ml
   - Size 2: 10 ml
   - Size 2.5: 14 ml
   - Size 3: 20 ml
   - Size 4: 30 ml
   - Size 5: 40 ml

Points to Remember

a. Avoid excessive amounts of lubricant on the anterior surface of the cuff or in the bowl of the mask.
b. Inhalation of the lubricant following placement may result in coughing or obstruction.
c. Extend the head and flex the neck.
d. Avoid LMA fold over:
   - Pull the lower jaw downwards.
   - Visualize the posterior oral airway.
   - Ensure that the LMA is not folding over in the oral cavity as it is inserted.

CERVICAL SPINE IMMOBILIZATION

Inline cervical spine is required in all trauma patients, unconscious patients and children even without radiological spine abnormality (SCIWORA).Cervical spine immobilization may be required in many positions, i.e. extrication from vehicle, road side injury, helmet injury and many others. Patient may be seen in different positions. The basic principal is to maintain inline head and neck stabilization. The technique use may be manual, hard cervical collar, spine (boards full or half), and other devices.

Pointers of Cervical Spine Injury

- Unconsciousness patient
- Focal neurological deficit
- Cervical pain, rigidity, muscle guarding
- Numbness
- Appearance of new neurological signs

Techniques of Cervical Spine Immobilization

Manual Inline Stabilization

Front (Fig. 8.17)
a. Stand in front of the patient
b. Place both hand on either side of ear

Fig. 8.17: Cervical spine immobilization—front

c. Put little finger on the posterior aspect of head
d. Place thumb in front of ear
e. Rest of fingers spread on face
f. Bring the patient head in neutral position and apply some pressure to maintain head in neutral position.

Back (Fig. 8.18)

a. Stand behind the patient
b. Place hands on both the ear

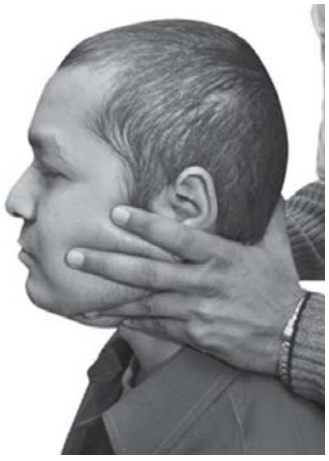


Fig. 8.18: Cervical spine immobilization—back

c. Put thumbs on posterior part of head
d. Spread rest of fingers on face
e. Bring the patient head in neutral position and apply some pressure to maintain head in neutral position.

Side (Fig. 8.19)

a. Stand on side of the patient
b. Place provider arm on patient shoulder and cups the posterior part of skull
c. Put index finger and thumb just above the chin
d. Bring the patient head in neutral position and apply some pressure to maintain head in neutral position.

Fig. 8.19: Cervical spine immobilization—side

From Top (see Fig. 8.20)

Supine (Fig. 8.21)

a. Position just above the patient's head by lying or kneeling
b. Place both hands on the ear, fingers facing the feet
c. Middle finger kept below the angle of mandible
d. Thumb on the forehead
e. Fourth and fifth fingers to stabilize the posterior part of head
f. Bring the patient head in neutral position and apply some pressure to maintain head in neutral position.

Standing

Fig. 8.20: Cervical spine immobilization—top

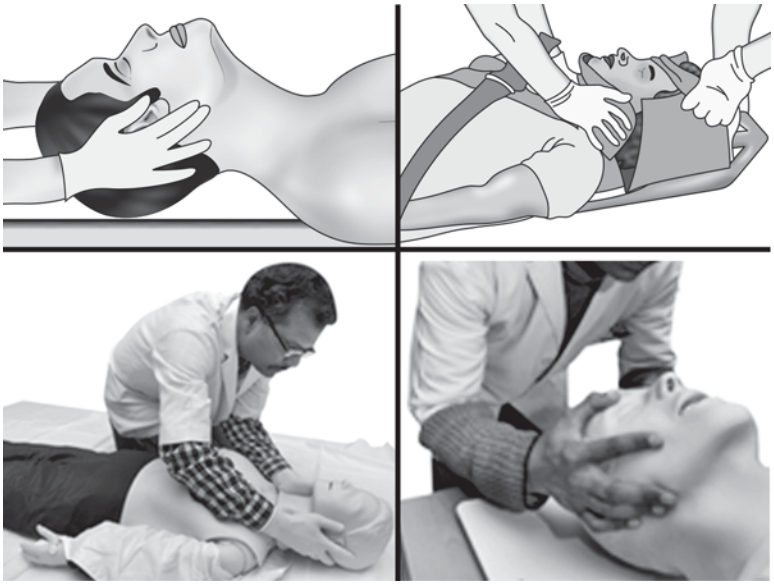


Fig. 8.21: Supine position

Prone (Fig. 8.22)

a. Turn the patient supine using logroll method
b. Rest as above.

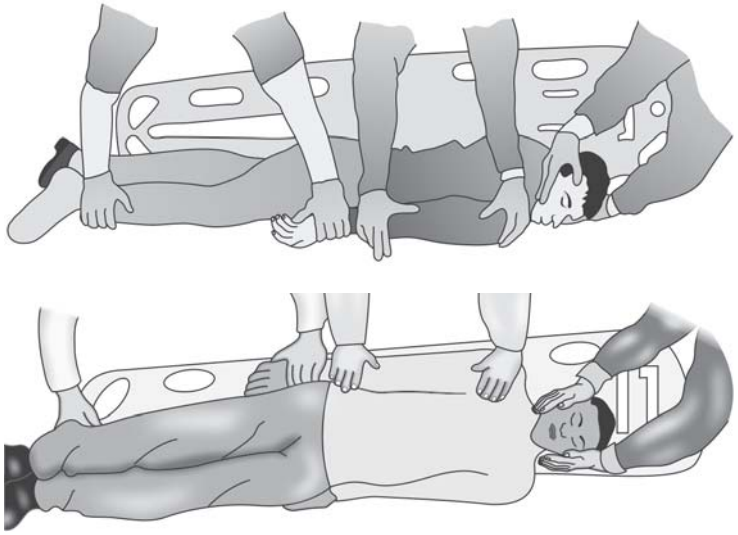


Fig. 8.22: Prone to supine position

Application of Hard Cervical Collar (Fig. 8.23)

Hard collars are available in different size. Collar must fit above at base of chin and below at suprasternal notch.

Fig. 8.23: Application of cervical collar

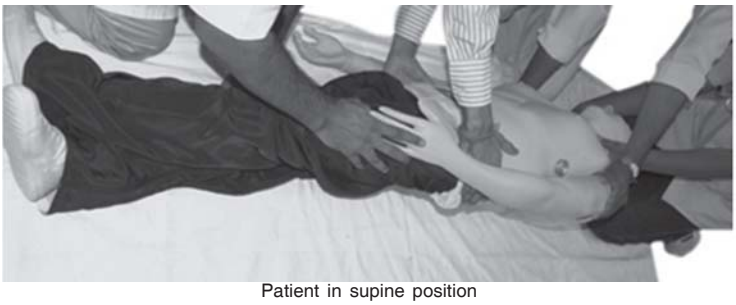
Cervical Spine Immobilization in Car Trauma (Fig. 8.24)

Fig. 8.24: Cervical spine car accident

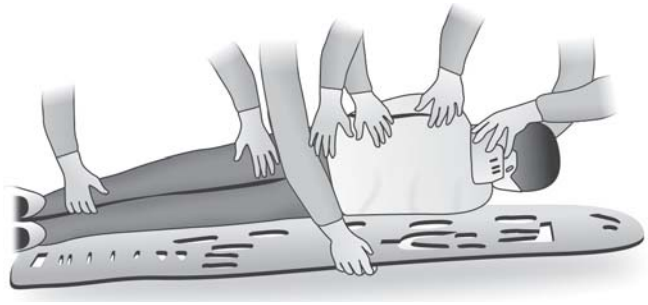
Logroll (Fig. 8.25)

This technique is used to lift the patients from accident site and to examine back.

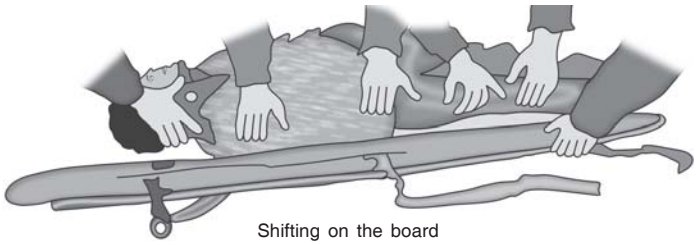
a. One provider will maintain the cervical spine inline stabilization.
b. Apply cervical collar.
c. Second person will kneels at patient's chest level.
d. Third person will kneel at knee level of patient.
e. Keep patient's arm along with body and limbs in neutral position.
f. Patient's shoulder and hip are hold in way to keep neutral inline position of lower extremities.
g. Logroll the patient on the side and put the long backboard on the back.



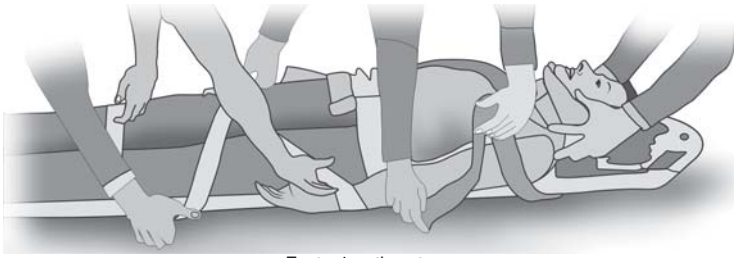
Patient in supine position



Applying long backboard



Shifting on the board



Fastening the strap

Fig. 8.25: Logroll

h. Head end of backboard should extend beyond the head and foot end between knee and ankle.
i. Patient can be moved maintaining inline stabilization.
j. If the patient is in prone position then put the backboard on the side of victim.
k. One provider will stabilize the cervical spine while second person will kneel on back side and will holding the shoulder, pelvis and wrist. The third provider will kneel at knee level and pelvis and lower extremities. Patient is logrolled on his side perpendicular to ground and aligned with backboard. Apply cervical collar.
l. Before transport of the patient put hard cervical collar and padding is inserted below the patient's head in adults and below chest in children. All empty areas should be padded including side of face and neck.
m. Fasten one strap lower forehead. Second strap is tightened on cervical collar.
n. Third and fourth strap are placed below and above the knee after padding.
o. Fifth and sixth strap are placed around chest and pelvis.

Sraddle technique of lifting the patient (Figs 8.26A and B)

A

Fig. 8.26A

Fig. 8.26B

Figs 8.26A and B: Sraddle technique

CHAPTER 9

Oxygen Therapy

No oxygen no life. Oxygen should be used cautiously and judiciously. Oxygen is a drug and not tonic. Any patient irrespective of age who is acutely ill should receive 100% oxygen.

1. *Clinical features of oxygen deficiency*
   a. Anxious look
   b. Increased work of breathing
   c. Perspiration
   d. Hyperventilation
   e. Tachycardia
   f. Arrhythmias
   g. Altered level of consciousness
   h. Peripheral vasodilatation
   i. Hypotonia (decrease muscle tone)
   j. Cyanosis
   k. Hypotension
   l. Coma
2. *Etiology of hypoxia*
   a. Inability of lung to oxygenate
   b. Improper oxygen delivery
   c. Decrease in oxygen content
   d. Abnormal affinity of oxygen to hemoglobin
3. *Types of oxygen delivery sources*
   a. *Oxygen concentrators*: These are primarily used at home and in primary health care settings. These devices use room air for giving higher concentration of oxygen using molecular sieve. They can deliver oxygen from 0.5 L to 10 L/min depending on type of concentrator. Most of them need electricity for their operation.
   b. *Compressed gas cylinders*: Portable compressed gas cylinders in different sizes are commonly used in hospitals and at home.

c. *Central gas supply*: Compressed or liquid gas is used in larger hospitals.

4. Calculation of life of cylinder in minutes

$$\frac{\text{PSI (Cylinder)} \quad \text{Safe residual (200 PSI)}}{\text{Flow rate in liter/min}} \quad \text{Bottle factor}$$

Type of cylinder	*Capacity (appo)*	*Bottle factor*	*Life of cylinder at flow rate 8 L/min*
D (steel)	350 L	0.16	45
D (aluminium)	414 L	0.16	52
E	625 L	0.28	78
G	5260 L	2.41	660
M	3028 L	1.56	378
H & K	6900 L	3.14	864

5. Calculation of requirement of oxygen during transport
   No. of cylinders =

$$\frac{\text{Duration of journery in minutes} \quad \text{flow in liter/min}}{\text{Cylinder capacity}}$$

Note: Always keep double the requirement.

OXYGEN DELIVERY DEVICES

Oxygen delivery devices can be classified into two categories:

1. *Low flow devices*: Variable performance devices (deliver variable fraction of oxygen concentration (FiO_2).
2. *High flow devices*:
   a. Fixed performance devices
   b. Variable performance devices.

Points to Remember

a. High and low flow rate is defined in relation to patient inspiratory flow rate.
b. Low flow does not mean delivery of low FiO_2.

Low Flow Devices

These devices deliver oxygen at flow rate less than the patient inspiratory flow rate/demands. The FiO_2 depends upon patient's

tidal volume, inspiratory flow, minute volume, delivered oxygen flow, ventilatory pattern and size of oxygen reservoir. Low flow devices are useful in spontaneously breathing patients with fairly stable vitals.

1. *Nasal cannula (Fig. 9.1)*:
   a. Useful in patients who have good inspiratory effort and who require minimal oxygen therapy. Nasal cannula delivers variable fraction of oxygen concentration.
   b. Available in variable designs and sizes for neonates to adults.
   c. Use humidified oxygen when flow rate is greater than 2 L/minute.
   d. Flow > 6 L/min can cause nasal irritation and dryness.
   e. Put the nasal cannula on the upper lip with prong pointed in the nostril and secure the cannula around head.

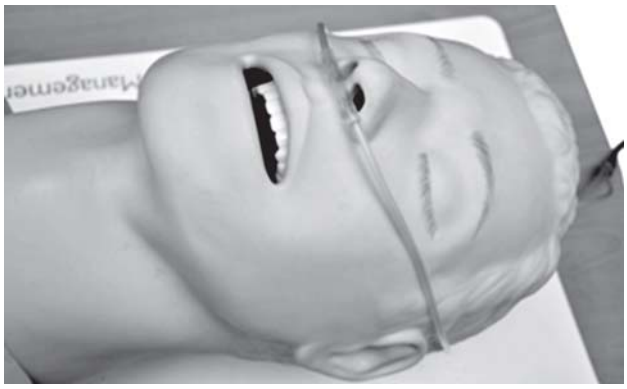


Fig. 9.1: Application of nasal cannula

2. *Nasopharyngeal catheters*:
   a. Available in various size for both children and adults (12-14 F).
   b. Select size by comparing the external nostrils.
   c. Made of soft plastic having blind end with multiple holes on side near tip.
   d. Measure length from nostril to tragus of ear for nasal catheter.
   e. Put the catheter from external nostril to just behind the uvula.

f. Fix the catheter with tape.
g. Nasal cavity acts as reservoir.
h. Risk of blockade of catheter is high.
i. Delivers variable FiO_2.
j. Give humidified oxygen if flow rate is more than 2 L/min and flow should not exceed > 6 L/min.
k. Useful in less severe cases.

3. *Simple oxygen masks (Fig. 9.2)*:
   a. Simple, transparent, light weight mask.
   b. Easily to apply.
   c. Available for both pediatric and adult population.
   d. Minimum flow rate to be kept is 6 L/min.
   e. Delivers variable FiO_2.
   f. Covers both mouth and nose.
   g. Useful only in spontaneously breathing patients with respiratory distress.

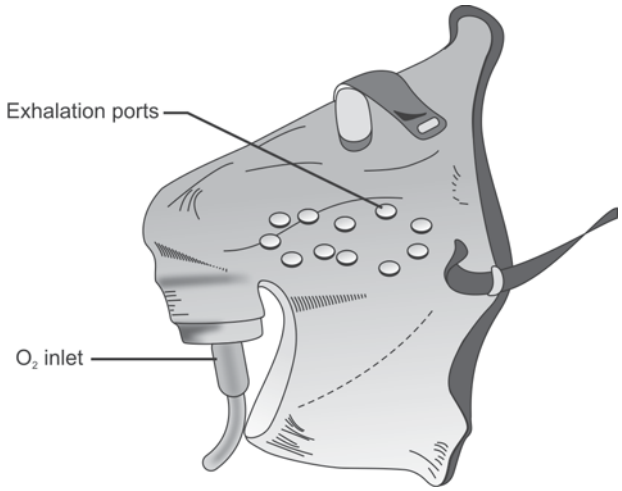


Fig. 9.2: Simple face mask

4. *Pocket mask or resuscitation mask (Fig. 9.3)*:
   Pocket mask is available in pediatric and adult size and used to deliver rescue or manual breath during resuscitation.

Fig. 9.3: Pocket face mask

5. *Partial rebreathing and nonrebreathing masks (Fig. 9.4)*:
   a. These are simple, transparent, disposable oxygen masks with reservoir. Non-rebreathing mask have one way valve to prevent the mixing of exhaled gas so that higher FiO_2 can be delivered.
   b. Available in pediatric and adult size.

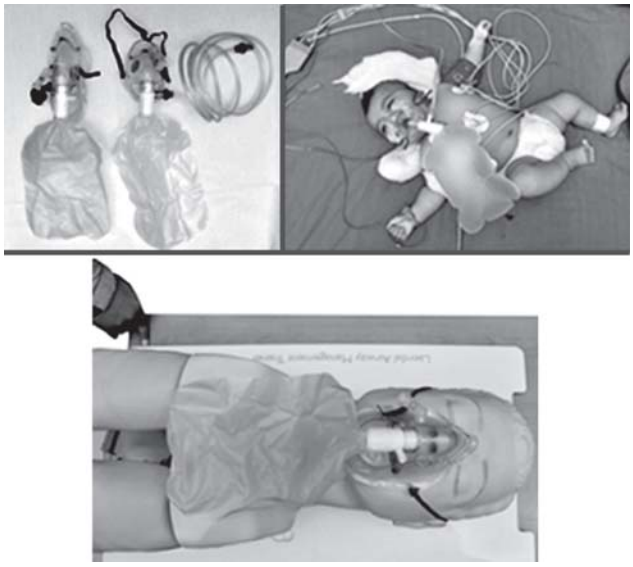


Fig. 9.4: Nonrebreathing masks

c. Indicated in all types of seriously ill patients who are spontaneously breathing and require high concentration of oxygen.
d. Keep the reservoir bag full, i.e. flow of gas must be 8-10 L/min to avoid rebreathing of carbon dioxide.
e. Application is similar to simple face mask.

6. *Guidelines for estimating FiO_2 with low flow devices*

100% O_2 flow rate (L/min)	*Predicted FiO_2*
Nasal cannula or catheter	
1	0.24
2	0.28
3	0.32
4	0.36
5	0.40
6	0.44
Oxygen mask	
5-6	0.40
6-7	0.50
7-8	0.60
Oxygen mask with reservoir bag	
6	0.60
7	0.70
8	0.80
9	0.80+
10	0.80+

High Flow Oxygen Delivery Devices

1. *Oxygen hood or head box (Fig. 9.5)*:
   a. Primarily used in children below one year of age or < 10 kg.
   b. Flow of oxygen is to be kept more than 6-8 L/min. Flow of less than 6 L/min can lead to CO_2 rebreathing.
   c. Delivers variable FiO_2.

2. *Self-inflating bags (Fig. 9.6)*: These are primarily used during resuscitation or intubation. Reservoir bag is attached to the device to increase the oxygen concentration. Self-inflating

Fig. 9.5: Oxygen hood

Fig. 9.6: Self-inflating bag

or ambu bag can even work without oxygen source. In seriously ill or trauma victim open the airway and put the Guddel's airway (absent gag reflex) or LMA or double lumen tube and attach to the self-inflating bag.

3. *Flow inflating bags (Fig. 9.7)*: They are used in patients who are not breathing spontaneously and intubated with ET tube or LMA. This device deliver 100% FiO_2. Oxygen source is essential. They are primarily used operation theaters.

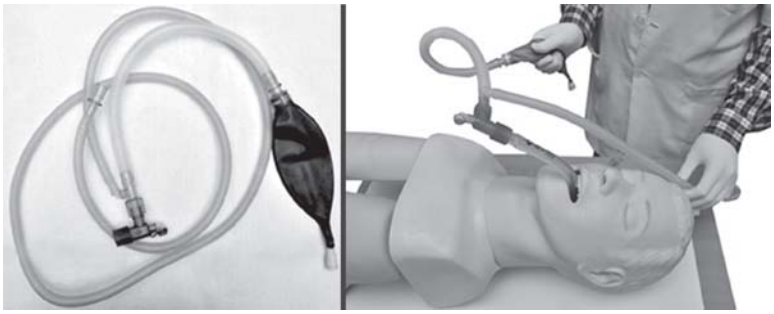


Fig. 9.7: JR circuit (flow inflating bag)

4. *Venturi masks (Fig. 9.8)*:
   a. Mixes a specific volume of air and oxygen.
   b. Useful for accurately delivering the low concentrations of oxygen.
   c. Valves are color coded and flow rate required to deliver a fixed concentration is shown on each valve (Table 9.1).
   d. Deliver oxygen concentrations between 24-60% (Table 9.2).
   e. Useful in patients where chances of CO_2 retention are high, e.g. COPD.
5. *Closed incubators*: Oxygen is attached to the incubators at higher flow rate during neonatal transport.
6. *Ventilators*: Ventilator can give fixed FiO_2 up to 100%.

Fig. 9.8: Venturi mask

Table 9.1: Color coding of venturi mask

Guide to colors of Venturi valves		
Venturi valve Color	Flow rate (l/min)	Oxygen delivered (%)
Blue	2	24
White	4	28
Yellow	6	35
Red	8	40
Green	12	60

Table9.2: Air to oxygen entrainment ratio

Room air to O^2 concentration ratio	
25:1	24%
10:1	28%
8:1	30%
5:1	35%
3:1	40%
1.7:1	50%
1:1	60%
0:1	100%

Monitoring Response to Oxygen Therapy During Transport

1. Oxygen saturation (SpO_2) and FiO_2 (if requirement of FiO_2 increases, this signifies worsening of the patient's condition).
2. Color (cyanosis or blue discoloration indicates increase in demand, worsening patient condition, malfunction of equipments or empty container).
3. Respiratory rate (increase in rate indicates increase demand, or decrease supply or malfunctioning of equipment or disconnection from ventilator).
4. Respiratory efforts (worsening respiratory effort indicates increase demand, equipment failure, loss of supply or empty cylinder).
5. Decrease in mental status may also be due to decrease oxygen supply.

CHAPTER 10

Fluid Therapy

It is essential to understand the fluid requirement (maintenance and therapeutic) of seriously ill patients in prehospital setting. Intravenous fluid may be required when patient is not able to take by mouth (normal size, relatively well, no kidney failure, heart failure, no abnormal losses, not taking from mouth), for keeping intravenous line patent and fluid boluses in cases of shock. The normal distribution of water in human body in different age groups is given in Table 10.1.

Table 10.1: Distribution of water in the human body

1. Fetus	90% Total body water (TBW)
2. Preterm	80%
3. Term	70-75%
4. Child	65-70%
5. Adolescent	60%
6. Adult male	60%
7. Adult female	50%
8. Intracellular	2/3rd of TBW
9. Extracellular	1/3rd of TBW (3/4th Interstitial + 1/4th Plasma water)

Maintenance Requirement

1. *Children:* Daily fluid and electrolytes requirement in children above 14 days of life.

Weight	Normal child	Seriously ill child
1-10 kg	100 ml/kg/24 hr	50 ml/kg/24 hr
11-20 kg	1000 ml + 50 ml/kg	500 ml + 30 ml/kg
Above 20 kg	1500 + Add 20 ml/kg	800 ml + 20 ml/kg
Sodium = 3 mEq/kg/d		
Potassium = 2 mEq/kg/d		
Chloride = 2 mEq/kg/d		

2. *Fluid requirement in neonates*

Day of life	Term (ml/kg)	Preterm < 1.5 kg	Preterm > 1.5 kg
1st	60-80	60-80	80-90
2nd	80-120	80-100	100-110
3rd	100-130	100-120	120-130
4th	120-150	130-150	130-150
5th	140-160	140-160	140-160
6th	140-180	140-160	140-180

3. *Insensible water loss replacement in neonates*

Weight	Radiant warmer (ml/kg)	Incubator
< 1000 gm	100-115	75-100
1-1.5 kg	75-100	50
1.5-2.0 kg	50	25-50
> 2.0 kg	50	25-50

4. *Adults require 2.5 L of fluid in 24 hours {(average 100-110 ml/hr) + Sodium 100 mEq + Potassium 50 mEq} or 110 ml/hr in normal healthy adults or 30 ml/kg/d.*

Requirement of maintenance fluid: Formula = 4 : 2 : 1

a. 4 ml/kg/hr for first 10 kg weight
b. Add 2 ml/kg/hr for next 10 kg
c. Add 1 ml/kg/hr for remainder of body weight
d. Sodium 1-2 meq/kg/day
e. Potassium 0.5-1 mEq/kg/day

5. *Fluid adjustment in special situations (children and adults)*

Disease conditions	Adjustment factor
Ventilated child during transport	0.7 × maintenance fluid
Hyperventilation	1.2 × maintenance fluid
Fever	Add 12% per centigrade above 38°C
Hypothermia	0.7 × maintenance
CHF	0.5-0.7 × maintenance fluid
SIADH	0.5-0.7 × maintenance fluid
Renal failure	0.3 × maintenance fluid + urine output
High humidity	0.7 × maintenance fluid

6. *Fluid requirement in some conditions*
   a. *CNS conditions*
      - Resuscitation fluid is always normal saline
      - Always give maintenance fluid unless contraindicated
      - Target systolic blood pressure (SBP) > 90 mmHg or mean arterial pressure (MAP) in adults > 65 mmHg and serum sodium 140 mEq/L.

   b. *Diabetes ketoacidosis*
      - Initial fluid of resuscitation is normal saline
      - Do not use dextrose containing solutions
      - Check blood sugar on hourly basis
      - Once blood glucose is < 300 mg/dl start with N/2 D5W.

   c. *Acute liver failure*
      - Fluid of choice N/5 D10W + potassium as per requirement
      - Maintain blood glucose level between 110-150 mg/dl.

   d. *Acute renal failure*
      - If features of hypovolemia are present give boluses of normal saline 20 ml/kg and reassess after each bolus. Look for signs of fluid overload.
      - Give 25% of maintenance fluid or 300 to 400 ml/m^2/24 hr.
      - Add insensible loss + urine output + third space loss
      - Use isotonic fluid for third space loss and hypotonic for GIT and urine losses.

   e. *Burns*
      - Only applicable in second degree burn > 15% or third degree burn > 10%
      - Fluid requirement = Percentage of burn × weight (kg) × 4
      - Add maintenance requirement in children
      - Therapy is guided by urine output 1 ml/kg/hr in children and 0.5 ml/kg/hr in adults. Use Ringer's lactate only.

   f. *Preoperative fasting*

Age	Milk and solids	Fluids
< 6 months	4 hours	2 hours
6-36 months	6 hours	2 hours
> 36 hours	6 hours	2 hours

g. *Pre/peri-operative deficit*
   - Give maintenance fluid × hours NPO (nil per oral)
   - Half is replaced in the first hour of surgery, one quarter in the second hour, and the remaining quarter in the third hour.

h. *Third space losses: Replacement guidelines*

Superficial procedures	2-4 ml/kg/hr
Moderate procedures	4-6 ml/kg/hr
Major procedures	6-8 ml/kg /hr

i. *Postoperative*: Give 85% of maintenance for first 24 hours
j. *Trauma*
   - Replace 1 ml of blood loss with 1 ml of crystalloid (ideal is 1:3 in nontraumatic conditions)
   - Do not be aggressive in fluid resuscitation, it may dislodge clot.

7. *Monitoring of patient on fluid therapy:*
   Monitor all patients who need intravenous fluid therapy (more than 50% of maintenance intravenous fluid).
   a. Input and output (history of losses)
   b. Weight recording in case of children
   c. Blood sugar
   d. Monitoring of liver size, heart rate, oxygen saturation, respiratory rate and mental status.

Summary of Various Commonly Available Intravenous Fluids (Table 10.2)

Following fluids are routinely available in ambulance >
- Normal saline
- Ringer lactate
- DNS
- Dextrose 5, 25 and 50%
- Hetastarch.

Table 10.2: Composition of intravenous fluids

Fluid	Na^+/L	Cl^-/L	Ca^{++}/L	K^+/L	Other/L	pH	Osmolality
Normal saline (NS)	154	154	–	–	–	5.7	308
NS + 20 mmol KCl	154	174	–	20	–	–	348
N/5 D5W	30	30	–	–	Dextrose (50 gm) 277	5.0	321
N/2 D5W	77	77	–	–	Dextrose (50 gm) 277	–	431
Dextrose NS	154	154	–	–	Dextrose (50 gm) 277	–	585
3% saline	513	513	–	–	–	5.7	1026
Ringer's lactate (RL)	130	130	3	4	Lactate (28)	–	273
RL D5	130	109	3	4	Lactate (28) Dextrose (50 gm)	–	585

CHAPTER 11

Management of Injured

The approach to a trauma victim should be structured one. It is also important to remember that all actions should be carried out simultaneously in seriously injured or sick patients. Assessment of the victim may be carried out at primary site, i.e. at accident scene or on arrival to the hospital. During this process one must also assess about mechanism of injury, speed of impact, severity of impact, condition of vehicle, injury to other occupants of vehicle and treatment given at primary site and during transport. It is presumed that initial one hour after trauma is crucial for the outcome. Management initiated within this period will have better outcome. **"Golden period"** previously known as **"Golden hour"** is the period between injury and definitive care. Presently the concept of platinum ten minutes has been introduced which says that within 10 minutes you must reach to the victim, finish primary survey, resuscitate and stabilize, and arrange for appropriate transport.

Children are different from adults, since their cognitive functions are not fully developed. They cannot escape from accident scene. Small children may not be able to describe pain. They are more frightened and less cooperative in their management. The relative elasticity of tissues allows more energy to be transferred to body parts thus have larger impact of trauma.

MANAGEMENT

Initial assessment includes ABCDE's approach to identify life threatening problems and their stabilization.

Principle of Assessment

a. General assessment
b. Airway with cervical spine control

c. Breathing (oxygenation and ventilation)
d. Circulation with external hemorrhage control
e. Disability and prevention of secondary insult
f. Exposure including temperature control
g. Arrange rapid and efficient transport
h. Do no further harm.

Resuscitation (Treat Life Threatening Problems Whenever Identified)

a. *General assessment*: Victim is unresponsive, no respiration, and no pulse need immediate CPR. Control of massive external hemorrhage. Resuscitation before extrication and transportation.
b. *Airway and cervical spine immobilization*: Any emergency, may it be anatomical or physiological, patent airway is the first priority (see Chapter 4).
   Airway in trauma may be obstructed due to following reasons;
   1. Blood, vomitus, secretions (use suction to clear the airway)
   2. Denture or foreign body
   3. Injury to structure of mouth wall
   4. Compression of mouth structure
   5. Large tongue size in children
   6. Edema due to burn and inhalation injury obstructing the airway needs early intubation.

   Supplementary oxygen with nonrebreathing mask must be started immediately. If we suspect that airway is not maintainable due to any reason or victim of burn injury immediately go for endotracheal intubation. It is always recommended that prior to intubation or failed attempt to intubate; patient must be oxygenated with bag mask. LMA may not be preferred in trauma patient initially.
   Management of airway (see also Chapter on Airway and Cervical Spine):
   1. Maintain head and neck in neutral position (Figs 11.1 and 11.2).
   2. Open airway using jaw thrust/trauma-chin lift maneuver (Figs 11.3 and 11.4).

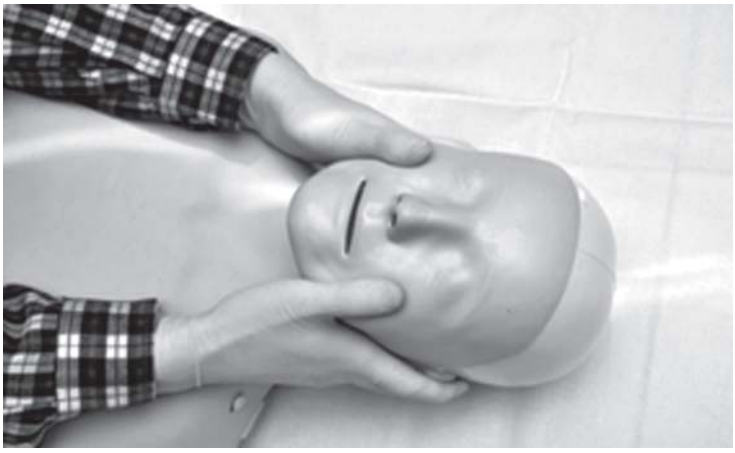


Fig. 11.1: Manual C-spine immobilization

Fig. 11.2: Application of cervical collar

3. Remove the visible foreign body by finger sweep (Fig. 11.5).
4. Insert oropharyngeal/nasopharyngeal airway if airway is not maintained (Fig. 11.6).
5. Laryngeal mask airway or endotracheal intubation may be used by advanced service provider.

Fig. 11.3: Jaw thrust

Fig. 11.4: Trauma-chin lift

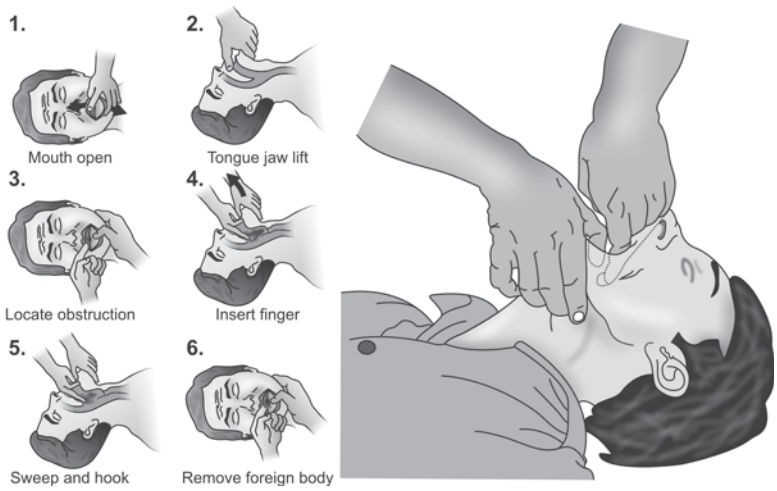


Fig. 11.5: Finger sweep

Fig. 11.6: Inserting OPA in different situations

6. Surgical airway/needle cricothyrotomy (indicated in patients with failed intubation twice or complete upper airway obstruction).

c. *Breathing (Fig. 11.7)*: Once you have secured the airway start assessment of breathing and ventilation as discussed in Chapter 4. If breathing is absent then give two effective rescue breaths. Patient may need assisted ventilation with bag mask. Following life threatening thoracic emergencies should be dealt immediately.

Fig. 11.7: Rescue breath using pocket mask

1. Tension/open pneumothorax
2. Flail chest
3. Massive hemothorax

d. *Circulation*: Assess circulatory status {(pulse rate, volume, and regularity), capillary refill time, blood pressure, and skin temperature}. No pulse in adult and heart rate < 60/min with signs of poor perfusion in children, start immediate chest compression. Manually control the external bleeding. In suspected case of internal bleeding (fluid unresponsive shock, pale, fall in temperature, poor pulse volume, decrease oxygen saturation), immobilize the patient as whole on backboard and apply splint on suspected fractured limb.

e. *Neurological assessment*: Assess responsiveness using Glasgow coma scale (severity of brain injury) or AVPU scale, pupillary size, equality and reaction to light, equality, abnormal posturing, signs of raised intracranial pressure (irregular breathing, decreased heart rate, and hypertension). Prevent secondary injury to brain (correct hypoxia and hypovolemia).

f. *Environment/exposure*: Children are more prone to hypothermia due to their larger body surface area and thin skin. Cover them with warm blankets. In cold environment adults are also prone to hypothermic injury.

THORACIC INJURIES

Chest injuries are important cause of death. The most common injuries which can lead to immediate death are tension pneumothorax, open pneumothorax, hemothorax, cardiac tamponade, aortic rupture and airway obstruction.

Clinical Features Suggestive of Thoracic Injuries

a. Tachypnea
b. Stridor
c. Respiratory distress
d. Change in voice
e. Decreased air movements
f. Altered sensorium
g. Cyanosis
h. Poor chest expansion
i. Asymmetrical chest movements
j. Tracheal shift
k. Diaphragmatic breathing

A. Tension Pneumothorax

Tension pneumothorax can lead to cardiac and pulmonary dysfunction due to acute compression of thoracic structures.

Features

- Respiratory distress and acute desaturation
- Tachycardia
- Fluid refractory hypotension
- Distended neck veins
- Hyper-resonant percussion note
- Asynchronous lung expansion
- Deviation of trachea to opposite side
- Unilateral absent breath sounds
- Cyanosis

Management

1. High flow oxygen with nonrebreathing mask.
2. *Immediate needle decompression*: Immediately insert disposable 18 G or 20 G needle or 18 G intravenous catheter in 2nd intercostal space in mid-clavicular line on the affected side.
3. Chest tube drainage should be inserted subsequently in the hospital after needle thoracostomy.
4. Blood transfusion.

B. Open Pneumothorax (Sucking Chest Wound)

Features

1. Air coming out from wound
2. Features of pneumothorax
3. May have associated features of hemothorax.

Management

If the opening in the chest is more than 2/3rd of the diameter of trachea and air passes through it, immediately occlude the defect with sterile gauge piece covering enough edges of the wound and taped securely three sides to provide flutter type valve effect. Put chest drain away from the defect.

C. Hemothorax

Features

1. Features of shock and hypoxia despite oxygen therapy
2. Decreased chest movements
3. Dull percussion note
4. Decreased air entry.

Management

1. High flow oxygen with reservoir mask
2. Volume replacement
3. Chest tube drainage.

D. Flail Chest

Due to more elastic properties of rib cage, flail chest is uncommon in children.

Features

1. Paradoxical chest movements
2. Hypoxia despite oxygen therapy
3. Crepitus on palpation.

Management

1. High flow oxygen with reservoir mask
2. Endotracheal intubation and ventilation
3. Morphine or fentanyl for pain relief.

E. Disrupted Major Airway

Features

1. Respiratory distress
2. Surgical emphysema (air in subcutaneous tissue)
3. Hemoptysis.

Management

1. Airway management
2. Treatment of pneumothorax
3. Transport immediately to cardiothoracic center.

F. Cardiac Tamponade

Features

1. Signs of shock
2. Muffled heart sounds
3. Distended neck veins.

Management

1. High flow oxygen
2. Volume replacement
3. Emergency needle pericardiocentesis.

G. Pulmonary Contusion

Incidence of pulmonary contusion is high in children.

Features

1. Dyspnea and hypoxia
2. Hemoptysis.

Management

1. High flow oxygen
2. Assisted ventilation
3. Physiotherapy to prevent lung collapse and secondary infection.

H. Myocardial Contusion

Myocardial contusion is commonly seen in acceleration/deceleration and crush/compression injuries. Though physiological dysfunctions are present but shock in such patient is rarely seen. Diagnosis is made by 12- lead electrocardiography.

I. Cervical Spine Injury

Cervical trauma, if not managed properly can lead to irreparable neurological deficit. Always suspect cervical trauma in patients with history of injury, unconsciousness, fall from height and penetrating injury, neurological deficit, and cervical spine deformity. It is very difficult to rule out cervical spine injury in such patients. Children can suffer cervical spine injury even without radiological abnormality (SCIWORA). Cervical spine can be immobilized either by manual in-line stabilization or using cervical collar/sand bags/straps (see Chapter on Airway and Cervical Spine Immobilization).

Evaluation of Cervical Spine Injury

1. Primary survey to assess life threatening problems and resuscitation.
2. Target to immobilize cervical spine rather to exclude spinal injury.

3. History and gentle physical examination.
4. Radiological evaluation.

Management

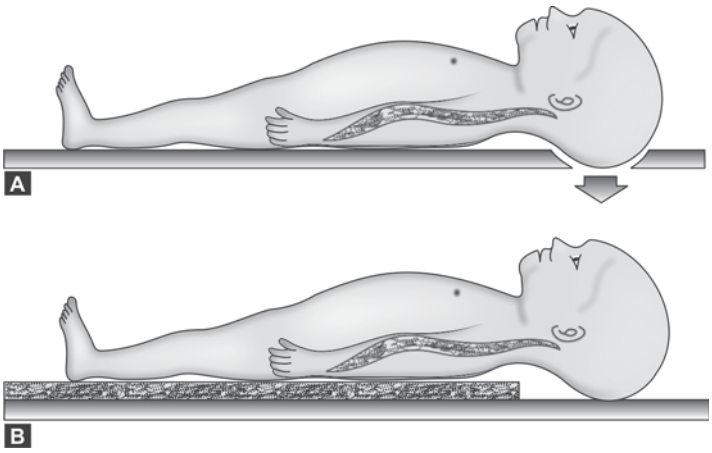
a. Assess scene safety.
b. Rule out life threatening problems.
c. Evict the patient from accident site/vehicle maintaining cervical spine immobilization. There are various equipments for spine protection, e.g. half spine board, scoop stretcher, immobilization vests. Target is safe removal of the patient from accident sites. Depending on the need and availability any technique can be used.
d. Head to be kept in neutral position unless contraindicated and stabilize by putting strap.
e. Apply hard cervical collar of appropriate size.
f. Immobilize the whole body (principle is to splint the joint above and below the injury) on rigid long backboard.
g. Apply straps on lower forehead, hard collar, shoulder including chest, pelvis, and arms and legs (above and below knee). Put towels/cottons between gaps to stabilize.
h. Check for neurological deficit (weakness, decreased movements, unable to lift the limbs) and pulses in all limbs.
i. Since the head of children is large, a pad may be kept under back of chest and in adults under the occiput.
j. Give analgesics for pain.
k. Shock is common in these patients. Assess frequently for features of shock.
l. Start intravenous fluid as normal saline if shock is suspected.
m. Lift the patient on backboard using logroll method.
n. Supine position is best for transport and CPR.
o. Maintain body temperature.

Transport Considerations

- Continue to reassess
- Monitor vitals including blood pressure
- Early detection of shock
- Prevent aspiration
- Control of pain
- Prevent hypothermia.

Pediatric Considerations

In children less than 8 years, allowances must be made for the relatively large head compared with the torso, which forces the neck into a position of flexion when the head and torso are supine on a flat surface. Hence, in these children, either the torso is elevated or an occipital recess be formed (Figs 11.8A and B).



Figs 11.8A and B: Large occiput needs adjustment

Abdominal Injury

Children are more prone to abdominal injuries due to following reasons.

1. Thin abdominal wall gives less protection to abdominal organs.
2. Elastic rib cage gives less protection.
3. Horizontally placed diaphragm put liver down and anteriorly making more prone to injury.
4. Thick capsule surrounding liver and spleen makes bleeding restricted.
5. Bladder when full is intra-abdominal, so more prone to injury.
6. Restricted diaphragmatic movements lead to respiratory compromise and respiratory failure.

Management

Most of the abdominal injuries are managed nonoperatively with supportive care and frequent monitoring. Investigation of choice in such case is CT abdomen and focused abdominal sonography for trauma (FAST).

Note: Fluid refractory shock with evidence of solid organ damage
1. Indicates internal bleeding
2. Penetrating abdominal injury
3. Evidence of bowel perforation.

Musculoskeletal Trauma

Musculoskeletal trauma is rarely life threatening except when there is massive bleeding. Goals are to recognize life threatening injuries, stabilization and continuous assessment of the victim. Patient may have associated life threatening injuries or multisystem involvement along with musculoskeletal trauma. Pelvic and large bone fracture (femur bone) can be life threatening. Swollen and tensed extremities should be watched carefully for the development of compartment syndrome (increased pressure) especially in children who are unresponsive. Classical signs of compartment syndrome include pain out of proportion to physical findings, pallor, pulselessness, paresthesia and or paralysis. If compartment pressure is more than 30 mmHg, one may consider for fasciotomy.

Management

- Assure scene safety.
- Primary survey to find out life threatening problems.
- If not a life threatening problem, remove clothes and examine.
- Control external bleeding by manual compression.
- Internal bleeding is controlled by immobilization.
- Ask patient about pain, weakness, numbness.
- Assess for swelling, wound, bleeding, hematomas (collection of blood in tissues), color, pulses distal to injury, capillary refill time, temperature, and crepitus (marker of fracture).

- Evaluate for sensations and gross functions.
- Give analgesic (morphine or fentanyl).
- Cover the open wound with sterile dressing.
- Immobilize the limb with suspected fracture;
  1. Remove all clothes, rings and jewellery by cutting.
  2. Check and record for distal pulse before and after splint application.
  3. Apply splint in same position of fracture.
  4. If limb is pulseless, try to straighten the limb (pressure should not exceed 4 kg). Keep limb in position where pulse appears.
  5. Splint should include joint above and below suspected fracture site.
  6. Do padding with cotton.
  7. Assess distal pulse and movements (if conscious) after applying the splint.
  8. Elevate the limb.
  9. Use ice packs to relieve pain.
  10. If patient has life threatening problem then splint can be done during transport.

Transport Considerations

a. Give analgesics.
b. Monitor pulse, temperature, capillary refill time, and movements distal to injury.
c. Early transport to trauma center.

Care of Amputated Limb

a. Clean the amputated part with Ringer's lactate or normal saline.
b. Cover with sterile, wet gauge piece.
c. Place it in plastic bag.
d. Place this bag in the crushed ice containing bag.
e. Do not freeze.
f. Early transport.

Facial Injury

The principle of management is assessment of airway and establishment of definitive airway, maintenance of breathing, and control of hemorrhage.

Head Injury

General principles of management

1. Ensure ABC of resuscitation (give high flow oxygen with non-rebreathing mask and intubation/LMA if GCS < 8, facial injury, burn, respiratory distress).
2. Treat associated chest injury and prevent hyperventilation
3. If victim is in shock resuscitate with normal saline, control bleeding and ensure evolemia. Target systolic blood pressure > 90 mm/Hg in adults and (> 70 + age × 2) in children. Maintain age specific mean arterial pressure (more than 65 mmHg in adults).
4. Maintain alignment between head and trunk.
5. Keep head of bed/stretcher at 15-30 degree elevated unless patient is in shock.
6. Use normal saline for resuscitation.
7. Control pain (morphine 0.1-0.2 mg/kg or fentanyl 0.5 µg/kg intravenously), fever (paracetamol 15 mg/kg or 500 mg for adult), seizures (diazepam 0.1 mg/kg or midazolam 0.1 mg/kg intravenously), avoid stimulation, avoid neck compression and shivering.
8. If features of raised intracranial tension or herniations are present (bradycardia, hypertension, and irregular breathing), use mannitol 0.25 gm/kg (1 gm in adults) as intravenous push.
9. If seizure persist use intravenous injection phenytoin 20 mg/kg loading dissolved in normal saline over 20 minutes followed by 5 mg/kg BID.
10. Arrange transfer to neurosurgical center or tertiary level hospital.

Transport Considerations

1. Avoid unnecessary movements
2. Transport in supine position
3. Keep head elevated in neutral position at 15-30 degree
4. Control pain
5. Prevent hypoxia
6. Control external hemorrhage to prevent shock
7. Control convulsions with injection diazepam
8. Monitor pulse rate, blood pressure, SpO_2, and GCS or AVPU scale, pupil reaction every 5-10 min, and appearance of new signs
9. Avoid higher PEEP if patient is on ventilator.

Control of Bleeding

1. Any external bleeding seen should be stopped by applying pressure dressing.
2. Scalp wound bleed profusely can lead to shock thus apply pressure dressing and later running locked suture.
3. Fractured long bones should be splinted to decrease bleeding and pain.
4. Bleeding vessels should not be clamped rather apply pressure dressing.
5. For nose bleed use packing or Foley's catheter inserted in nasopharynx and dilated and traction should be applied.

Pain Management in Trauma Victims

Pain management is important in trauma victims. No sedative is given if patient is having respiratory depression/shock or altered level of consciousness. Most commonly fentanyl or morphine is used to relieve pain.

1. Basic therapy includes immobilization of fractured limb, application of ice packs, and good counselling.
2. Fentanyl (2-3 µg/kg in adults and 1-3 ug/kg in children IV) or morphine (2-5-15 mg SC/IM/IV in adults and 0.1 mg/kg in children).

Golden Principles of Prehospital Management (Golden Period)

1. Ensure safety of trauma victim, self and bystanders
   a. Evacuation from accident site (toxic gas, fire).
   b. Call for fire personnel if needed.
   c. Stabilization of the vehicle.
   d. Inform police.
   e. Use of personal protection equipments.
2. Assess the scene: Call for extra help in case multiple casualties are suspected.
3. Understand the mechanics of injuries and kinematics of trauma (if time permits or may be explored during transport): This will help in understanding the various injuries.
4. Primary survey using ABCDE's approach: Assess the patient globally
   a. Assess responsiveness.
   b. Find out life threatening problems immediately (compromised airway, inadequate breathing, extensive bleeding, shock, penetrating injury to vital organs, extreme of age, pregnant woman and associated serious medical conditions). Such patients should be immediately shifted to appropriate center.
   c. Prioritize your intervention on the basis of initial assessment.
   d. Multiple casualties: Assess, decide and act on priority basis. Sort out the patients based on need of treatment and resources available to provide that treatment.
5. Keep the head and neck in neutral position (rule out contraindications).
6. Airway management with inline cervical spine immobilization
   a. Open airway using jaw thrust or chin lift using inline stabilization.
   b. Obstructed airway: Remove visible foreign body.
   c. Clear secretions.
   d. Use oropharyngeal or nasopharyngeal airway (if airway is not maintained by simple maneuver).

   e. Ideal is endotracheal intubation but if intubation is not possible one can use LMA.
   f. Achieve inline stabilization of cervical spine.
7. Give high concentration oxygen using nonrebreathing mask targeting oxygen saturation (SpO_2) > 94%
   a. If gasping/or respiratory rate slow or very fast do bag-mask ventilation using appropriate size face mask (make a good seal around mouth and nose), prevent pressure injury to eyes. Target oxygen saturation > 94%.
   b. Plan early intubation in inhalation and burn injuries.
8. Control of significant external bleeding
   a. Manual compression (direct pressure).
   b. Pressure dressing using gauge piece.
   c. Obtain intravenous or intraosseous access.
   d. Assess features of shock and treat (give 1-2 L bolus of warm normal saline (108°F) in adults and 20 ml/kg in children).
9. Prevent hypothermia especially in children.
10. Apply splint to fractured limbs which will help in preventing internal hemorrhage.
11. Immobilize the victim as a whole on long backboard. Airway is priority in management.
12. Arrange transport and inform the receiving hospital (type of services required, number of casualties, and mechanism of injury).
13. Monitor vitals and continue to reassess during transport.
14. Do no further harm.

CHAPTER 12

Cardiac Arrest

Providing basic life support is key to success of trauma case management. Efficient and effective initial assessment and rapid stabilization done in cardiac arrest occurring in trauma cases will result in better outcome. Poor resuscitative efforts carry bad outcome. Hypoxia and hypovolemia are two important causes of cardiac arrest in trauma victims.

IMPORTANT CAUSES OF CARDIAC ARREST IN TRAUMA VICTIMS

a. Airway obstruction due to foreign body
b. Tracheobronchial injury
c. Tension pneumothorax
d. Flail chest
e. Smoke inhalational injury
f. Near drowning
g. Hemorrhagic shock
h. Aortic injury
i. Myocardial injury
j. Cardiac tamponade
k. Acute myocardial infarction
l. Electric shock
m. Penetrating injury of heart
n. Pulseless electrical activity (PEA)
o. Asystole
p. Severe brain injury secondary to poor perfusion and oxygenation.

Management

Initial steps include determination of responsiveness, securing airway, inline head and cervical spine immobilization, giving

100% oxygenation, control of external bleeding, establishing vascular access and providing circulatory support.

1. Extricate the victim, ensure scene safety, and call for more help.
2. Assess responsiveness and decide severity of illness.
3. Establish patency of airway:
   a. Open airway using jaw thrust, remove visible foreign body and insert oropharyngeal or nasopharyngeal airway and start bag-mask ventilation at 10-12 breath/min using 100% oxygen.
   b. Look for effective chest rise with each assisted breath (reflects adequacy of air delivery).
   c. Early intubation or LMA insertion and giving positive pressure ventilation using bag-mask or flow inflating bag.
4. Immobilize cervical spine (manually and or using appropriate size hard cervical collar).
5. a. Control external bleeding using manual compression and tourniquet.
   b. Check for circulation (carotid artery in patients above 1 year and brachial artery in infants).
   c. If no pulse, start chest compression. Push hard push fast (100/min). Allow chest recoil in between compressions.
   d. Attach monitor and analyze rhythm.
   e. Identify treatable causes of cardiac arrest: Distended neck veins (tension pneumothorax, cardiac tamponade, and hemothorax), tracheal shift (tension pneumothorax), crepitus (air leaks), flail chest.
   f. Intervene to correct above conditions (see Chapter 11).
6. Obtain IV/IO access. Infuse ringer lactate or normal saline 1-2 L if patient is in shock.
7. Arrange for transport and continue to monitor after successful resuscitation.

Pulseless Arrest (Nontraumatic)

Etiology of Arrest

a. Ventricular fibrillation (VF)
b. Pulseless ventricular tachycardia (VT)

c. Pulseless electrical activity (PEA)
d. Asystole.

Management of pulseless arrest is as under:
1. Call for help and start CPR.
2. Secure airway and start assisted ventilation using 100% oxygen.
3. Attach monitor/AED and analyze rhythm.
4. Obtain IV access.

Shockable Rhythm: Ventricular Fibrillation or Pulseless Ventricular Tachycardia

1. Continue five cycles of CPR for two minutes.
2. Give one shock 120-200 J in adults and 2 J/kg in children (use pediatric size paddles between 1-8 years of age).
3. Resume CPR and give minimum 5 cycles of CPR and check for rhythm (reanalyze).
4. Continue CPR (100/min, 30:2 compression: Ventilation) while AED is charging.
5. Again rhythm is VF/Pulseless VT.
6. Give another shock of 120-200 J in adults and 4 J/kg in children.
7. Resume CPR immediately after shock.
8. Give epinephrine 1:1000 (1 ml) in adults and 0.01 ml/kg in children IV or intraosseous. Always flush with normal saline.
9. Continue CPR.
10. Give another shock and continue CPR till advance help arrives or patient is shifted to advance center.

Note: Look at every step for underlying cause(s) of VF and pulseless VT (hypotension, hypoxia, hypoglycemia, hypothermia, tension pneumothorax, poisonings, and trauma.

Rhythm Not Shockable: Asystole or Pulseless Electrical Activity

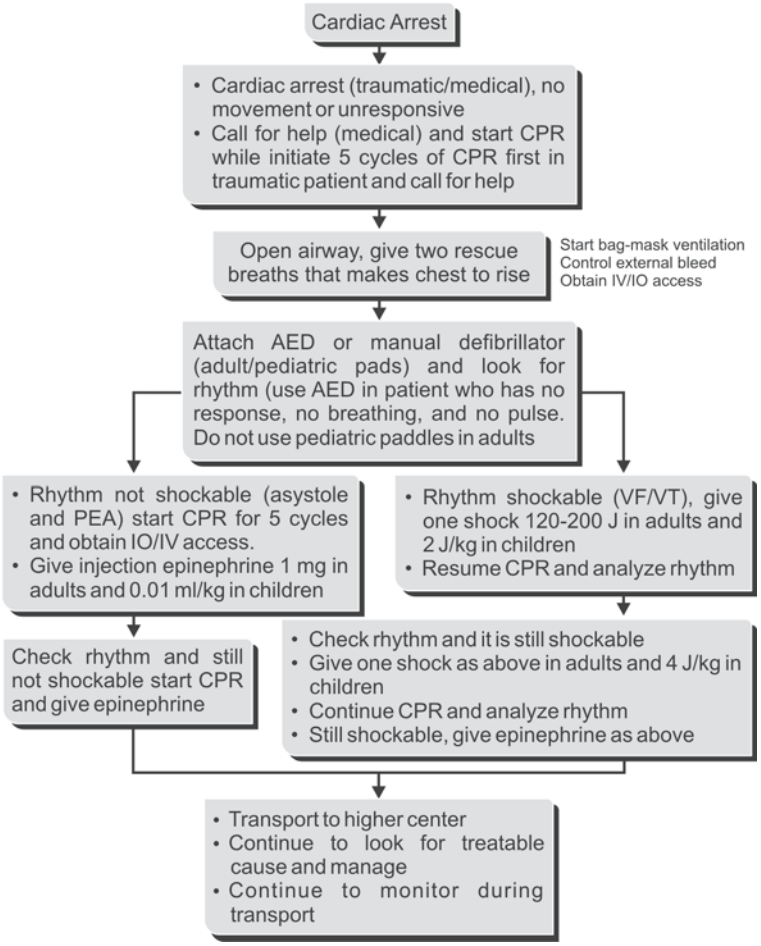
1. Resume CPR.
2. Secure airway, start assisted ventilation with 100% oxygen.
3. Obtain IV/IO access.

4. Give epinephrine as advised above.
5. Continue CPR and repeat epinephrine very 3-5 minutes till advance help arrives or patient is dead.

SUMMARY

Flow chart 12.1 shows approach and management in patient with cardiac arrest.

Flow chart 12.1: Approach and management in patient with cardiac arrest



CHAPTER 13

Medical Emergencies

SHOCK

Shock is a clinical state or syndrome characterized by impaired tissue perfusion and oxygenation due to various reasons. Early aggressive fluid and oxygen therapy in shock will improve outcome. There are four major types of shock (Fig. 13.1). The most common types seen in adults are hypovolemic and cardiac shock.

Types of Shock

1. Hypovolemic
2. Cardiogenic
3. Distributive (septic and neurogenic)
4. Obstructive

Common Causes of Shock

1. Sepsis
2. Trauma and tension pneumothorax
3. Myocardial ischemia
4. Myocardial infarction
5. Myocarditis
6. Burns and severe diarrhea
7. Diabetic ketoacidosis
8. Persistent vomiting
9. Pancreatitis
10. Complicated malaria
11. Dengue hemorrhagic shock
12. Excessive vaginal bleeding in females

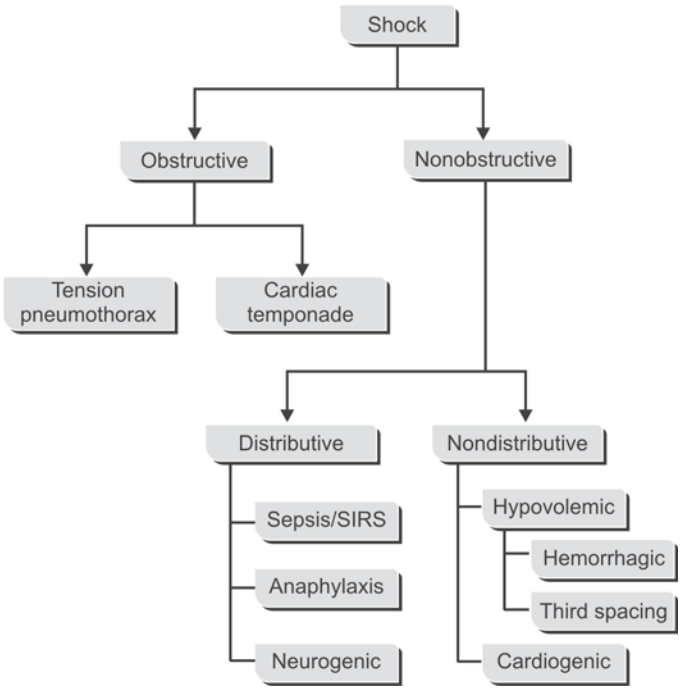


Fig. 13.1: Classification of shock

Clinical Features

This chapter will primarily focus on hypovolemic shock (hemorrhagic and nonhemorrhagic). Many features are similar in all types of shock. Initial management of all types of shock is almost same. Shock may present in compensated or decompensated stage;

a. *Compensated shock*: The blood pressure remains within normal range.
b. *Decompensated shock*: Clinical features combined with fall in blood pressure constitute hypotensive shock.

1. History of trauma, bleeding, and fluid loss
2. Excessive sweating
3. Tachycardia
4. Thready pulse
5. Increased respiratory rate
6. Cold and mottled skin
7. Increased capillary refill time
8. Mild confusion
9. Narrow pulse pressure
10. Warm extremities and wide pulse pressure in septic shock
11. Hypotension systolic blood pressure < 90 mmHg (late)
12. Decreased urine output
13. Cardiac arrest (terminal event)

Goals of Management

1. To improve oxygenation and perfusion
2. Normalizing blood pressure
3. Treating underlying etiology
4. Prevent further injury/harm

Prehospital Management

1. Assess responsiveness, airway, breathing, and circulation.
2. Give high flow oxygen using nonrebreathing mask.
3. If patient is not able to maintain airway use nasopharyngeal or oropharyngeal airway to secure airway.
4. No respiration or respiratory rate < 10/min or patient in altered mental state, use bag-mask ventilation to provide oxygen (look for adequate chest rise during assisted ventilation).
5. LMA insertion may be required in some patients.
6. Keep the leg end raised (contraindicated in head injury).
7. Control external hemorrhage or bleeding.
8. Obtain vascular access (intravenous or intraosseous).
9. Attach monitor and start monitoring heart rate, respiratory rate, SpO_2 and blood pressure.

10. Give bolus of normal saline or Ringer's lactate 500-1000 ml.
11. Continue to monitor heart rate, oxygen saturation and blood pressure.
12. Monitor response (heart rate will settle down, CRT will normalize, saturation will improve, and systolic blood pressure improves > 90 mmHg).
13. Repeat up to two boluses and see response.
14. If no response is seen after two fluid boluses, suspect internal hemorrhage, tension pneumothorax, cardiac injury and cardiac tamponade as a cause of shock especially in trauma patients.
15. Splint the fractured limb in anatomical position.
16. Check for blood sugar in unconscious patient.
17. Prevent hypothermia.
18. Arrange transfer to higher center.
19. Continue to give oxygen and fluids.
20. Continue to monitor heart rate, oxygen saturation, respiratory rate, blood pressure, and urine output during transport.

ACUTE CORONARY SYNDROME

Acute coronary syndrome is the most common medical emergency seen in adults and elderly population. The most common causes of death in such patients are ventricular fibrillation (VF) and pulseless ventricular tachycardia (VT). The syndrome is further divided into two categories:

1. Unstable angina
2. Acute myocardial infarction
   a. Non-ST elevation myocardial infarction (NSTEMI)
   b. ST elevation myocardial infarction (STEMI)

Clinical Presentation

a. Chest pain/discomfort lasting more than few minutes
b. Chest fullness
c. Squeezing sensation
d. Pain radiating to neck, jaw, shoulder, arm, between shoulder blades

e. Shortness of breath
f. Anxiety
g. Sweating
h. Palpitation
i. Syncope.

Management

a. Goal of management is to increase oxygen supply, decrease demand, and reversal of ischemia.
b. Start treatment on the basis of clinical presentation. No investigation is required at initial stage of presentation.
c. Obtain clinical history and identify risk factors (diabetes mellitus, hypertension, smoking, obesity, age, sedentary life style, etc.
d. Assess responsiveness, airway, breathing, and circulation.
e. Attach to monitor and analyze rhythm.
f. Keep defibrillator ready and look for shockable or non-shockable rhythm.
g. If patient is having shockable rhythm (VT or pulseless VT), immediately deliver shock.
h. Start oxygen with nasal cannula 4 L/min.
i. Give tablet *nitroglycerine 0.3 mg or isosorbide dinitrite 5 mg* sublingually at an interval of 3-5 min up to three times (monitor blood pressure and heart rate) to control pain.
j. Stop the nitroglycerine if systolic blood pressure falls < 90 mmHg.
k. Obtain IV access.
l. Give injection morphine 2 mg/IV to relieve pain and may repeat up to three times. Monitor respiration and blood pressure.
m. Give tablet aspirin 150-300 mg orally. Monitor for gut bleed.
n. Give clopidogrel 300 mg stat.
o. Arrange transport to the hospital and monitor abnormal heart rate, blood pressure, oxygen saturation and ECG.

STATUS EPILEPTICUS

Convulsions (tonic-clonic movements of the limbs and body) for more than 30 min or two episodes of convulsions without

regaining consciousness or you are attending a call for convulsing patient should be treated as status epilepticus. For clinical purpose treat every patient with convulsion as status epilepticus as a PHLS provider.

Most common causes of status epilepticus in adults

- Acute stroke
- Head injury
- Drug withdrawal and toxicity
- Meningitis/Encephalitis
- Anoxia
- Metabolic disorders
- Idiopathic epilepsy

Management

1. Prevent from further injury. Move patient away to safe place.
2. Assess and secure airway (prevent tongue bite). Put soft cloth between teeth.
3. Keep patient in left lateral position to prevent aspiration (if there is no contraindication exists).
4. Give high flow oxygen and attach to monitor.
5. Suction the mouth and remove secretions.
6. Obtain intravenous or intraosseous access.
7. Estimate blood sugar with glucometer.
8. Start normal maintenance fluid as normal saline.
9. If low blood sugar is detected, give 50 ml of 50% dextrose and injection B-complex (thiamine 100 mg).
10. Give intravenous diazepam 5 mg IV or rectally or lorazepam 4-8 mg IV.
11. Give midazolam 5 mg buccal or intranasal route or rectal diazepam suppository.
12. Repeat the dose after 5-10 minutes if convulsion persists.
13. Monitor blood pressure and respiration.
14. Arrange transfer and continue to monitor vitals and prevent injury.

Pediatric Considerations

1. Give 2 ml/kg of 25% dextrose for hypoglycemia.
2. Midazolam 0.15 mg/kg IV or 0.2 mg/kg buccal route or intranasal (divided in two parts and installed in both the nostrils) or diazepam 0.1 mg/kg IV or rectally. Lorazepam 0.1 mg/kg may also used intravenously.
3. Repeat the dose if convulsions persist after 10 minutes.

Transport Considerations

1. Do not tie the patient (convulsing patient will have more chance of injury and raised intracranial pressure).
2. Prevent tongue bite.
3. Prevent aspiration (keep in left lateral position).
4. Assess blood glucose.
5. Control breakthrough convulsions using midazolam or lorazepam.
6. Inform receiving hospital.
7. Counsel family member.

ACUTE STROKE

Stroke is defined as sudden onset of focal neurological features due to diseases of cerebral vasculature lasting for more than 24 hours. Rapid assessment, stabilization, and transport are keypoints in management of a patient with acute stroke to prevent further brain injury.

Clinical Features

1. Identify the possible signs of stroke:
   a. Weakness or numbness of face, arms, legs (one side)
   b. Headache
   c. Confusion
   d. Difficulty in walking
   e. Lack of coordination
   f. Visual disturbances.
2. Confirm stroke using prehospital stroke scale:
   a. Facial drop: Ask patient to show teeth or smile. Normally both side of face move equally.

b. Arm weakness: Ask patient to close eyes and extend both arms keeping palms up for 10 seconds. Normally both arms move in same direction.
c. Abnormal speech: Patient does not slur during speech.

Management

Assess responsiveness, airway, breathing, and circulation:
a. Airway: Suction the airway (prevent aspiration).
b. Give oxygen with nasal cannula.
c. Use nasopharyngeal airway in semiconscious patient and oropharyngeal airway in unconscious patient.
d. Use LMA if airway is not maintainable with above methods.
e. Start assisted ventilation using bag-mask or flow inflating bag.
f. Maintain cervical spine immobilization (chance of injury due to fall are high).
g. If not breathing give rescue breaths.
h. Assess for circulation: These patients usually have hypertension. Stroke per se does not lead to shock in adults.
i. Check for blood glucose.
j. Obtain IV access.
k. Start IV fluid normal saline or Ringer's lactate.
l. Do not use dextrose solutions.
m. Arrange transport immediately.
n. Monitor heart rate, blood pressure, respiration, oxygen saturation, and blood glucose during transport.

ACUTE RESPIRATORY FAILURE

Respiratory system is primarily involved in oxygenation and ventilation. Respiratory failure can occur due to failure to oxygenate or ventilate or both. Acute respiratory failure occurs when the respiratory system is not able to meet the metabolic demands of the body.

Etiology of Respiratory Failure

a. Asthma
b. Exacerbations of chronic obstructive pulmonary disease (COPD)

c. Pneumothorax
d. Pneumonia
e. Pulmonary embolism
f. Pulmonary edema
g. Acute respiratory distress syndrome
h. Traumatic brain injury
i. Poisonings
j. Upper airway obstructions
k. Muscle disorders
l. Heart failure

Clinical Features

a. History suggestive of acute respiratory failure (asthma, chronic lung disease, pneumonia, trauma, muscle weakness, etc.)
b. Nasal flaring
c. Excessive sweating
d. Respiratory distress (use of accessory muscles, retractions, abnormal respiratory pattern)
e. Increased heart rate
f. Increased or decreased respiratory rate
g. Cyanosis
h. Decreased level of sensorium: Agitation and somnolence
i. Convulsions
j. Coma
k. Oxygen saturation < 90%.

Management

1. Follow the principle of ABC assessment.
2. Maintain airway and give oxygen with simple mask (controlled oxygen therapy is preferred). Propped up position in conscious patient.
3. Attach monitor or pulse oximeter.
4. Give nebulized salbutamol 5 mg in 3 ml saline or terbutaline 2.5 mg with nebulizer and may repeat after 2-4 hours.
5. Salbutamol Metered dose inhaler (MDI) 1-2 puff every 20 minutes for three times.
6. Give prednisolone 40 mg orally in patient with asthma.
7. Obtain IV access and start maintenance intravenous fluid.

8. Arrange transfer.
9. Monitor vitals.

RESPIRATORY ARREST

Patient is seen unconscious with no breathing but pulses are present.

Management

1. Check responsiveness.
2. Start basic life support skills (ABCDE).
3. Give rescue breaths.
4. Use OPA for airway maintenance.
5. Use advance airway adjuncts like LMA.
6. Start positive pressure ventilation using bag-mask.
7. Assess circulation (check carotid above one year to adult and brachial in infants).
8. If pulses are present continue breathing 10-12/min in adults and 12-20/min in children till advance help arrives or patient is shifted to hospital.

CHAPTER 14

Pediatric Emergencies

SHOCK

As we understand from definition of shock, it is inadequate oxygen delivery to the tissues to meet the metabolic demand. Shock can be further defined on the basis of clinical, hemodynamic, oxygen, and cellular variables. Clinical variables are routinely used in day to day practice to assess shock. There are four types of shock with different physiological characteristics.

Classification and Etiology of Shock

1. *Hypovolemic*: Diarrhea, hemorrhage, burns, peritonitis, vomiting.
2. *Cardiogenic*: Arrhythmia, acute heart failure, sepsis.
3. *Distributive / Septic*: Anaphylaxis, spinal cord injury, vasodilator drugs, sepsis.
4. *Obstructive*: Tension pneumothorax, cardiac tamponade, pulmonary embolism, flail chest. Septic and hypovolemic shock are important contributors of childhood mortality and morbidity.

Physiology

Cardiac output depends on heart rate and stroke volume. Stroke volume is further determined by preload, afterload, and contractility. Heart muscles are not poorly developed in infants. Preload can be influenced by fluid adjustment. Afterload and cardiac contractility can be altered by drugs. These interventions can modify cardiac output to some extent. In children cardiac output is primarily altered by change in heart rate. Baseline heart rate in children is higher and cannot increase beyond

certain extent. After a definite threshold, the increase in heart rate is not beneficial in increasing the cardiac output and further will harm to the patient. Oxygen delivery to tissue primarily depends on cardiac output and oxygen content in arterial the blood.

a. *Oxygen delivery* = Cardiac output × Arterial oxygen content
b. *Cardiac output* = Heart Rate × Stroke volume
c. *Stroke volume* = Factors which influence stroke volume are; preload (fluid therapy), contractility (inotropes), afterload (vasodilator or vasopressors)
d. Arterial oxygen content = Hemoglobin (blood transfusion) × 1.36 (pH, PCO_2, temp) × SaO_2 (oxygen) + (0.003 × PaO_2). (Parenthesis indicates factors which can modify the primary factor)

Signs of Shock in Children

- History of fluid loss, trauma, fever
- Tachycardia
- Cold, mottled skin, delayed capillary refill (> 3 seconds)
- Weak peripheral and or central pulses
- Decreased urine output (< 1 ml/kg/hr in child)
- Altered mental status

Recognizing Different Types of Shock (Table 14.1)

Identification of shock is important rather than variety of shock. It becomes important to identify the variety of shock when not responding to initial therapy. Outcome of shock is better if interventions are started early during compensated shock. Patient carries poor prognosis in decompensated shock.

General Management of Shock

Many of these actions are to be carried out simultaneously.

1. Assess responsiveness, airway, breathing, and circulation.
2. If the child is responsive and breathing;
   a. Use high flow oxygen delivery devices, e.g. non-rebreathing mask or go for early intubation or LMA insertion and ventilation with bag-mask.

Table 14.1: Shock recognition flow chart in children

Clinical signs	*Hypovolemic*	*Distributive*	*Cardiogenic*	*Obstructive*
A. Patency	**Airway open and maintainable/not maintainable**			
B. Respiratory rate	Increased			
Respiratory effort	Normal to increased		Labored	
Breath sounds	Normal	Normal (± crackles)	Crackles, grunting	
C. Systolic blood pressure	COMPENSATED SHOCK → HYPOTENSIVE SHOCK Normal to Below Normal (70 + age × 2)			
Pulse pressure	Narrow	Wide	Narrow	
Heart rate	Increased			
Peripheral pulse quality	Weak	Bounding or weak	Weak	
Skin	Pale, cool	Warm or cool	Pale, cool	
CRT	Delayed > 3 sec	Variable	Variable	
Urine output	Decreased (< 1 ml/kg/hr)			
D. Level of consciousness	Irritable in early stage and Lethargic in late stage			
Temperature	**Variable**			

Adapted from PALS manual

b. Establish vascular access: Intravenous or intraosseous (age is no bar).
c. Positioning: Position the stable child in mother's lap and unstable child on his/her back and raise legs above the level of heart (ensure that respiration is not compromised).

   d. Fluid resuscitation: Crystalloid (normal saline) bolus is given as 20 ml/kg over 5-10 min, may repeat up to 40-60 ml/kg. Monitor heart rate, capillary refill, oxygen saturation, urine output, level of consciousness, liver size and work of breathing. If shock is fluid responsive i.e. normalization of blood pressure and/or perfusion after fluid therapy, consider for transfer to higher center.
3. *Hypoglycemia*: Check for blood sugar in all patients having shock and if blood glucose is less than 45 mg/dl in neonates and ≤ 60 mg/dl in children, treat with dextrose (2 ml/kg of 25% dextrose or 5 ml/kg of 10% dextrose).
4. *Continue monitoring*: Clinical assessment of cardiovascular, respiratory, and neurological system including pulse oximetry (heart rate, peripheral pulses, capillary refill time, skin color, blood pressure, respiratory rate and efforts, urine output, level of consciousness, liver size, puffiness around eyeball, and blood glucose).
5. *Reassess*: Reassess the child after every intervention.
6. *Transfer the child to higher center and;*
   a. Continue oxygen and fluid therapy.
   b. Attach monitor and record/monitor (heart rate, respiratory rate, efforts, oxygen saturation, blood pressure, urine output).
   c. Prevent hypothermia (cover with blankets).
   d. Monitor signs of fluid overload (increase in liver size, edema around eyeballs, and decrease in oxygen saturation).

Targets in Shock

a. Oxygen saturation > 94%, if saturation is falling despite fluid therapy either the condition is worsening or evidence of fluid overload.
b. Blood pressure (> 70 + 2 × age).
c. Normalization of body temperature.
d. Urine output: > 1 ml/kg/hr.
e. Blood glucose > 60 mg/dl.
f. Hepatomegaly: Increase in liver size for fluid overload.
g. Stabilization of respiratory rate, decrease work of breathing, and disappearance cyanosis.

CARDIAC ARREST

Cardiac arrest is defined as cessation of circulation of blood as a result of absent or ineffective cardiac mechanical activity. *Clinically the patient is unresponsive, with no respiration, and detectable pulse*. Pediatric cardiac arrest usually occurs as a result of either respiratory failure or hypotensive shock. Sudden cardiac arrest is uncommon in children.

Types of Pediatric Cardiac Arrest

1. *Hypoxic or asphyxial arrest*: It is the most common cause of cardiac arrest as, result of inadequate supply of oxygen to tissues. The deficiency can result either due to respiratory failure, shock, or both.
2. *Sudden cardiac arrest*: Common conditions are ventricular fibrillation and pulseless ventricular tachycardia.
3. *Cardiac arrest is also associated with one of the following arrest rhythms*:
   a. *Asystole*: No electrical activity on ECG (Fig. 14.1).
   b. *Pulseless electrical activity (PEA)*: Organized electrical activity on ECG or monitor with no palpable pulse (Fig. 14.2). This excludes asystole, VF, and pulseless VT.

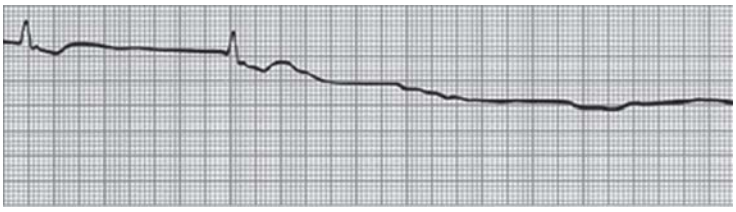


Fig. 14.1: Asystole

Fig. 14.2: Pulseless electrical activity

c. *Ventricular fibrillation (VF)*: Pulseless arrest with no organized activity or chaotic activity on ECG or monitor (Fig. 14.3).
d. *Pulseless ventricular tachycardia (VT)*: Pulseless arrest of ventricular origin with organized, wide QRS complex (Fig. 14.4).

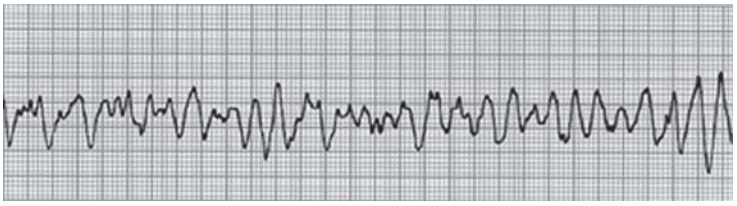


Fig. 14.3: Ventricular fibrillation

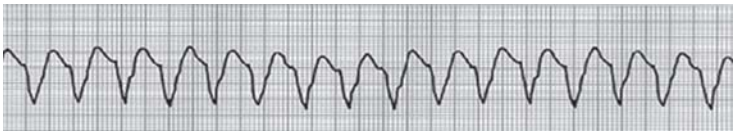


Fig. 14.4: Ventricular tachycardia

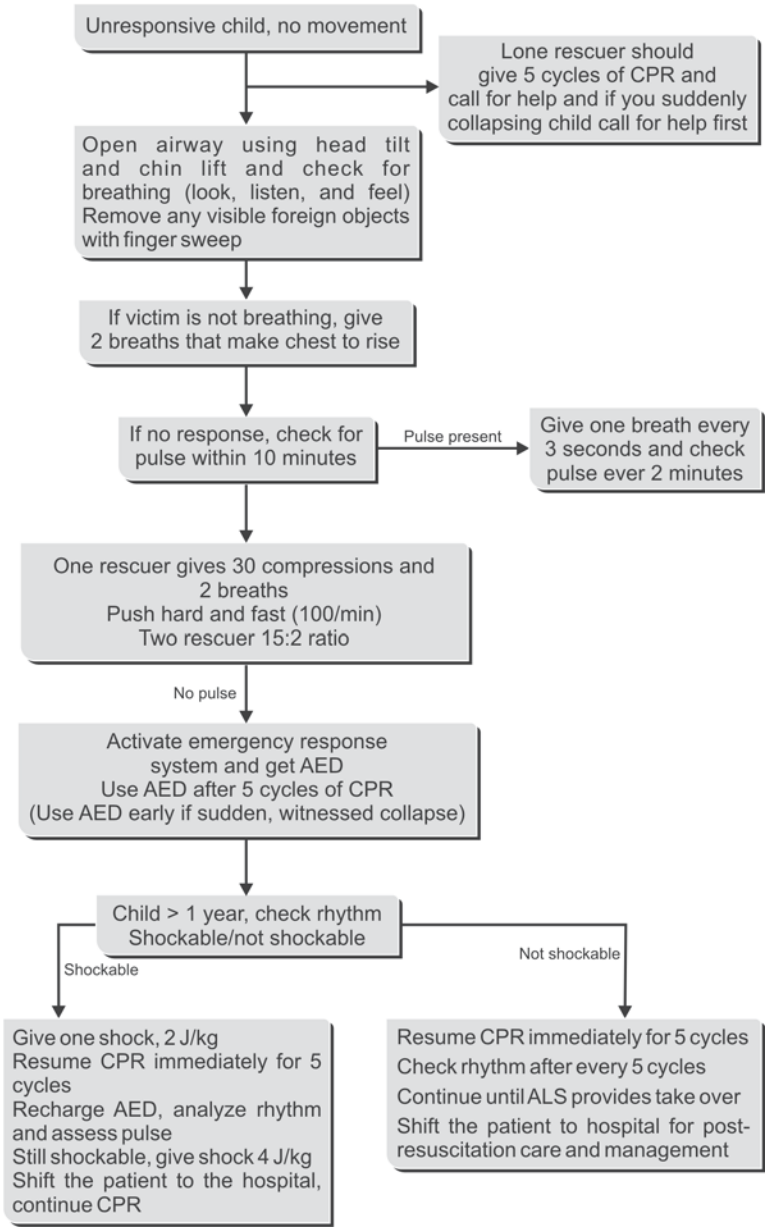
Management

a. Key to success is high quality CPR.
b. Assess and stabilize ABCs.
c. Insert appropriate size oropharyngeal airway.
d. Oxygenate with 100% oxygen using bag-mask.
e. Begin chest compression (push hard push fast).
f. For approach to child cardiac arrest see Flow chart 14.1.

RESPIRATORY DISTRESS AND FAILURE

Children have wide range of respiratory illnesses but upper and lower respiratory tract diseases are most common. Approximately 30-40% children with respiratory problems require hospital admission annually.

Flow chart 14.1: Pediatric BLS algorithm



Children have high metabolic rate and oxygen demand. Deficiency of oxygen can result into hypoxemia in blood and/or hypoxia at tissue level. Inadequate ventilation results hypercarbia. Both defects can occur simultaneously. Arterial hypoxemia can be measured noninvasively using pulse oximeter.

Clinical Features of Hypoxia

a. Tachypnea
b. Tachycardia
c. Agitation
d. Nasal flaring
e. Chest retractions
f. Tiredness
g. Altered consciousness level
h. Bradypnea and bradycardia appears late.

Clinical Features of Hypercarbia (Raised Carbon Dioxide in Blood)

Symptoms and signs of hypercarbia are nonspecific (inadequate respiratory effort, chest retractions, agitation and altered mental status) and usually diagnosis is made when patient's symptoms of hypoxemia do not improve with oxygen therapy.

Classification of Respiratory Problems on the Basis of Severity

Respiratory illnesses on the basis of severity of illness can be categorized either respiratory distress or respiratory failure on the basis of severity. Respiratory distress is a clinical state characterized by increased respiratory rate and effort and respiratory failure represents the end stage of respiratory distress and result from inadequate oxygenation, ventilation, or both. The diagnosis of respiratory failure is confirmed by arterial blood gas analysis.

Respiratory distress	*Respiratory failure*
Tachypnea	Marked tachypnea and later bradypnea
Increased respiratory efforts	Abnormal respiratory efforts
Tachycardia	Tachycardia and later bradycardia
Pale, cool skin	Cyanosis
Abnormal airway sounds	May have silent chest
Severe case may have altered mental status	Stupor and coma

Classification of Respiratory Illnesses by Type

a. Upper airway obstruction
b. Lower airway obstruction
c. Lung tissue disease
d. Disordered control of breathing
e. Disease outside lung parenchyma
f. Disorder of respiratory muscles.

General Management

Guidelines of management of respiratory distress/failure

Assess responsiveness, airway, breathing, and circulation.

A. Airway
   1. Keep the child in position of comfort (mother's lap)
   2. Open the airway (head tilt-chin lift)
   3. Clear the airway (use bulb-syringe/manual or electric suction to clear the airway secretions)
   4. Insert oropharyngeal in unconscious child and nasopharyngeal in semiconscious child

B. Breathing
   1. Provide high concentration of oxygen using nonrebreathing mask or bag-mask if child needs assisted ventilation
   2. Monitor response to therapy using pulse oximetry (target oxygen saturation > 94%).
   3. Decide for endotracheal intubation or use LMA
   4. Nebulization with drug(s) as indicated

C. Circulation
   1. Monitor heart rate, rhythm, oxygen saturation
   2. Obtain vascular or intraosseous access
   3. Start maintenance intravenous fluid
D. Reassess after every intervention
E. Arrange transfer and continue to monitor

UPPER AIRWAY OBSTRUCTION

Etiology

Common causes of upper airway obstruction in children are foreign body inhalation, large tongue in unconscious child, croup syndrome, anaphylaxis, epiglottitis, retropharyngeal abscess, infections (diphtheria, acute tonsillitis, infectious mononucleosis), vascular ring, and vocal cord injury.

Clinical Features

Symptoms of upper airway obstruction are mainly inspiratory

1. Increased respiratory rate
2. Increased respiratory effort
3. Decreased air movements (poor chest rise and air entry)
4. Inspiratory stridor in croup syndrome, retropharyngeal abscess
5. Snoring or gurgling cough
6. Change in voice in laryngitis
7. Drooling of saliva in epiglottitis
8. In case of complete obstruction there will be no air movement and inspiratory sounds will be absent

Management

General management of upper airway obstruction

1. General management of airway as discussed above
2. Remove secretions from nose and mouth
3. Remove visible foreign body
4. If complete obstruction is suspected call for help. Start CPR
5. Nebulize with epinephrine (1:1000 dissolved in 4ml saline)
6. Prevent agitation (keep child calm)
7. Use airway adjuncts (OPA/NPA)
8. Arrange for transfer

LOWER AIRWAY OBSTRUCTION

Etiology

Acute severe asthma and acute bronchiolitis are two most common conditions causing lower airway obstruction.

Clinical Features

a. Increased respiratory rate and efforts
b. Prolonged expiratory phase
c. Wheezing heard commonly on expiration
d. Cough.

A. Acute Bronchiolitis

a. Age: 2 months to 1 years
b. Onset: Acute
c. Etiology: Viral
d. Clinical features: Starts with upper respiratory symptoms followed by tachypnea, wheeze, respiratory distress, chest retraction, and hyperinflation of chest.
e. Treatment:
   i. Mild: Mild type does not require oxygen supplementation while moderate to severe degree require oxygen therapy.
   ii. Severe type:
      1. Mainly supportive.
      2. Assess ABC.
      3. Give oxygen with nasal cannula or simple mask if saturation is < 94% and respiratory rate > 60/min. Target oxygen saturation > 94%.
      4. Obtain IV access and start maintenance fluid therapy.
      5. Avoid early feeding.
      6. Nebulized with epinephrine: Dissolve 1 ml of 1:1000 epinephrine in normal saline to make the volume 5 ml. Keep flow of oxygen at 6-10 L/min.
f. Referral criteria: Apnea, seizure, persistent distress, cyanosis.

B. Acute Bronchial Asthma

Asthma is a chronic inflammatory disease of lower airway characterized by reversible complete or partial airway obstruction either spontaneously or with therapy.

Clinical Features

a. Recurrent cough (nocturnal cough)
b. Wheeze
c. Chest tightness
d. Family history
e. History of associated illness.

Treatment

1. Assess ABC.
2. Give humidified high flow oxygen.
3. Administer nebulized salbutamol (< 20 kg: 0.5 ml, > 20 kg 1 ml dissolved in 4 ml normal saline) every 20 minutes for one hour or salbutamol MDI with spacer 6 puff < 4 years, 12 puffs > 4 years.
4. If no response, give oral prednisolone 1 mg/kg.
5. Nebulize with ipratropium bromide (< 1 year 0.5 ml, > 1 year 1 ml).
6. Still no response continues above treatment.
7. Obtain IV access and start intravenous fluid.
8. If no response transport to higher center.

Summary of management of respiratory emergencies

- Airway (positioning, head tilt-chin lift, suctioning, oropharyngeal airway)
- Assist ventilation with bag-mask as needed
- Give high flow oxygen with nonrebreathing mask
- Monitor respiratory rate, efforts, saturation, heart rate, level of consciousness
- Vascular access (intravenous or intraosseous)
- Frequent reassessments

Upper airway obstruction

Specific management for selected conditions

Croup	Anaphylaxis	Aspiration foreign body
• Nebulized epinephrine	• IM/SC epinephrine • Nebulized salbutamol	• Allow position of comfort

• Corticosteroids (decaxmethasone or nebulized budesonide)	• Antihistamines • H_2 blocker • Corticosteroids	• Heimlich maneuver • Refer to specialist
Lower airway obstruction		
Specific management for selected conditions		
Bronchiolitis • Clear airways by suctioning • Humidified oxygen • Monitor SpO_2, apnea		**Asthma** • Oxygen • Nebulized salbutamol • Corticosteroids (oral/IV) • Magnesium sulphate • IV aminophylline • Fluids

PEDIATRIC AIRWAY MANAGEMENT

Stabilization of Airway

A. *Initial assessment*: Use "Pediatric Assessment Triangle" to assess the airway and categorize whether airway is clear, maintainable or nonmaintainable.

B. *If initial assessment indicates spontaneous breathing mild respiratory distress with no airway compromize*:
   a. Monitor respiratory rate, respiratory efforts, work of breathing and oxygen saturation.
   b. Administer humidified oxygen.
      1. Infants via infant mask @ 2-4 L/min
      2. Small child (1-8 years) via pediatric mask @ 6 L/M (humidified)
      3. If mask is not tolerated, use nasal cannula.

C. *Initial assessment indicates spontaneous breathing with marked respiratory distress:*
   a. Maintain airway with manual maneuver—head tilt and chin lift (Fig. 14.5).
   b. Suction as needed using bulb syringe or suction catheter (Figs 14.6 and 14.7).

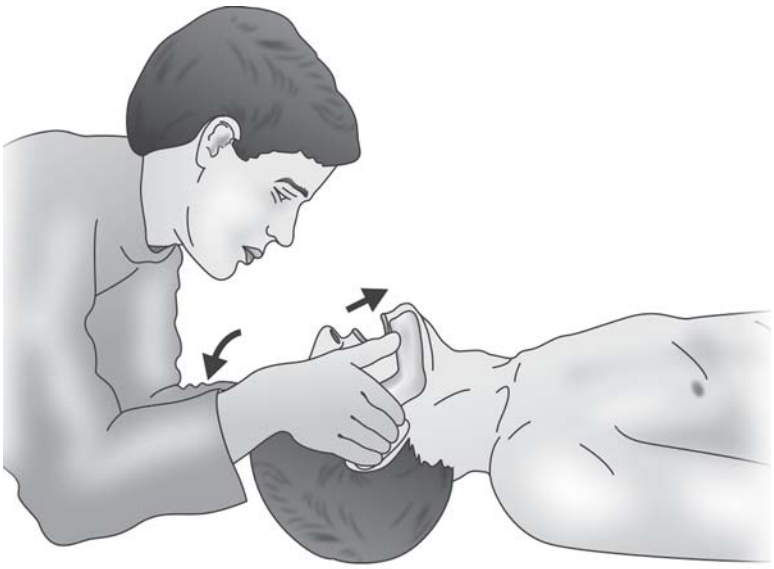


Fig. 14.5: Opening the airway

Fig. 14.6: Depth of insertion of suctioning catheter

Fig. 14.7: Suctioning the mouth with bulb syringe

c. Use oral airway in unconscious child and nasal airway for semiconscious child (Figs 14.8 to 14.12). Technique of insertion has been discussed in Chapter 8.
   i. Select appropriate size oral airway or nasal airway
   ii. Insert oral airway directly or by rotation
   iii. Secure airway and assess
d. Administer oxygen with simple mask or nonrebreathing mask or assisted ventilation with bag-mask with reservoir.
e. Monitor oxygen saturation with pulse oximeter.

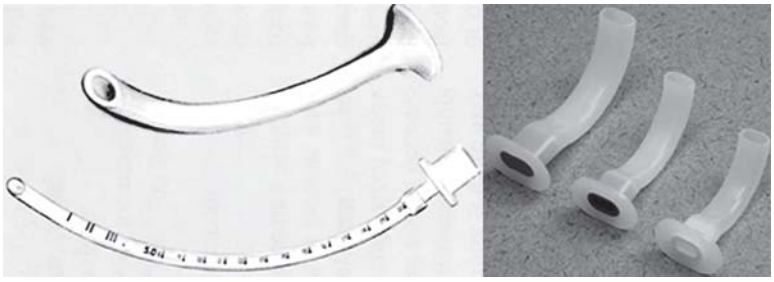


Fig. 14.8: Nasal and oral airways

Fig. 14.9: Selecting correct size of oral airway

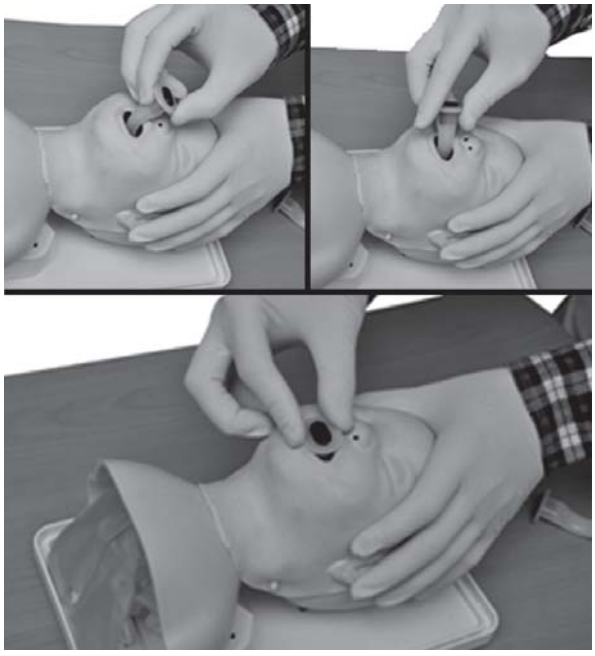


Fig. 14.10: Technique of insertion of oral airway

Fig. 14.11: Alternative method of OPA insertion

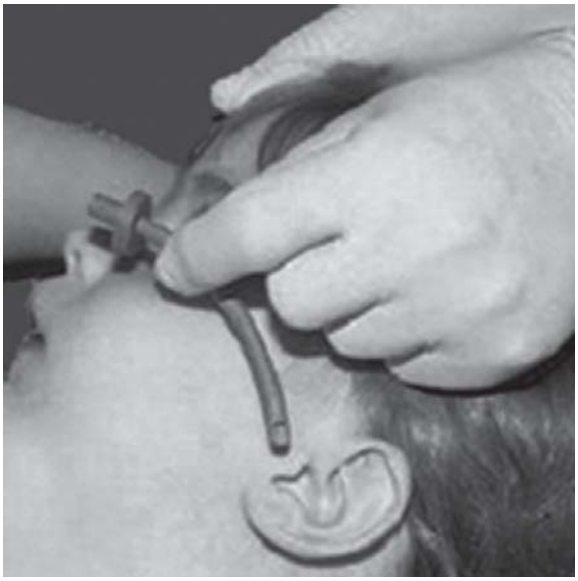


Fig. 14.12: Selection of appropriate size nasopharyngeal airway

D. *Initial assessment indicates absent breathing or severe respiratory distress:*
   a. Maintain airway with head tilt-chin lift maneuver.
   b. Clear the secretions with manual (Fig. 14.13) or mechanical suction machine
   c. Insert an OPA or NPA as above
   d. Ventilate with bag-mask using 100% oxygen
   e. Monitor oxygen saturation
   f. Establish IO or IV vascular access
   g. Consider need for LMA or endotracheal intubation.

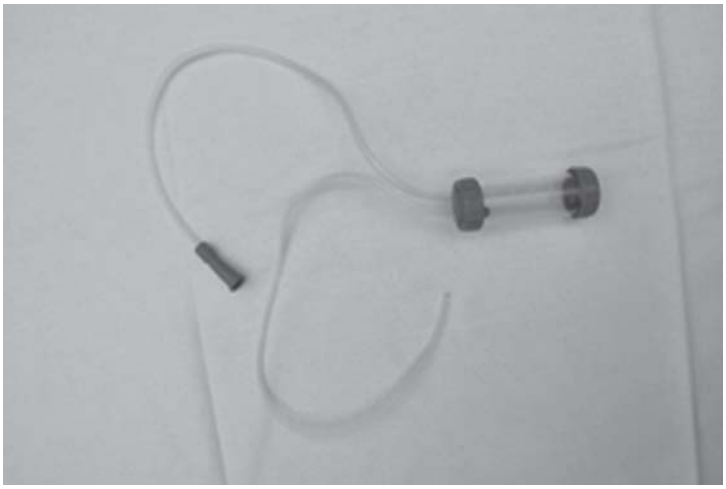


Fig. 14.13: Manual suction device

E. *Airway management with bag-mask ventilation*: Bag-mask ventilation is the preferred technique for providing rescue breathing for pediatric patient with inadequate respiratory effort or cardiorespiratory arrest. Patients who are in respiratory distress and failure may respond to bag-mask ventilation and may not even require prehospital endotracheal intubation.

Indications

a. Inadequate respiratory rate
b. Inadequate respiratory effort

c. Absent or diminished breath sounds
d. Paradoxical breathing (chest and abdomen moving in opposite directions)
e. Persistent cyanosis on 100% oxygen by nonrebreathing mask
f. Symptomatic bradycardia.

Procedure

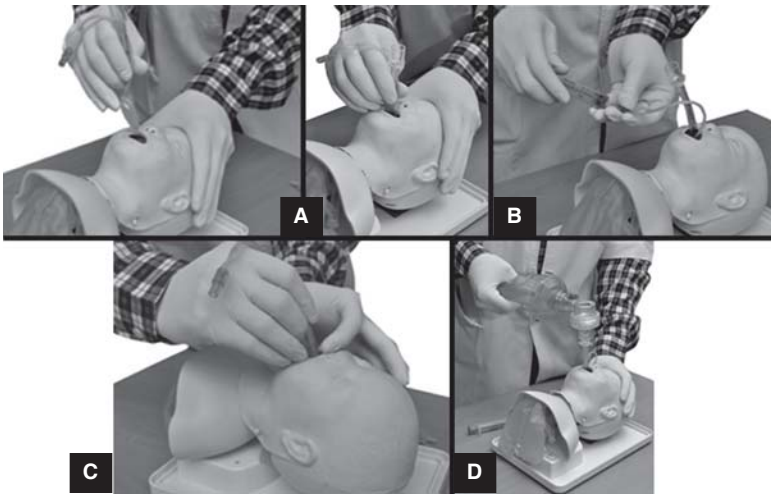
a. Suction the airway.
b. Remove visible foreign body by finger sweep.
c. Use an appropriate size oral or nasal airway adjunct with BVM ventilation.
d. Use an appropriate sized mask for best fit and to avoid pressure over the eyes (Fig. 14.14).
e. For the single provider, use the "E-C clamp" technique of holding the mask (Fig. 14.15).
f. Monitor ECG and oxygen saturation.
g. Ventilate with 100% oxygen with enough volume. Look for effective chest rise.
h. If the patient does not have an adequate chest rise with bag-mask ventilation
   - Ensure that airway is open and clear
   - Use two hands jaw lift technique (Fig. 14.16)

Fig. 14.14: Appropriate fitted mask

Child Adult

Fig 14.15: E-C clamp technique

Fig. 14.16: Two hands jaw lift method



Figs 14.17A to D: Insertion of LMA: (A) Inserting LMA, (B) Inflating LMA, (C) Alternative method of insertion, (D) Attached with bag

- Use an OPA or NPA
- Increase the volume of ventilation if the airway is clearly open and maintained
- Evaluate for gastric distension and the need for decompression with an orogastric tube
- Consider the need for LMA insertion or endotracheal intubation if bag-mask ventilation is unsuccessful.

Alternative method: Secure airway is use of LMA (Figs 14.17A to D), endotracheal intubation, and surgical airways (see Chapter 8).

CHAPTER 15

Thermal Injuries

Large number of patients suffer from thermal injuries in India. Thermal injuries are common in females, children, and persons working in oil and gas depot and fire crackers industries.

a. *Assessment of degree of burn*:

a. First degree burn: Superficial, erythematous and painful
b. Second degree burn (partial thickness): Red, swollen, blister formation, weeping and painful
c. Third degree burn (full thickness): Painless, dry, white, and leathery

b. *Calculation of percentage of burn (Fig. 15.1)*: Size of burn is essential to calculate fluid requirement, treatment, and prognosis.

1. Rule of 9 for adults: Head and neck 9%, each arm 9%, anterior and posterior trunk 18% each, each lower limb 9%, 18%, perineum 1%
2. Rule of 1% : Palm of patient is approximately 1% total body surface area (this formula is commonly used in children)

General Management

1. Assess the scene and call for help.
2. Alarm the fire team and stop the burn process.
3. Evacuate the victim from the site.
4. Ensure self and bystander's safety.
5. Remove clothes of the patient.
6. Use blanket or coat between rescuer and victim to avoid injury.

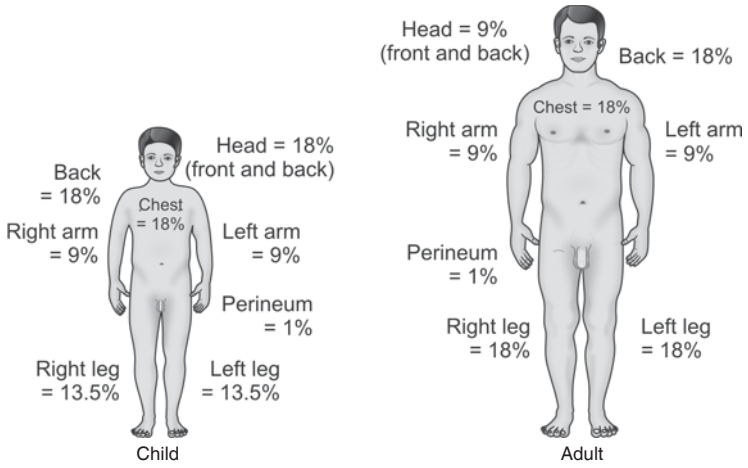


Fig. 15.1: Estimation of % age burn

7. Cool the burn wound with tepid water for 10-20 min. Wash the wound with saline in case of chemical burn. Do not use alcohol based solutions.
8. Do not apply ice.
9. Apply dry dressings.
10. Cover with sterile sheets to prevent hypothermia.
11. Assess the patient using ABCDE's approach. Open the airway using jaw thrust maneuver and keep cervical spine immobilized. Use oropharyngeal or nasopharyngeal airways to keep airway patent.
12. In case of inhalational injuries early intubation is preferred.
13. Start high flow oxygen with nonrebreathing mask.
14. Control pain using analgesics (morphine or fentanyl).
15. Maintain semi-upright position.
16. Exclude other traumatic injuries during assessment.
17. Give tetanus toxoid prophylaxis.
18. Assess the degree and depth of burn using Lund-Browder chart (Table 15.1).
19. Start fluid therapy after obtaining intravascular or intraosseous access.
20. Insert nasogastric or orogastric tube, if burn is > 20% (risk of gastric dilatation and aspiration).

21. Insert Foley's catheter to measure urine output (target > 0.5-1 ml/kg/hr).
22. Continue to monitor vital signs (airway compromise and shock are major concerns).
23. Perform secondary survey after initial resuscitation and stabilization.

Points to Remember

- Burns of face, airway, perineum and genitalia are serious type.
- Rule out other coexisting injuries.
- Burns are serious in small children and neonates.

Table 15.1: Age-wise assessment of percentage of burn

Area	*Neonate*	*1 year*	*5 years*	*10 years*	*Adult*
Head	19	17	13	11	7
Neck	2	2	2	2	2
Anterior trunk	13	13	13	13	13
Posterior trunk	13	13	13	13	13
Buttocks	2.5	2.5	2.5	2.5	2.5
Genitalia	1	1	1	1	1
Upper arm	2.5	2.5	2.5	2.5	2.5
Lower arm	3	3	3	3	3
Hand	2.5	2.5	2.5	2.5	2.5
Thigh	5.5	6.5	8	8.5	9.5
Leg	5	5	5.5	6	7
Foot	3.5	3.5	3.5	3.5	3.5

Chemical Burns

1. Remove the patient from accident site and his/her clothing.
2. Wash the exposed area with water for 20 minutes.
3. Do not apply any chemicals.
4. Wash eyes with water.
5. Arrange transfer.

Electrical Burns

1. Switch off electrical current.
2. Ensure self and bystanders safety.
3. Remove from the accident site.
4. Rest of management is as discussed above.
5. Monitor for arrhythmia (abnormal heart rate) and color of urine.

Indications for Transfer and Admission

1. Second degree burn involving >10% of body surface area.
2. Second or third degree burn involving face, genitalia, perineum and major joints.
3. Third degree burn > 5%.
4. Electrical and lightening burn.
5. Inhalational injury (inhalation injury causes direct thermal injury to airways, chemical injury to mucosa and lung parenchyma and carbon monoxide intoxication).
6. Chemical burns.
7. Associated trauma or child abuse.

Fluid Therapy

The most widely used is "Parkland formula" for calculating fluid requirement. These are just guidelines fluid therapy may be titrated according to clinical response and electrolytes level. Obtain two large bore intravenous/intraosseous accesses.

Adult

- 4 ml Ringer's lactate solution x Body weight in kg x % TBSA of burn (second degree burn >15% and third degree burn >10%)
- Half of the fluid is given in first 8 hours and rest in next 16 hours

Children

- 4 ml Ringer's lactate solution x Body weight in kg x % TBSA of burn + Maintenance fluid
- Half of the fluid is given in first 8 hours and rest in next 16 hours

Transport Considerations

1. Monitor heart rate, capillary refill time, blood pressure, respiratory rate, SpO_2, temperature, and urine output.
2. Continue to assess for airway compromise and features of shock.
3. Early intubation in inhalational or facial burns.
4. Maintain temperature in the cabin, lower temperature can aggravate hypothermia.
5. Take the history: Time of injury, open or closed space injury, source of burn, and any toxic material present.
6. Transfer initially to trauma center and later to burn center.

CHAPTER 16

Hypothermia

Hypothermia is a serious but preventable cause of morbidity and mortality. Hypothermia is defined as when core temperature is < 95°F or < 35°C. Hypothermia is common in extreme of age, diabetes mellitus, hypothyroidism, malnutrition, trauma, chronic alcohol use, stroke, cold water immersion, and exposure to cold weather.

PATIENT IS NOT DEAD TILL HE/SHE IS WARM

Degree of Hypothermia

1. Mild hypothermia is defined as when core temperature is between 90-95°F (32-35°C)
2. Moderate hypothermia is defined when core temperature is between 82-90°F (28-32°C)
3. Severe hypothermia is present when core temperature is below 82°F or < 28°C

Clinical Features (Primarily Depend on Degree of Hypothermia)

a. History of exposure to cold or cold water immersion.
b. Cold extremities.
c. Core body temperature as defined above.
d. Nausea, dizziness, chills, and increased muscle tone.
e. Tachycardia and arrhythmias.
f. Tachypnea or increased work of breathing.
g. Confusion and slurred speech.
h. Patient will moderate hypothermia will have decreased reflexes, abnormal pulse, dilated pupils, and loss of shivering.
i. In severe hypothermia patient may be pulseless, unresponsive, areflexic, and even may have respiratory arrest, fixed pupil, and cardiac arrest.
j. Assess for other associated traumatic injuries.

Initial Management of Patient with Hypothermia (No Respiration and Pulse)

1. Remove patient from cold source or environment.
2. Remove all wet clothes and protect from heat loss by covering with blankets or dry clothes or plastic or newspaper.
3. Avoid exposure to wind chill.
4. Maintain horizontal position to prevent shock.
5. Protect the airway (assess airway using jaw thrust).
6. Suspect cervical spine injury in all unconscious patients.
7. Handle gently: Manipulations will precipitate arrhythmias.
8. Monitor core temperature (rectal temperature).
9. Assess responsiveness, breathing, and circulation (pulse).
10. If patient is breathing and having pulse start passive rewarming (raise body temperature 0.5-1°C/hr).
11. In mild to moderate hypothermia start passive (cover with blankets) and active (heating pads, use of radiant heat by warmer, warm air, and use of warm saline) rewarming. *Do not warm periphery (increases risk of vasodilatation and heat loss).*
12. In hypothermic patients pulse and respiration are usually slow. It is always recommended that you should assess breathing followed by pulse for 30-45 sec to confirm cardiac arrest.
13. *If the patient is not eating give two effective rescue breaths further if no pulse is detected immediately start CPR.*
14. Attach monitor or defibrillator (AED) and analyze rhythm. Dry the chest before paddles application.
15. Give one shock 120-200 J (biphasic) or 360 J (monophasic) in adults and 2 J/kg (AED-25-50 J) in children. Give one cycle of shock if temperature is below 30°C and arrange transport. Repeat cycle of shock once temperature rises above 30°C. Defer drugs till core temperature is 86°F.
16. Resume CPR for five cycles, rewarming, and reassess for pulse and rhythm.
17. Use more force during CPR.
18. Secure airway using OPA or LMA and give high flow warm (108°F) humidified oxygen.

19. Establish IV/Intraosseous access and infuse warm ***dextrose normal saline*** only (102°F or 39°C). Give one bolus of DNS (500-1000 ml). Due to cold diuresis risk of dehydration is high.
20. Check for blood glucose (risk of hypoglycemia is more).
21. Continue resuscitation till the core temperature is 90-95°F or 32-35°C.
22. Repeat defibrillation as per need (medications and defibrillation will not work till temperature is above 30°C).
23. Stop resuscitation if body is frozen and chest compression is not possible, or incompatible life threatening injuries.

Patient is Breathing and having Pulse

1. Continue passive rewarming.
2. Active external rewarming.
3. Give glucose containing fluids.
4. Avoid use of alcohol and caffeine.

Transport Considerations

1. Keep the patient covered with blankets.
2. Attach monitor, if pulseless VT/VF present, use defibrillator.
3. Temperature blow 28°C, medication and defibrillation may not work.
4. Check for blood sugar frequently.
5. Increased diuresis can lead to dehydration. Continue to give warm fluids.
6. Maintain cabin temperature and switch off AC and fans.
7. Give warm and humidified oxygen.
8. Inform to the receiving hospital.

CHAPTER 17

Submersion Injury

Submersion injuries are common in all ages but children and adolescents are more prone because of poorly developed cognitive skills and increased mobility. Submersion is common in rural areas.

Clinical Features

1. Patient may be asymptomatic.
2. Symptomatic: Agitated, air hunger, fast respiration and heart rate, coughing.
3. Cardiopulmonary arrest.

Management

a. Assess scene safety.
b. Evacuate victim from water and remove all wet cloth.
c. Do primary survey using ABCDE's approach.
d. Suspect head and spinal injury if history of fall from height or depth of water is less, although there are less chance of injuries in water.
e. Patient is unresponsive, no respiration, and no pulse, immediately start with cardiopulmonary resuscitation.
f. Patient is unresponsive but breathing;
   i. Remove all wet clothes
   ii. Open and maintain the airway and
   iii. Give high flow oxygen using nonrebreathing mask.
g. Immobilize head and cervical spine inline as discussed in Chapter 8.
h. Start maintenance warm intravenous fluid (normal saline or Ringer's lactate).

i. Attach monitor and look for abnormal rhythms, oxygen saturation, and temperature.
j. Keep body warm (cover with blankets).

Points to Remember

1. All patients with submersion injury should be hospitalized irrespective of clinical and physiological status.
2. Continue CPR in arrest state till body temperature is above 30°C.

Transport Considerations

1. Continue to monitor and reassess
2. Prevent hypothermia
3. If features of shock appear, start bolus warm of normal saline or Ringer's lactate
4. Inform the receiving hospital
5. Record all events.

CHAPTER 18

Poisoning

Poisonings either accidental or suicidal or homicidal are of common occurrence in India. Large number of patients dies due to lack of basic care. Common poisonings seen in Indian scenario are celphos poisoning, insecticides poisoning, snake bites, etc. Various nonpoisonous substances considered as poisonous are given below (Table 18.1).

Table 18.1: Nonspecific household nonpoisonous agents

• Hair dye, cream, emulsions, eyebrow pencils, lipstick, adhesive
• Toothpaste, shampoo, shavingcream, toilet soaps, candle, chalk, clay, ball point, pen ink, match sticks, blackboard chalk, talc, sweetener, vitamins, castor oil, contraceptives, dry cell battery
• Dry indoor paints, antacids, mercury of thermometer, modelling clay
• House lizard in food

Diagnosis of Poisoning

- History of ingestion and/or exposure to poisonous material.
- Clinical symptoms and toxidromes suggestive of poisoning (Tables 18.2 and 18.3).
- Sudden onset of altered sensorium or shock or respiratory distress.

Management Guidelines

a. Removal of victim from site of exposure in case of gas leak, insecticide spray, etc.
b. In case of contact poisoning, remove clothes and wash the skin with tap water for 15 minutes. Prevent hypothermia.
c. Start initial assessment using ABCDE's approach.

d. Secure airway using simple methods (head tilt-chin lift, and OPA/NPA) or advanced maneuver (LMA or endotracheal intubation).
e. Give high flow oxygen using nonrebreathing mask.
f. Obtain intravenous or intraosseous access as early as possible.

Table 18.2: Diagnosis of specific poisoning

Symptoms	***Substances***
Meiosis (pinpoint pupil)	Cholinesterase inhibitors, barbiturates, opium, morphine, parasympathomimetics
Mydriasis (dilated pupil)	Coccaine, dhatura, cyanide, carbon monoxide (CO), sympathomimetics
Blindness	Methyl alcohol
Purple yellow vision	Digitalis
Blurred vision	Cholinesterase inhibitors, dhatura, ergots
Alopecia	Arsenic, thallium, lead
Facial twitching	Lead, phenothiazines, mercury
Pallor	Insulin, sympathomimetics, pilocarpine
Cyanosis (bluish discoloration of mucosa and body)	CO, cyanide, morphine, methemoglobinemia
Yellow skin	Arsenic, heavy metals, mushrooms
Sweating	Physostigmine, cholinesterase inhibitors, pilocarpine, nicotine
Dry hot skin	Dhatura, botulinum
Odor of breath	Chloral hydrate, acetone, cyanide, arsenic, organophosphorus (OP), kerosene
Hypertension	Amphetamines, cocaine, antihistaminics, TAD, nicotine, antipsychotic agents
Hypotension	Benzodiazepines, barbiturates
Altered mentation	Benzodiazepines, barbiturates, antihistamines, OP, CO, narcotics, atropine
Seizures	Antidepressants, antihistaminic, cholinergics, sympathomimetics, CO,
Bradycardia	Antipsychotics, barbiturates, benzodiazepines, OP, cobra envenomenation

Table 18.3: Identification of toxidromes

Toxidromes	*Eye*	*Skin*	*CVS*	*Pulmonary*	*CNS*	*Other*
Anticholinergic	Dilated	Flushed, dry skin	Tachycardia	Increased	Agitated	Urinary retension, fever
Cholinergic	Pinpoint		Bradycardia	Increased, wheeze	Coma	Salivation
Hemoglobinopathy		Cyanosis	Tachycardia	Dyspnea	Disoriented	GIT
Opioids	Pinpoint	Tracks	Hypotension	Decreased	Coma	Hypothermia
Salicylates		Diaphoretic		Increased	Tinitis, agitation	Fever
Phenothiazine			Cardiac arrhythmia, hypotension	Decreased	EPS, coma	
Sedative	Dilated		Arrhythmias, hypotension	Decreased	Coma, convulsion	
Sympathomimetics	Dilated	Diaphoretic	Tachycardia	Increased	Agitated, hyperreflexia	Fever
Tricyclic anti-depressants (TAD)	Dilated		Arrhythmias, wide QRS	Decreased	Seizure, myoclonus, coma	Emesis

g. Start maintenance intravenous fluid either normal saline or Ringer's lactate.
h. Check blood glucose with glucometer in all unconscious patients (if blood sugar is < 60 mg/dl give 50 ml of 50% dextrose IV in adults and 2 ml/kg of 25% dextrose in children).
i. Continue to provide symptomatic and supportive treatment:
   - Management of hypotension and shock (give bolus of 1-2 L Ringer's lactate or normal saline in adults and 20 ml/kg in children).
   - Manage respiratory problems: If RR is < 10 or > 30/min in adults and < 10-or > 50/min in children or no respiration, start assisted ventilation using bag-mask.
   - Treat convulsions: Give 0.1 mg/kg midazolam intravenously or rectally or intranasal in children and injection diazepam 5 mg IV in adults.
   - Remove unabsorbed poison: Perform gastric lavage (3 ml/kg tap water or normal saline) within 60 minutes of ingestion of toxic substance. Give activated charcoal 1-2 g/kg through Ryle's tube within one hour of ingestion of poison.
   - ***Gastric lavage is contraindicated in hydrocarbon ingestion and acid/alkali poisoning.***
   - Cover with blankets and during transport to prevent hypothermia.
   - Use specific antidotes (Table 18.4).

Transport Considerations

a. Continue to stabilize the patient and monitor vitals (heart rate, respiratory rate and efforts, oxygen saturation, systolic blood pressure, and consciousness level).
b. Prevent further injury in agitated patients, hypothermia and aspiration.
c. Do not tighten the straps of backboard/stretcher.
d. Treat seizures with midazolam or lorazepam or diazepam.
e. Inform receiving hospital.
f. Continue to counsel the family members.

Table 18.4: Specific antidotes

Antidote	*Indication*	*Dose*	*Side effects*
Atropine	Cholinesterase inhibitors	0.05 mg/kg, repeat every 10-15 minutes	Tachycardia, psychosis, cerebellar symptoms, blurred vision, hypothermia
NAC (N-acetyl cystine)	Paracetamol, chloroform, carbon tetrachloride	Loading 140 mg/kg orally followed by 70 mg/kg every 4 hours over a period of 3 days for 17 doses	Nausea, vomiting, hypokalemia
Bentropine	Drug induced movement disorders	1-2 mg/IM/IV	Anticholinergic symptoms
BAL	Arsenic, copper, gold, lead, inorganic mercury	12-24 mg/kg/d in six divided doses	Muscular pain, urticaria, rash, convulsions, coma
Desferroxamine	Iron	15 mg/kg/hr infusion	Retinal damage, cataract, deafness
Fumazenil	Benzodiazepines	0.2 mg/kg IV	Vomiting, anxiety
Glucagon	B blockers	0.25-1.0 mg	GIT upset
Physostigmine	Dhatura, antimuscarinic drugs	0.5-2.0 mg IM every 30 min	Muscarinic effects
Oxygen	CO poisoning		Absorption atelectesis, BPD
Naloxone	Opioids	0.01 mg/kg/dose	
Pralidoxime	Cholinesterase inhibitors	25-50 mg/kg	Flushing

SNAKE BITE

Snake bites are commonly seen in rural areas. Twenty percent bites are by nonpoisonous snakes. Many times death occurs to due psychosocial shock. Reassurance is very important in snake bite.

Clinical Features (Common to all types)

a. Local pain
b. Edema
c. Swelling
d. Numbness
e. Bleeding
f. Blisters
g. Necrosis
h. Shock
i. Fast respiration
j. Systemic bleeding

a. *Sea snakes*: Dysphagia, ophthalmoplegia, acute renal failure, no local pain.
b. *Cobra*: Pain is usually less, weakness, lethargy, altered sensorium, cranial nerves palsy, blurred vision, diplopia, dysartharia, and muscle flaccidity.
c. *Vipers*: Nausea, vomiting, bleeding, shock.

Prehospital Measures

1. Remove from site.
2. Reassurance (patient and family).
3. Relieve anxiety: All bites are not dangerous.
4. Keep the part in functional position and below the level of heart.
5. Remove watch and rings from limbs.
6. Pressure immobilization with Crepe bandage 2-4 inches above the bite and 0.75-1.5 inch wide.
   a. It should not occlude blood flow
   b. It should not be around the joint

   c. One should be able to pass finger in between bandage and skin.
7. Do not incise the fang mark in the field.
8. No suction by mouth.
9. Do not apply ice.
10. Do not apply tourniquet.
11. Assess and stabilize ABC.
12. Obtain IV access and start maintenance fluid.
13. Monitor features of shock. Give fluid boluses.
14. Arrange transport. If snake is killed, carry it for identification in a bottle.
15. Do not open the crepe bandage during transport.
16. Continue to monitor vitals (heart rate, rhythm, respiration, ptosis, weakness, bleeding).
17. Do not give antivenin in the field.

CHAPTER 19

Obstetric Emergencies

As a prehospital life support service provider or transport service provider you may be asked to attend certain obstetrical emergencies. There are two lives (fetus and mother) involved in pregnant female. Gravid uterus possesses certain unique problems. Our first target is to save mother and if we can stabilize her, then we will be able to save the fetus. Most common emergencies which you will come across in day to day practice are mentioned below:

1. Patient in active labor
2. Excessive vaginal bleeding
3. Pre-eclampsia and Eclampsia (Pregnancy induced hypertension-PIH)
4. Trauma in pregnancy.

Points to Remember

1. During pregnancy uterus becomes intra-abdominal structure and is predisposed to injury.
2. The heart rate increases by 15-20 beats/min at term from non-pregnant level.
3. The blood pressure fall 10-15 mmHg in the second trimester but stabilizes in third trimester of pregnancy.
4. The gravid uterus may compress the inferior vena cava causing significant decrease in blood flow to heart and hypotension. So pregnant woman should be allowed to lie down in left lateral position 20 degree above the base (use pillow or blanket).
5. Due to increase in blood volume during third trimester of pregnancy, pregnant female can tolerate greater loss of blood (30-35%) before significant fall in systolic blood pressure.

6. Significant blood loss during third trimester of pregnancy may not produce hypotension in mother but can lead to significant hypotension in fetus.

Prehospital Assessment of Obstetrical Emergencies

1. Initial assessment: Rule out life threatening problems.
2. Obtain history of:
   a. Last menstrual period
   b. Expected date of delivery
   c. Abdominal pain
   d. Bleeding per vaginum or any other abnormal discharge
   e. Parity and gravidity
   f. Number of live births
   g. Previous cesarean section or any other pelvic or abdominal surgery
   h. Rupture of amniotic membrane
   i. Headache, blurring of vision, and epigastric pain
   j. Duration and frequency of labor contractions
   k. Complications if any in previous pregnancy
3. Monitor vitals
   a. Heart rate/pulse rate
   b. Blood pressure
   c. Respiration
4. Physical assessment
   a. Vaginal examination is not permitted by the prehospital life support provider.
   b. Abdominal examination may help in assessing fetal presentation.
   c. Inspect the external perineum for presentation of fetus, bleeding, discharge, and cord prolapse.

Management

Aim of prehospital care is to stabilize the mother till she is transported to definitive care.

1. Assess ABC's of mother.
2. Start high flow oxygen.
3. Obtain vascular access.

4. Start maintenance intravenous fluid. Treat shock with bolus of 250 ml normal saline. Vital signs may be poor indicator of hemodynamic status. Maintain systolic blood pressure > 90 mmHg.
5. Arrange for transport.
6. Continue to monitor during transport (heart rate, capillary refill time, blood pressure, oxygen saturation).
7. If delivery is inevitable than prepare for delivery.
8. Conditions like breech presentation, prolapsed cord and patient with history of previous cesarean section should not be tried at periphery.

Normal Delivery

These are general guidelines to attend the normal delivery process.

1. If delivery is inevitable, do not hold mother's leg together and do not allow mother to go to the toilet.
2. Keep delivery kit ready.
3. Keep patient in supine position with thigh spreaded, knees flexed and feet flat preferably at the edge of table/bed.
4. Open the delivery kit.
5. Wear gloves, gown, mask and protection for eyes.
6. Clean and drape perineum.
7. Ask mother to take deep breaths during pain.
8. Keep your gloved hand in the vagina over fetus head to prevent explosive delivery.
9. Allow fetal head to rotate and deliver with perineal support.
10. Guide head to upward for delivery of shoulder.
11. Support rest of body.
12. Place the baby on mother's abdomen, resuscitate if necessary. Baby will start breathing within 30-60 seconds.
13. Give injection oxytocin (syntocinon) 05 units intra-muscularly.
14. Apply one clamp ten inch away the baby's umbilicus and second clamp three inch below it and cut the umbilical cord between clamps.

15. Wrap the baby in dry clothes and stimulate to cry.
16. Placenta will be delivered in 20 to 30 minutes (try controlled cord traction, if needed).
17. Place dressing pad on vagina and put baby on mother's breast.
18. In case of prolapsed cord push the baby off the prolapsed cord with two gloved fingers into vagina. Elevate mother hips. Maintain this position to prevent cord compression till mother is transported to the hospital.

Vaginal Bleeding

The important causes of bleeding which require emergency management are:

1. Abortion
2. Ectopic pregnancy
3. Antepartum hemorrhage (abruptio placentae and placenta previa)
4. Postpartum hemorrhage (PPH)
5. Perineal or vaginal trauma.

Management

1. Assess responsiveness and do primary survey using ABCDE's approach.
2. Provide oxygen using non-rebreathing mask.
3. Look for evidence of shock, i.e. increased heart rate, fall in blood pressure, pale and cold skin, decreased core temperature.
4. Obtain two intravenous lines.
5. Give bolus of 250 ml normal saline.
6. Arrange transport to hospital.
7. Continue to monitor vitals and act accordingly.
8. In case of postpartum hemorrhage give injection methergin or oxytocin 05 units IM.

Pre-eclampsia/Eclampsia

Pregnancy induced hypertension.

Signs and Symptoms

1. Headache
2. Right upper quadrant pain
3. Shortness of breath
4. Swelling of hands and face
5. Vision disturbances
6. Nausea/vomiting
7. Decreased urine output
8. Increased heart rate
9. Raised blood pressure > 140/90 mmHg.

Concerns in Eclampsia

1. Convulsions
2. Coma
3. Increase chance of fetal death
4. Increased rate of neonatal death.

Prehospital Management

1. Secure airway, give oxygen, and access IV/IO line.
2. Attach monitor.
3. Place the patient on left lateral position.
4. Control convulsions: Give injection magnesium sulphate (20%) 4-6 gm dissolved in 200 ml of normal saline over 10-15 min intravenously or same dose can be given intramuscularly (5 gm on each buttock).
5. May use intravenous diazepam 5 mg or 0.1 mg/kg (risk of neonatal respiratory depression) for convulsions.
6. Arrange transport.
7. Monitor vitals during transport and control seizures with diazepam (5 mg IV).

Trauma in Pregnancy

Pregnancy is unique situation where two lives are at risk. Hypoxia and hypotension are two major concerns for fetus during trauma.

1. Approach using ABCDE approach and identify of life threatening problems.

2. Maintain airway, breathing, and circulation.
3. Keep the cervical spine in neutral position.
4. Start high flow oxygen with non-rebreathing mask.
5. Start intravenous fluids.
6. Keep the patient in left lateral position or pad on right side of backboard (hypotension is the major risk).
7. If this is not possible, displace uterus on left side manually.
8. Fetal assessment is not required in the field.
9. Arrange transport at an earliest to a center where surgical and obstetrical services are available.

Transport Considerations

1. Monitor vitals (heart rate, respiration, oxygen saturation, temperature).
2. Early detection of hypotension and management by giving fluids.
3. Increased risk of vomiting thus frequent suctioning may be required.
4. Inform the receiving hospital for early obstetrical consultation.

CHAPTER 20

Accident Scene Management

The most difficult task is to handle the accident scene and extrication of trauma victims from road side accidents. There is no such course in place for health care providers. These are broad guidelines regarding accident scene management and evacuation of trauma victims. Modification may be done as per need but the principle of extrication will remain the same.

PRINCIPLES OF ACCIDENT SCENE MANAGEMENT

1. Remain calm, do not create panic.
2. If risky or hazardous material is present, inform all.
3. Ensure scene safety.
4. Ensure self and bystanders safety.
5. No smoking near accident site (risk of fire due to spillage of oil).
6. Call for more help.
7. Ask someone to control traffic.
8. Prepare safety zone near accident site.
9. Preferably persons trained in basic life support skills/ advanced life support skills or specially trained in PHLS care should attend the scene.
10. Wear personal protective equipment (PPE).
11. Carry necessary equipment in advance.
12. Remove victim(s) from accident site keeping head and cervical spine inline immobilization (use cervical collar and half backboard).
13. Assess responsiveness: Responsive or unresponsive.
14. Decide who will be benefitted more from intervention, e.g. unresponsive victim with no respiration and pulse may not be benefitted.

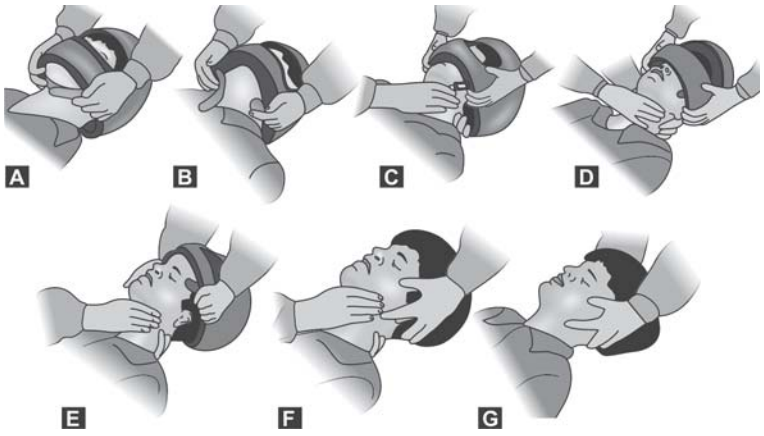
15. Next assess victim's Airway, Breathing, Circulation, and Neurological Status, prioritize and decide need for resuscitation/interventions.
16. Patients with decreased sensorium and compromised airway, consider "load-and-go" approach.
17. Clear the airway from foreign body and secretions.
18. Provide cervical spine immobilization (rigid cervical collar).
19. If breathing is absent, give two effective rescue breaths (look for chest rise).
20. Absent pulse in adults and children or < 60/min with poor perfusion in children: Initiate chest compression and ventilation (chest compression: Ventilation ratio 30:2).
21. Control external bleeding (areas of extensive bleed) by manual compression.
22. Classify severity of injury.
23. Relieve tension pneumothorax by needle decompression, flail chest by occlusive dressing, and visible foreign body obstructing the airway by finger sweep.
24. Call for more help (if required), ambulance, and arrange transfer.
25. Continue resuscitation, stabilization, and monitoring during transport.
26. If trained in advanced life support skills perform endotracheal intubation keeping cervical spine immobilization.

HELMET REMOVAL

Injury to motorcycle riders are very common. There are various types of helmet available in the market depending on the need (motorcycle, games, etc.). The main principle of removal will remain the same for all types of helmets.

Procedure for Helmet Removal

1. At least two persons must be present.
2. First remove facial glass of helmet. One person will maintain inline immobilization of cervical spine by placing hands on helmet and finger resting on mandible while second person will cut/remove the straps (Figs 20.1A and B).



Figs 20.1A to G: Procedure of helmet removal in trauma victim

3. The second person places one hand on the angle of mandible (thumb on one side and middle and index fingers on the other side). With other hand apply pressure from the occipital region (Figs 20.1C and D).
4. The first person should clear the ears and nose and second person maintains the inline cervical spine immobilization (Fig. 20.1E).
5. Now the first person will maintain the inline cervical spine immobilization by keeping hands on either side of head and palm resting on ear as shown in Figures 20.1F and G till straight backboard/cervical collar are available.

Evacuation of Trapped Victim in Road Traffic Accidents

As a health care provider you should know how to extricate the victims from wrecked vehicles. Poor handling of road side accident increases victim morbidity and mortality. In many countries, the primary responsibility of police personnel are to take care of accidents, while fire personnel's are supposed to extricate the victim. At times police team is also not available and even may not be trained in handling the scene. Most of ambulances are neither well-equipped nor managed by skilled staff.

Management

1. Ensure safety first: Put the accident sign, create more space, inform the police and fire personnel, handle risk of oil spillage, electric hazards, environmental hazards and remove or cover the sharp objects to prevent further injury.
2. Stabilize vehicle: Roof and side of vehicles are usually unstable.
3. Gain access to vehicle depending on the impact of injury and damage to vehicle.
4. First remove/displace, or unbolt the door.
5. Remove the door which will not endanger the victim and provider.
6. Break the window glasses for access if needed.
7. Do not break front windshield/glass first (they are difficult to break).
8. Used gloved hand to remove glasses.
9. To have more space break rear window.
10. Quickly do primary survey and stabilize the head and neck inline.
11. Use cervical collar and backboard (partial or full) to stabilize the head and cervical spine.
12. Displace the seat to have more space.
13. Break the front glass in case of urgency with hammer.
14. Remove the steer wheel.
15. Displace dash and roof.
16. Remove the victim.
17. Prioritize your action after initial assessment (responsiveness, airway, breathing, and circulation).
18. Remove visible foreign body from mouth by finger sweep method and the secure airway.
19. No respiration and pulse, initiate CPR.
20. Start oxygen with nonrebreathing mask or assisted ventilation with self inflating resuscitation bag.
21. Control external bleeding by manual compression to prevent further loss and organ injury.
22. Obtain intravenous or intraosseous access and start intravenous fluid (normal saline or ringer lactate).
23. Arrange transport, inform receiving hospital, continue to monitor vitals, stabilize, and reassess during transport.
24. Maintain records of events.

CHAPTER 21

Infection Prevention

Infections are major killer and every efforts should be made to prevent these deaths. There are certain defined protocols for control of infections and should be followed in every set up. Emergency health care providers or prehospital life support service providers can play a big role in preventing infections.

GENERAL MEASURES OF INFECTION PREVENTION

1. Hand washing: Frequent hand washing is the single most important method to prevent infection. Use gloved hands before handling patients or equipments. Wash hands before and after touching the patient, entering and leaving the ambulance or emergency department, before doing any procedure, after smoking and using toilets.
2. Change gloves and wash hands in between patients.
3. Always use gloves before handling secretions.
4. Procedures to be performed with aseptic technique and use personal protection equipment (PPE) while doing procedures.
5. Thorough skin preparation and use of sterile drapers are essential.
6. Use disposable syringes, needles, and airway devices.
7. Do not reuse disposable items.
8. Store all sterile items in clean and dry area.
9. Linen to be kept in clean and dry area to prevent contamination. Wear gloves for handling linens.
10. Soiled linens to be kept in disposable bags.
11. Prepare medicine in clean area with no touch technique.
12. Wear clean uniform.
13. Proper waste disposal as per hospital policy.
14. Clean soiled surface with disinfectant.

Hand Wash

1. Use either alcohol gel or soap.
2. Remove rings and wrist watch prior to hand wash.
3. Wet hands under running water.
4. Apply 3-5 ml of soap or detergent, and thoroughly distribute it all over hands. Rub to create good lather.
5. Vigorously wash all surfaces of hands including webs, fingers, and nails and back of hands for at least 10-15 seconds. Rinse to remove soap and thorough dry hands.
6. Use paper towel to turn faucet off.

PERSONAL PROTECTION EQUIPMENT (PPE)

1. Wash hands.
2. Put long sleeve gown with opening at back. Tie neck and waist ties.
3. Apply face mask.
4. Apply protective eye wears (goggles or face shield).
5. Wear gloves, pull gloves over cuff of gown.
6. Removal steps include; first remove gloves, wash hands, untie neck and waist ties, take out gown not touching outer area, again wash hands, remove eye protection and mask, discard in basin, and perform hand wash.

Environmental

1. Daily cleaning of all surfaces of ambulance with a damp cloth with hospital approved cleaner.
2. Keep disinfectants closed when not in use.
3. Clean backboard/stretcher and equipment after patient transport.
4. Clean all area at least once a week.

Equipment

1. Use disposable LMA, ET tubes, and catheters.
2. Ambu bags after rinsing in plain water should be submerged in 2% gluteraldehyde and cleaned in sterile water.
3. Masks: Wash and sock in alcohol for 10 min.

4. Suction bottles:
   a. Clean when full or every 24 hours.
   b. Contents to be emptied in toilets.
   c. Must be rinsed and autoclaved.
   d. If autoclave facility not available use disinfectant.
   e. Do not leave fluid in bottles standing.
   f. Wash all connections properly.

Standard Precautions for All

1. Use pocket mask during CPR.
2. Wash hands using alcohol based gel before examining and after exposure to infective material.
3. Use gloves when in contact with body fluids.
4. Wash hands after removing gloves.
5. Clean infective material promptly using detergent or soap.
6. Appropriate bio-waste handling.
7. Use universal personal protection devices (mask, gloves, gowns, and eye protection).
8. Hepatitis B immunization for health workers is essential.
9. If exposed to blood /body fluids immediately wash the area thoroughly.

Transport Considerations

1. Turn exhaust to circulate air.
2. Minimum persons to travel in ambulance.
3. All persons traveling in ambulance wear personal protective equipment.
4. Inform receiving hospital.

WASTE DISPOSAL IN AMBULANCE

Safe disposal of biomedical waste is essential. Biomedical waste should not be mixed with other type waste. The biomedical waste is collected in different types of bags/container which are color coded and labeled (Table 21.1). This waste should be disposed within 48 hours.

Table 21.1: Color coding of bags for disposal of biomedical waste

Color coding	*Type of container*	*Items*	*Treatment options*
Black	Plastic bag	Discarded drugs, food, waste paper, packing covers, uninfected items	Disposal in municipal landfill
Yellow	Plastic bag	Human tissues/ organs, vaccines, cultures, cottons, linens, material contaminated with blood and body fluids	Incineration/deep burial
Blue	Plastic bag/ puncture proof container	Used and unused sharp materials (needles, glass syringes)	Autoclaving/ chemical treatment and destruction/ shredding
Red	Disinfected container/plastic bag	Catheters, ryles tube, urinary catheter, IV set, IV bottle, suction catheter, syringe, gloves	Autoclaving/ chemical treatment

CHAPTER 22

Procedures

DEFIBRILLATION

Many types of defibrillator available in the market. In the ambulance most commonly used are manual and automated external defibrillator.

1. Types of defibrillator
   a. Automated External Defibrillator (AED)
   b. Manual defibrillator (monophasic or biphasic)
   c. Combination of a and b
2. Indications for defibrillation
   a. Ventricular fibrillation (VF)
   b. Pulseless ventricular tachycardia (VT)
   c. Polymorphic ventricular tachycardia
3. Equipment for shock therapy
   a. Defibrillator preferably pulse oximetry
   b. Paddle gel
   c. Cables and electrodes
   d. Medication for sedation
   e. IV catheter
   f. Aseptic solution
   g. Adhesive to secure the catheter
   h. Supplemental oxygen
   i. Resuscitation kit including LMA and intubation equipment
4. Procedure
   Indications: Shockable rhythm (displayed on AED/manual defibrillator)
   a. Confirm that patient has no signs of circulation.
   b. Select appropriate paddles: Pediatric paddles 1-8 years and adult paddles above 8 years of age (Fig. 22.1).

Fig. 22.1: Application of paddles

c. Switch on machine.
d. Attach ECG electrodes: This is not required with AED.
e. Before applying paddles ensure that chest is dry and without excessive hair. Do not apply alcohol and anti-perspiration agents below the paddles.
f. Do not place paddles on nipple or pacemakers.
g. Apply conductive gel on chest.
h. Place one paddle just left to patient's left nipple in mid-clavicular line and another just below the right clavicle.
i. Select the button analyse in AED type machine or on AED mode in case of manual defibrillator. ECG analyze requires 6-9 seconds.
j. You will hear the sound analyse and clear.
k. If rhythm is shockable, message will heard; shock advised.
l. Set energy level in manual defibrillator: Select energy level 2 Joules/kg for first shock and 4 Joules/kg for subsequent shock in children and 120-200 J in adults (biphasic type). In AED, select pediatric or adult.

m. Ensure good contact of paddles with chest (apply approximately 25lb pressure on both the paddles and do not touch the patient with your body).
n. Ensure safety to all. No one should touch the patient when shock is being delivered. All clear including oxygen.
o. Clear the patient from oxygen and ventilator.
p. No body should touch the patient.
q. Press the discharge button.
r. After shock, reassess pulse and start 5 cycles of CPR.
s. Reanalyze rhythm and allow AED to recharge.
t. Follow-up to three times.

PERIPHERAL VENOUS ACCESS

Venous access is indicate in all sick patients for giving fluid and medications.

Equipment

1. Venous catheters (18-24 G)
2. Antiseptic swabs
3. Venous tourniquet
4. Gloves
5. Adhesive tape
6. Syringes 2-10 ml
7. Normal saline.

Procedure

1. Select site (Fig. 22.2): Always prefer limbs (upper limb) with distal sites (dorsum of hands, cubital fossa, legs, external jugular vein).
2. Apply venous tourniquet on limb distal to insertion site.
3. Clean the area with antiseptic solution.
4. Stabilize the skin distal to insertion site.
5. Insert the needle keeping bevel end up at 30 degree, parallel or above the vein.
6. Once the blood is seen, advance the catheter and remove the needle.
7. Fix catheter, push saline and attach to IV set.

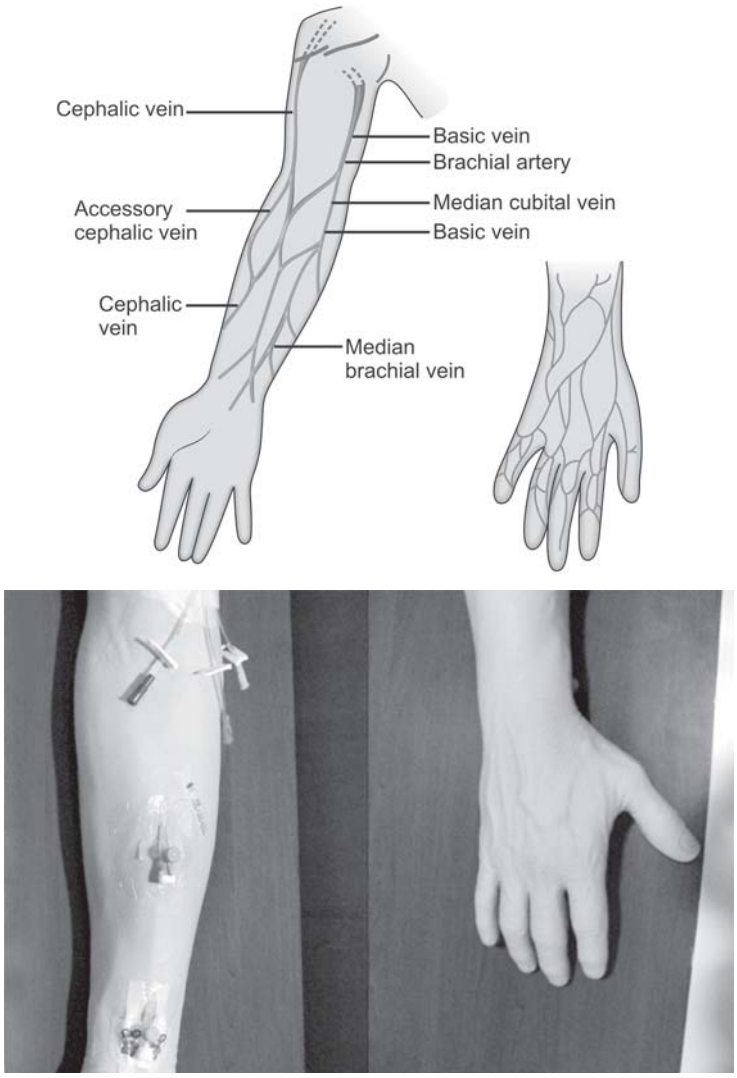


Fig. 22.2: Venous system for IV placement

INTRAOSSEOUS NEEDLE INSERTION

Vascular access is important during cardiopulmonary resuscitation and during other emergency conditions.

Intraosseous is preferred method of vascular access during emergency situations, specifically patient is small child or in shock. Several types of IO needles are available for use in children and adults. Theoretically, the specially designed IO needles are the best choice. In case of non-availability bone marrow aspiration needle or 16 gauge needle can be used. All kind of medicines and fluid including blood can be given through IO access.

Indication

Emergency vascular access.

Various Sites for Intraosseous Needle Insertion

1. Anteromedial aspect of tibia one finger below and medial to tuberosity (easy to access and no vital structure nearby)
2. Medial aspect above medial malleolus
3. Femur: Lateral epicondyle
4. Anterior iliac spine
5. Distal radius and ulna
6. Sternum

Note: Upper tibia below 3 years and lower part of tibia above 3 years including adults.

Equipment

- IO/bone marrow needle (Fig. 22.3)/15-18 G spinal needle
- Sterile gauze, gloves, antiseptic solution

Fig. 22.3: Intraosseous needle

- Xylocaine injection (may not be used in emergency situation)
- 3 ml, 5 ml, 50 ml disposable syringes, T-connectors
- IV infusion set
- IV fluids
- Adhesive tape
- Infusion pump (not compulsory in emergency)
- Pulse oxymeter or cardiac monitor
- Supplemental oxygen

Procedure

- Use aseptic precautions (wear gloves, gown, mask, and eye protection)
- Identify the site of cannulation
- Prepare aseptic field
- Identify tibial tuberosity (Fig. 22.4)/medial malleolus by palpation.
- The site of IO cannulation on tibia is approximately 2 cm (1 finger width), below the tuberosity and medial on antero-medial aspect of tibia.
- Check the needle for patency before insertion.
- Support the leg on a firm surface.
- Infiltrate xylocaine in fully conscious patient. No infilteration required in unconscious patients.

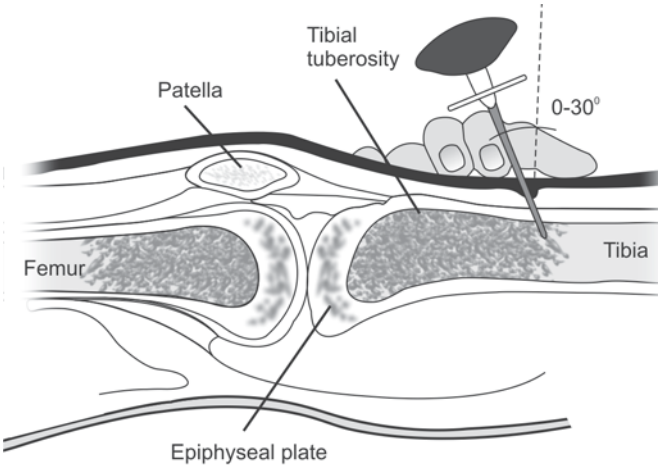


Fig. 22.4: Insertion of intraosseous needle

- Do not allow any portion of the hand to rest behind the insertion site.
- Locate the landmark as explained earlier and hold the needle hub rests under palm and use thumb and index finger to hold the needle 1-2 cm above the tip.
- Insert the needle.
- Using gentle but firm twisting (screwing) motion advance the needle through the bony cortex.
- Do not just push it into the marrow.
- Direct the needle perpendicularly or slightly towards facing the toe.
- When placing an IO needle in any other location, aim slightly away from the nearest joint space to reduce the risk of injury to the epiphysis or joint.
- Stop advancing the needle when you feel a sudden decrease in resistance to forward motion, this indicates entry into marrow cavity.
- Remove the stylette from the needle, attempt to aspirate the marrow with the syringe:
  - If aspiration is successful, flush with saline
  - If aspiration is unsuccessful, attempt flushing with saline to dislodge the marrow or the cortex blocking the cannula, if still unsuccessful, you may need to advance the needle further.
- Signs that confirm the needle is in the marrow cavity are:
  - A sudden decrease in resistance
  - Needle remains upright without support
  - Marrow can be aspirated through the needle
  - Fluid infuses freely without subcutaneous infiltration.
- Once needle is in marrow cavity, secure the needle with tape.
- Administration of emergency drugs should always be followed by a saline flush of 3-5 ml.
- Always administer fluids through IO route using a 50 ml syringe or infusion pump.
- If there is infiltration of the subcutaneous tissue, remove the needle and attempt the procedure on another bone.
- If the needle becomes obstructed with bone marrow, the needle can be replaced with second one through the same cannulation site provided there is no evidence of infiltration.

Complications

1. Injury to growth plate
2. Fracture
3. Skin necrosis
4. Compartment syndrome
5. Pain
6. Chemical burn in preterm neonates

Contraindications

- Fracture above or at the site of insertion
- Local infection at insertion site

NASOGASTRIC TUBE INSERTION

Indications

1. Poisoning
2. Full stomach
3. Polytrauma

Selection of Size

1. Newborn	8 F
2. One year	12 F
3. Teenage	18 F
4. Adolescent and	28-36 F adults

Equipment

1. Feeding tubes
2. Sterile gloves
3. Xylocaine jelly
4. Tape

Procedure

1. Measure the length from tragus to tip of nose to mid of umbilicus and xiphisternum (Fig. 22.5).
2. No sedation for NG tube placement.
3. Stiffen the tip with ice (if required).

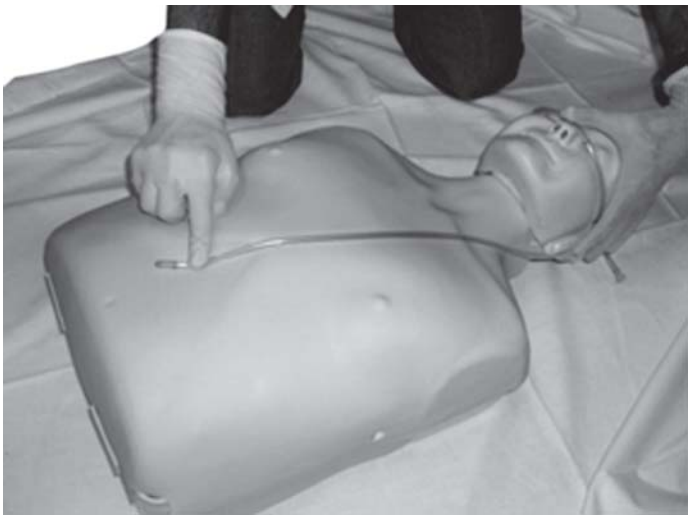


Fig. 22.5: Selection of size

4. Hold tube 5-8 cm beyond the tip and pass the tube through nose and advance posteriorly along the floor of nose and downwards. Keep the neck slightly flexed (Fig. 22.6).

Fig. 22.6: Nasogastric tube insertion

5. Check for placement with syringe by injecting air into stomach and listening with stethoscope and also by aspirating gastric contents.
6. Secure the tube.

GASTRIC LAVAGE

Gastric lavage is indicated in patients with poisoning and drug overdose. It is contraindicated in patients with hydrocarbon and acid/alkali poisoning. Gastric lavage should be done within 30-60 min of ingestion of toxic substance.

Equipment

1. Orogastric tube of 24-50 French (oral route is preferred)
2. Lubricant jelly
3. Suction device
4. Guedel's airway
5. Normal saline or tap water
6. Syringe 20-50 ml
7. Container to collect drainage
8. Personal protective equipment for health care provider
9. Pulse oxymeter
10. Resuscitation equipment

Procedure

1. Inform the patient or relatives.
2. Take appropriate size tube.
3. Measure length from nose to tragus to epigastrium.
4. Keep the suction machine ready.
5. Attach pulse oxymeter.
6. Obtain adequate airway protection.
7. Keep patient in left lateral position with foot end raised about 20 cm.
8. Insert the lubricated tube into the stomach and check for placement by aspirating the gut fluid. Slight flexion of neck may facilitate tube insertion.
9. Remove the tube if patient develops respiratory distress.
10. Save the fluid for toxicological purpose.

11. Introduce aliquot of 200 ml fluid (normal saline or tap water) in adult and 10 ml/kg in children through tube with 50 ml syringe kept 2 ft higher than patient (by gravity method). Repeat the procedure till gastric fluid is clear.

URINARY BLADDER CATHETERIZATION

Indications

1. Unconscious patient
2. Shock
3. Acute renal failure

Equipment

1. Rubber gloves
2. Cotton balls /sponges
3. Antiseptic solution or soap
4. Collection bottle/urine drainage bag
5. Sterile drapes
6. Lubricant (water soluble)/Xylocaine jelly
7. Urethral Foley's catheters/ feeding tubes age appropriate (each French unit is the equivalent of 1/3 mm; that is, 9 F indicates a diameter of 3 mm).

Procedure

1. Penis is scrubbed with antiseptic soaked sponge. Foreskin should be retracted and glans cleansed thoroughly. Swabbing should begin around the urethral meatus and then directed proximally towards base of penis.
2. Preparation for catheterization of female includes separation of labial folds, swabbing urethral meatus and perineum.
3. Do not use alcohol.
4. Follow universal aseptic precautions.

5. In males, gentle traction is applied to the penis perpendicular to lower abdomen in caudal direction to straighten the course of penile urethra. Lubricated catheter tip (Xylocaine jelly may also be used) is held about 2-5 cm from its terminal end and gently inserted into the urethra. The catheter is slowly advanced until some resistance is felt at the external sphincter. By gentle continuous force this resistance is overcome and the catheter tip will enter the bladder.
6. In females labia is held widely apart with non-dominating hand, urethral orifice clearly identified and lubricated catheter tip is gently introduced into the opening. The female urethra is somewhat C-shaped. Hence, catheter should be started in slightly downward direction. And after a few centimeters, urinary bladder is reached.
7. Catheters with guide wire can be used to introduce smaller size catheters to make the procedure easy. The guidewire should be removed once the catheter enters the posterior urethra and the catheter alone should be introduced into the bladder.
8. In small children feeding tubes may also be used.
9. Condom drainage may be tried in conscious or non-seriously ill patients.

Points to Remember

1. Always check the catheter bulb before insertion.
2. Attached catheter to sterile closed drainage system.
3. Do not irrigate catheter unless obstruction is suspected.
4. Do not clamp the catheter.
5. Never invert the drainage bag or elevate it to bladder level.
6. Clean the area daily.

Complications

1. Infection, especially with indwelling catheters.
2. Trauma to urethra or bladder.

DEVICE SELECTION

Approximate size of different devices used in children and adults

Age	*Weight (kg)*	*NG Tube*	*Foley's Catheter (Fr)*	*Chest tube (Fr)*
Preterm	1-2 kg	5	5 feeding	8-10
Newborn	3.5 kg	8	5 feeding	10-14
6 months	7	8	5 feeding	12-16
1 year	10	10	8 Foley's	14-20
3 years	15	10	10 Foley's	18-22
6 years	20	12	10 Foley's	20-28
8 years	25	12	10 Foley's	28-32
10 years	30	14	12 Foley's	28-32
12 years	40	14	12 Foley's	28-32
15 years	50	16	14 Foley's	32
18 years and Adult	65	16	16 Foley's	32

CHAPTER 23

Communication Skills in Acute Care

Communication skills are essential component of any health care management. Communication may be verbal, nonverbal or in writing. Process of communication in human life begins at birth. One may be efficient in managing the patients but may be lacking in good communication skills. Communication may be involved between doctor-patient, doctor-family, and between health professionals and administrators. Good communication helps in developing rapport with patient, family, making better diagnosis, effective treatment plan, decrease chance of clinical errors, satisfaction of patient, family and health providers, and avoid medicolegal problems. In acute care settings during prehospital care you may have to communicate with different category of persons (family members of patients, police or fire personnel, bystanders, transport team members, and receiving hospital team) for various reasons (explaining the procedure, nature of illness, breaking bad news, making request for organ donation, consent for transport to hospital, and postmortem). In emergency situations emotions are at peak and a small mistake (verbal or nonverbal) can create big problem. Poor communication during situations of stress can have adverse consequences. It is also difficult and challenging to convey bad news. Patient or family may express emotions in the form of anxiety, anger, fear, guilt, fight, blank face, and disbelief. Health personnel are also having fear to break the bad news for various reasons. These skills can be learnt like other subjects.

COMMUNICATION TECHNIQUE

Essential components of good communication skills are:

1. *Establish initial rapport:* Prepare and plan for counseling

- Introduce yourself and define your role and responsibility.
- Know your patient/what patient/family knows about the disease/explore what patient or family want to know.
- Confirm about the facts before you speak.
- Do not create panic among staff and family members.
- Remain calm and control your emotions during stress situations.
- Identifying patient's problems and prioritize your action.
- Select appropriate place and maintain privacy.
- Sit close to patient or family in order to attend the emotional outburst.
- Involve other family members as desired by patient.
- Stay with family during crisis.
- Make appropriate eye contact and do not be in hurry.
- Avoid confrontation.
- Switch off your mobile phone.

2. *Gathering information:*
   - Assessment of immediate problems.
   - Gathering relevant information using open ended questions and also from the record. Avoid close ended questions.
   - Explore biomedical perspective of disease.
   - Understanding patient/family perspective.
   - Encourage them to speak and explore their concern.
   - Observe nonverbal clues and analyze.
   - Providing structure to the management.
3. *Building relationship*: Build relationship with patient, family, other team members, administrators and receiving hospital steam.
   - Use appropriate nonverbal behavior.
   - Explain procedures/intervention to patient or family.
   - Do not discourage.
   - Use language carefully.
   - Appropriate communication with receiving hospital.
4. *Explanation and planning:*
   - Provide relevant, basic and correct information honestly.
   - Do not disclose all information at once. Break news one by one and give chance to reconcile. Avoid negative prognostication acutely.

- Keep voice tone, body language, and touch appropriately.
- You may repeat information many times.
- Give information in small chunks and observe feeling.
- Identify plan of management.
- Do not react prematurely to patient problems or concerns.
- Do not show apathy, demonstrate empathy.
- Give hope tempered with realism.
- Plan shared decision.
- Explain each move from time to time before implementing if possible.
- More serious is illness and not improving, more we mast talk to family or caregivers.
- Give options in planning.
- Do not show anger, frustration, rudeness or diffidence.
- Be "patient" and “tolerant” to parental or family outbursts.
- Offer an option of second opinion.
- Do not hide appropriate anxiety and emotions of yours.

5. *Closing the session*:
   - Clarify all concerns and encourage them to ask and feel free about doubts any time.
   - Summarize.
   - Do not rush the owner decision.

These are guidelines and modification can be made accordingly.

CHAPTER 24

Transport Guidelines

Efficient transport of seriously ill or trauma victims will have better outcome. Patients may be required to be shifted in emergency from home and accident scene to the health care facility. Acutely ill or injured patients are at more risk of morbidity and mortality during transport. Published data suggests 6-71.1% patients will have adverse events if transfer is not done properly. Few of these patients also require transportation after initial stabilization for further management or for other reasons.

TRANSPORT

a. Primary transport (prehospital transport): Transfer from location (home or accident site) to hospital
b. Secondary transport: Transfer within the hospital (intrahospital transport) or into another hospital (interhospital transport)
c. Long distance transport
d. Air transport
e. From tertiary care hospital to primary care center or home

Problems Encountered During Transport

These problems can be related to:

a. Equipments.
b. Transfer facility: Physicians is not clear and transfer done without stabilization (scoop and run) and selection of wrong facility.
c. Transport team: Team composition/competency not appropriate.
d. Wrong decision of transfer.

e. Inadequate communication before or during transfer: The receiving hospital has not been given full details of patient condition and requirement.
f. Environmental conditions/transport vehicle.

Targets of Safe Transport

a. To reach patient in need as quickly as possible with trained personnel to higher center.
b. Stabilization of patient's condition before transport to prevent further deterioration.
c. To move the patient to a facility capable of providing more extensive care or additional services that will enhance patient outcome.
d. To offer the level of care equal to the receiving institution recognizing the limits inherent in traveling.
e. Do no further harm during transport.

Conditions Requiring Transport

Following conditions (medical or surgical) will require prehospital services and transport services in day to day practice.

Adult

1. Polytrauma
2. Respiratory distress and failure
3. Acute exacerbation chronic obstructive pulmonary disease and asthma
4. Tension pneumothorax
5. Acute coronary syndrome/chest pain
6. Arrhythmias
7. Acute heart failure
8. Altered sensorium
9. Acute stroke
10. *Status epilepticus*
11. Severe sepsis
12. Acute liver failure
13. Acute renal failure
14. Poisoning and drug over dosage

15. Snake bites
16. Submersion injury
17. Acute neurological insult
18. Pregnancy and related complications
19. Antepartum and postpartum hemorrhage
20. Massive vaginal bleeding
21. Blood vessel injuries
22. Severe facial trauma
23. Eye injury
24. Postresuscitation care
25. Investigations
26. Expert consultation.

Newborn

1. Severe birth asphyxia (newborn did not cry at birth)
2. Birth weight less than 1800 gm
3. Convulsions in neonates
4. Acute respiratory distress
5. Hypothermia
6. Metabolic disturbances
7. Bleeding neonate
8. Severe jaundice
9. Severe sepsis
10. Acute abdomen
11. Traumatic injury.

Children

1. Depressed or decreasing sensorium
2. *Status epilepticus*
3. Respiratory distress or failure
4. Airway obstruction
5. Pyrexia
6. Shock
7. Massive hemorrhage requiring blood transfusion
8. Head and spinal cord injury
9. Significant blunt injury to thorax or abdomen
10. Fracture of two or more large bones
11. Cardiac rhythm disturbances

12. Poisonings
13. Second or third degree burn
14. Electrical injury
15. Serious infections
16. Postresuscitation care
17. Diagnostic workup
18. Conditions requiring invasive monitoring and PICU care
19. Expert consultation.

What can go Wrong if Transfer is not Proper?

If the transport of critically ill or injured is not proper due to any reason it can lead to increased morbidity and mortality. Pediatric patients are 22 times more prone to adverse events as compare to adults and 2.4 times prone to death. Various problems encountered in different categories are given below.

Adult

1. Hypoxia (specially in air transport and in ventilated patients)
2. Convulsions
3. Hypercarbia (increased carbon dioxide in blood)
4. Hypotension/hypertension
5. Arrhythmias
6. Myocardial infarction
7. Pulmonary embolism
8. Raised intracranial pressure—deterioration in consciousness level
9. Migration of catheters
10. Cardiac arrest and death if patient not stabilized before transfer
11. Long-term pulmonary dysfunction.

Newborn

1. Hypothermia (large body surface area)
2. Hypoxia and hypercarbia
3. Hypoglycemia (decreased glucose store and increased demand)

4. Convulsions
5. Intracranial bleed
6. Cardiac arrhythmias
7. Death.

Children

A. Physiological derangements
   1. Hypoxia,
   2. Hypotension
   3. Arrhythmia
   4. Cardiac arrest.
B. Neurological
   1. Raised intracranial pressure
   2. Convulsions
   3. Cervical spine injury
C. Metabolic
   1. Metabolic disturbances
   2. Hypoglycemia.

Problems Related to Equipments (Common to all)

1. Ambulance breakdown
2. Equipment failure
3. Battery failure
4. Monitoring device failure
5. Endotracheal tube displacement
6. Gas expansion during air transport.

Miscellaneous

1. Stress related (change in vital signs)
2. Acceleration (increased blood flow in legs leading to momentarily fall in consciousness level) and deceleration (increase in intracranial and ocular pressure)
3. Environment related (hypothermia or heat stroke)
4. Motion related (loosening of screws of equipments)
5. Motion sickness.

Level of Care Required During Transport

1. *Level Zero*: No specific monitoring required. These patients can be transported without paramedics. Periodically monitoring of heart rate, ECG and blood pressure are required.
2. *Level I*: These patients are at risk of deterioration. They may need care of paramedics during transport. These patients need continuous monitoring of ECG, pulse oximetry and intermittent monitoring of blood pressure.
3. *Level II*: These patients require detailed observation and intervention including support for a single failing organ or postoperative care and those stepping down from higher level of care. Care by trained personnel is essential. Continuous monitoring of ECG, heart rate, blood pressure, temperature and urine output are required.
4. *Level III*: These patients require basic or advanced respiratory support with support of at least two organ systems. This level includes all complex patients requiring invasive as well as noninvasive monitoring including ventilatory management.

Transport Team's Responsibility

There are three components of transport.

1. *Stabilization phase*
   a. Obtaining consent and talk to parents/family.
   b. Check for functional status of machinery and equipments including ambulance. Also look for safety equipments for transport team.
   c. Quick assessment of patient clinical status.
   d. Stabilization of patient before transport.
   e. Anticipation of problems likely to be encountered during transport.
   f. Secure all lines and tubes.
   g. Collection of all records/data of patient.
   h. Before departure, call receiving hospital with updated patient information and bed availability.
   i. Good communication and coordination.

2. *Transport phase*
   a. Adopt best and safe route for travel.
   b. Ensure safe movement of patient in and out of vehicle.
   c. Frequent assessment and ongoing monitoring of major organ systems during transport.
   d. Recording all events.
   e. Prompt recognition and treatment of problems en route.
   f. Provision of detailed report to admitting personnel.
   g. Detailed documentation of events during transport.
   h. Adequate communication.
3. *Receiving team's responsibility*
   a. After obtaining history, assess appropriateness of transport and dispatch team.
   b. Document all information exchanged and timing of transport activation.
   c. Advise and assist the referring staff/doctor in initial stabilization of patient.
   d. Provide additional recommendations/help as needed until transport team arrives.
   e. Giving advice during transport.
   f. Maintain communication.

What is Essential before Transfer?

1. Evaluation of basic condition and indication for transport
2. Resuscitation (if needed)
3. Stabilization
4. Transport
   a. Obtain consent before transfer from parents/family.
   b. Define selection criteria and level of care required.
   c. Communicate at receiver end: Patient name, age, sex weight, condition or status of patient, type of facility required and need for transport, treatment offered before and during transport.
   d. Decide appropriate mode of transport: Commercial ambulance or public transport in consultation with referring and receiving physician. It also depends upon the disease condition of the patient, location, distance involved, weather condition and types of vehicle available.

e. Evaluate distance of transport.
f. Select appropriate transport team members.
g. Appropriate monitoring devices and check their functioning status.
h. Appropriate battery backup and oxygen supply.
i. Selection of appropriate therapy medications (extra drugs) and equipments required.
j. Understanding possible complications and management.
k. Continue treatment what is being offered.
l. Secure patient and all tubing's.
m. Patient's record, investigations.

Mode of Transport

Selection of mode of transport depends on clinical requirement, availability of vehicle, urgency, location, weather and nature of illness.

Transport Vehicle

Only vehicle designed for transport purpose should be used. It should be safe to both patient and staff, have adequate space for patient and performing procedures, adequate power supply and medical oxygen, adequate light and temperature control, stretcher, appropriate equipments, adequate space for patient and passengers, lower noise level, minimal vibration, good communication system, and alarms and sirens (see Chapter 25 for ambulance).

Concerns During Air Transport

Air transport can be either by fixed wing aircraft or helicopter.

a. Decrease in oxygen and pressure ($PAO_2 = PB - PH_2O \times FiO_2 - PaCO_2/R$) at high altitude (important in patient with lung diseases and cardiac failure) can lead to hypoxia. Patient needs higher concentration of oxygen during air transport.
b. As we go high, air pressure decreases and the volume of gas increases (risk of gas expansion in cavities).
c. Due to risk of gas expansion in various body spaces: Put orogastric tube in stomach, if you suspect air in any other cavity put the drainage tube.

d. Increase danger of worsening of pulmonary embolism.
e. Shift of body fluids from intravascular to extracellular space.
f. Temperature decreases with rise in height (1000 ft = ↓ 2°C). This will increase risk of hypothermia in neonates and children.
g. Noise (assessment of lung sounds are difficult and it also affects the vital signs).
h. Vibration (vibration transmission to equipments lead to error).
i. Acceleration and deceleration can also lead to change in pressures.
j. Dehydration: Due to decrease in humidity and there is increase chance of dehydration and thickening of secretions. Give extra fluid.
k. Effect on medical devices.
l. Risk of depressurization: Decrease in pressure can lead to decrease in partial pressure.
m. Danger of loose and mobile equipments: Keep the equipments tight.
n. Limited space and lightning facility.

INTRAHOSPITAL TRANSPORT

Intrahospital transport is required in many conditions. Intrahospital transport is not taken as seriously and adverse events are also not recorded. Patients from accident and casualty department are transported without supervision in the wards. In most of the hospital either the staff is not trained or not available. It is essential to monitor patients during intrahospital transport. Minimum monitoring in the form of pulse oximetry or multiparameter is required. Always keep the resuscitation tray ready during transport.

Conditions Requiring Intrahospital Transport

1. From accident and emergency department to concerned department
2. Surgical department to operation theater
3. Inter-department
4. ICU to wards and vice-versa.
5. For diagnostic workup: CT, MRI, EEG, ECHO, EMG.

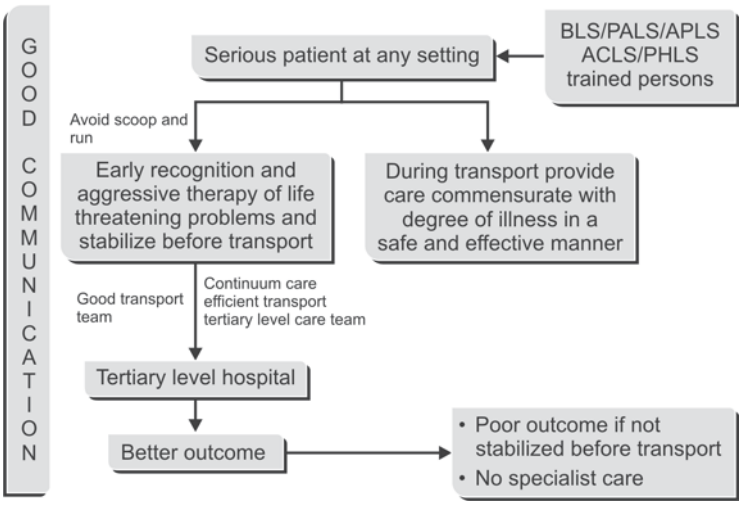


Fig. 24.1: Summary of transport

SUMMARY OF TRANSPORT (FIG. 24.1)

1. Outcome will be better if patient is handled by trained health provider.
2. Utilize platinum 10 minutes (quick response, extrication, assessment and stabilization and arranging transport) at accident site effectively.
3. Assess using ABCDE's approach, prioritize the emergency, and stabilize before transport (except in few situations).
4. Continue to monitor and provide necessary support.
5. Outcome is better if transport of trauma victim is done from accident site to tertiary care hospital within 60 min.

CHAPTER 25

Ambulance and Equipments

Ambulance is an integral part of prehospital life support services. For effective transport of seriously ill or injured, an efficient transport team (minimum trained in basic and advanced life support care) with well equipped ambulance is required. In present set up many of transport ambulances are neither well equipped nor manned by trained people. We have no guideline or law in this regard. Our aim is to provide guidelines for better transport of seriously ill patients.

Ambulance is a vehicle, which is designed for the use for transport of sick/injured or disabled patients. Specified guidelines are available for the design of ambulances. Ambulance should have certified equipments.

Types of Ambulance

1. *Advanced life support ambulance*: Ambulance is able to provide treatment of life-threatening medical emergencies including advanced airway management, cardiac monitoring, and electrical therapy.
2. *Basic life support ambulance*: Able to provide basic life support skills services.
3. *Patient transport ambulances*: These are used in non-emergency transport of patients.

Requirements for a Good Ambulance

1. Vehicle dedicated for patients transport only as per guidelines (interior patient compartment dimensions; length 2700 mm, width 1500 mm, height 1500 mm).
2. AC with heater (temperature control).
3. Adequate power back-up.

4. Ambulance cot (four wheeled, multilevel) with water proof mattress, patient restraining devices (minimum three), cot mounted dual IV stand.
5. Multipara monitor/vital sign/pulse oximeter with pediatric and adult probes and cuffs (Heart rate, ECG, respiratory rate, oxygen saturation and temperature) if not, one pulse oxymeter, sphygmomanometer with adult and pediatric BP cuffs, stethoscope, temperature monitor device with low temperature recording capability.
6. Automated external defibrillator (AED) or manual defibrillator.
7. Fire extinguisher.
8. Communication system (mobile phones).
9. Dress code for ambulance staff.
10. List of nearby hospitals including superspecialty hospitals, emergency contact numbers of various hospitals.
11. Emergency flash lights with extrabatteries.

BASIC (MINIMUM)

1. Portable oxygen apparatus with flowmeter (0-15 L/min), large tubing, sterile humidifier chamber and wrench (If available fixed oxygen supply equipment should be made available).
2. Oxygen delivery devices (simple facemask, non-rebreathing mask, venturi mask, nasal cannula with tube (pediatric and adult sizes), oxygen hood.
3. Manual resuscitator: Self inflating bag and mask {(neonatal, pediatric, and adult) (450 and 1000 ml)} with reservoir and clear facemask (neonatal, child, adult), flow inflating bag (pediatric and adult) with circuit.
4. Pocket resuscitation mask (pediatric and adult).
5. *Airways*: Oropharyngeal (Guedel's airway 000-6 size) and nasopharyngeal airways (16-34F).
6. Portable suction device with different sizes plastic wide bore catheters (6-16F).
7. Bulb syringe suction apparatus.
8. Nasogastric tubes of different diameter.

9. Intravenous delivery sets (micro and macro), intravenous catheters of different gauge (18/20/22/24 G), and scalp vein set (18/20/22/23/24).
10. Venous tourniquet (1).
11. Intraosseous needle (1).
12. Intravenous arm boards (4).
13. Intravenous fluids (Normal saline, ringer lactate, 25% dextrose, 50% dextrose, DNS) four bottles each.
14. Glucometer.
15. Nebulizer.
16. Cold packs.
17. Delivery kit (commercial kit) containing towels, dressing material, umbilical tape, sterile scissor or cutting blade, bulb suction, cord clamps, sterile gloves and gown and blankets. Head cover for neonates, aluminum foil or transparent plastic bag to cover the low birth weight baby, placenta container and heavy bandage.
18. Pediatric drug dosage chart.
19. Rigid cervical collars (infant, child and adult size).
20. Head immobilization device, if available.
21. Upper and lower extremity Splints (pediatric and adult) two each.
22. Backboards (half and full): head to pelvis and head to feet length with strips, folding stretcher. Three straps in half type and four straps in full board.
23. Lower extremity traction devices. Limb support slings, paddled pelvic support, traction strap, paddled ankle hitch.
24. Sterile burn sheets. Limb.
25. Dressing trays (two).
26. Adhesive tapes in different sizes, safety pins.
27. Crape bandage at least 10.
28. Gauze rolls in various sizes.
29. Arterial tourniquet (one).
30. Blankets (four) and sheets.
31. Towels (four) and occlusive dressings.
32. Disposable trash bags and basins.
33. Disposable bedpan and urinal.
34. Stair chair and carry chair.

35. Water soluble lubricating jelly.
36. Mask, gown, gloves, goggles, and shoe cover.
37. Waterless hand cleaner.
38. Disinfectant solution.
39. Syringes and needles (2-50 ml).
40. Personal protection devices (Gloves, Gown, Goggle, and Mask).
41. Adequate bandaging material.
42. Activated charcoal.
43. Drugs chart (adult).
44. Protection helmets.
45. IV stand hooks.
46. IV sets with flowmeter (micro and macro).
47. Urinary catheters with bags.

ADVANCED

1. Laryngoscope straight blade (Miller) and curved (Macintosh) (pediatric and adult) with extra bulbs and batteries.
2. Laryngeal mask airways (LMA) 1-5 sizes.
3. Endotracheal tubes (2-8 size), stylette.
4. $ETCO_2$ monitor.
5. Meconium aspirator.
6. Transport ventilator (volume cycled) and disposable ventilator.
7. Bains circuit and Modified JR circuit.
8. Transport incubator for neonates.
9. Warmer fixed in ambulance enter.
10. Infusion pumps (2).
11. Automated blood pressure measurement device.

Extrication Equipments

Ideally the ambulance should have adequate extrication equipments. Though it is duty of fire brigade personnel but no such system exist in our country. It should have following categories of equipment (one set each);

1. Disassembly tools
2. Pulling tools
3. Spreading tools

4. Cutting devices
5. Pulling devices
6. Protective devices
7. Miscellaneous items like flood lights, generator, wood/ wedges
8. Additional equipment as per need.

Drugs for Ambulance

SN	*Drug*	*Formulation*	*Adult*	*Pediatric*
1.	Adenosine	2 ml ampoule, Inj 3 mg/ml,	6 mg bolus in 1-2 min	0.01 mg/kg
2.	Adrenaline	1 ml ampoule, 1 mg/ml, 1:1000	1 mg bolus repeat after 3-5 min.	0.01 mg/kg repeat 3-5 min
3.	Amino-phyllin	10 ml ampoule, 25 mg/ml	5 mg/kg, over 20 min, followed by 0.5 mg/kg/min	same
4.	Amiodarone	3 ml ampoule, 50 mg/ml	300 mg over 1 hr	5 mg/kg
5.	Aspirin	75-150 mg dispersible tab	150 mg PO	NR (not recommended)
6.	Atropine	1 ml ampoule, 0.6 mg/ml	0.6 mg; repeat as indicated	0.02 mg/kg
7.	Calcium gluconate	10 ml ampoule, 10% solution	10 ml over 0.1 ml/kg 10 min	0.1 ml/kg
8.	Diazepam	2 ml ampoule, 5 mg/ml	5 mg IV	0.1-0.2 mg/kg
9.	Dobutamine	5 ml ampoule, 50 mg/ml	5-20 µ/kg/min	Same
10.	Dopamine	5 ml ampoule, Inj 40 mg/ml	2-20 µ/kg/min, titrate	Same
11.	Fentanyl	2/10 ml ampoule, 50 µ/ml	0.7-2 µ/kg	Same
12.	Furesomide	2 ml ampoule, 10 mg/ml	slow IV 5-40 mg	1 mg/kg

Contd...

Contd...

SN	*Drug*	*Formulation*	*Adult*	*Pediatric*
13.	Glycopyrrolate	1 ml ampoule, 0.2 mg/ml	0.1-0.2 mg	0.01 mg/kg
14.	Hydrocortisone	Powder for injection 100 mg	100-500 mg	0.2-4 mg/kg
15.	Labetolol	4 ml amp, 5 mg/ml	0.25 mg/kg, slow IV in 2 min	
16.	Lignocaine spray	10% solution		
17.	Lorazepam	2 ml amp, 2 mg/ml	20-50 µ/kg	0.1 mg/kg
18.	Mannitol	100 ml vial, 20% solution	0.25-1.0 g/kg	Same
19.	Methergine	1 ml ampoule, 0.2 mg/ml	0.2 mg IM for postpartum hemorrhage	NR
20.	Midazolam	5 ml vial 1 mg/ml, 1 ml ampoule (5 mg/ml)	1-2.5 mg	0.15 mg/kg IV 0.2 mg/kg Intranasal
21.	Morphine	2 ml ampoule, 15 mg/ml	0.05-0.2 mg/kg	Same
22.	Nifedipine	10-20 mg capsule	use sublingually in emergency	
23.	Nitro glycerine	0.3 mg	1 tab repeat after 5 min up to three times	
24.	Noradrenaline	2 ml ampoule 2 mg/ml	2-20 µg/min	
25.	Oxytocine	1 ml ampoule, 5 IU	20-120 IU, infusion	
26.	Paracetamol injection and suppositories	150 mg/ml	upto 20 mg/kg	15 mg/kg

Contd...

Contd...

SN Drug	*Formulation*	*Adult*	*Pediatric*
27. Propofol	10-50 ml vial, milky white solution, 10 mg/ml	1-2 mg/kg	Same
28. Salbutamol respiratory solution/ respule	5 mg/ml, 15 ml 2.5 ml, 2.5 mg	2.5-5 mg nebulization	Same
29. Sorbitrate	5 mg, tab	5 mg PO/Sublingual	
30. Succinyl-choline	10 ml vial, 50 mg/ml	1-1.5 mg/kg	1-2 mg/kg
31. Thiopental	0.5-1.0 gm, powder		
32. Vecuronium	powder 4 mg ampoule, 10 mg vial	Loading 0.1 mg/kg, maintenance 1/4 of loading dose	Same

Additional Drug

1. Oral glucose powder
2. Inj magnesium sulphate
3. Antidotes

POINTS TO REMEMBER

1. Always check functional status of equipment and vehicle regularly.
2. Ensure availability of drugs
3. Keep map of the area in ambulance.
4. Develop good communication skills.

Suggested Reading

1. Accident scene management. Available at http://www.scrcpotomac.com/main/docs/accidentmanagement.
2. Acute Medical Emergencies. The Practical Approach. BMJ Blackwell Publishing; London, 2001.
3. Advanced Cardiovascular Life Support (provider manual). Texas (US): American Heart Association; 2006.
4. Advanced Pediatric Life Support. The Practical Approach. 4th edn. BMJ Blackwell Publishing; Oxford (UK), 2005.
5. Airway Management (student guide). Texas (US): American Heart Association; 2007.
6. American College of Surgeons, Committee on Trauma; American College of Emergency Physicians; Pediatric Equipment Guidelines Committee-Emergency Medical Services for Children (EMSC) Partnership for Children Stakeholder Group; American Academy of Pediatrics. Equipment for ambulances. Available at: http://www.acep.org/workarea/downloadasset.aspx?id=8850.
7. American Heart Association. Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care. Circulation 2005;112:III-1-4.
8. Basic Assessment and Support in Intensive Care. Shaitan (HK). Department of Anesthesia and Critical Care. The Chinese University of Hong Kong; 2007
9. Bassin S, Smith TL, Bleck TP. Clinical review: Status epilepticus. Crit Care 2006;6(2):137-42.
10. Bernhard M, Gries A, Kremer P, Bottiger BW. Spinal cord. Prehospital management. Resuscitation 2005;66:127-39.
11. BLS for healthcare providers (student manual). Texas (US): American Heart Association; 2006.
12. Calland V. Extrication of the seriously injured road crash victim. Emerg Med J 2005;22:817-21.
13. Campbell JE. Basic Trauma Life Support 5th edn, Prentice Hall; Englewood Cliffs (NJ), 2004.
14. Chan JWY, Wastertain CG. Status epilepticus: Pathophysiology and management in adults. Lancet Neurol 2006;5:246-56.
15. Coats TJ, Davies G. Prehospital care for raod traffic casualities. BMJ 2002; 324:1135-38.
16. Crash scene handling. Available at http://www.oregon.gov/ODOT/HWY/GEOMTRONIC/docs

17. Gupta S. Guidelines of the transport of critically ill patients. JK Sci 2004; 6(2):109-12.
18. Hawken SJ. Good communication skills. Benefit for doctors and patients. NZFP 2005;32(3):185-90.
19. Helmet removal from injured patients. Spokane County Revised 8/05. Available at http://www.emsoffice.com/protocols/References/
20. Jindal SK, Aggarwal R. Oxygen therapy. 2nd edn. Jaypee Brothers Medical Publishers, New Delhi, 2008.
21. KennethNovarro LP. Prehospital management of obstetric complications. Texas EMS magazine 2009; Jan/Feb: 32-39.
22. Lewis. Emergency vehicle rescue device and method. 1972 (3667660). Available at http://www.wikipatents.com/US-Patent-3667660/emergency-vehicle-rescue-device-and-method.
23. Luis CJ, Caminos CB, Esain BF, Díez DR, Otano TB. Prehospital management of trauma patients. Drug and therapeutic Bulletin of Navarre Spain 2008;16(3):38-54.
24. Management of Pediatric Trauma. American Academy of Pediatrics. Pediatrics 2008;121(4):849-53.
25. Mark PE, Varon J. The management of status epilepticus. Chest 2004; 126:582-91.
26. Mclean B, Zimmerman J. Fundamental Critical Care Support. 4th edn. Society of Critical Care Medicine; Illinois (US), 2007.
27. Minimum standards for transport of critically ill patients. Joint faculty of intensive care medicine, Australian and New Zealand College of anesthetist and Australian college of emergency medicine. Review IC-10(2003). Available at www.anzca.edu.au/resources/professional-documents/professional-standards/pdfs/PS39.
28. Mitchell WG. Status epilepticus and acute serial seizures in children. J Chil Neurol 2002;17:536-43.
29. Mittal K. Identification, Assessment, Stabilization and Transport Manual for Acutely Illchildren. Jaypee Brothers Medical Publishers, New Delhi, India; 2010.
30. Pediatric Emergency, Assessment, Recognition and Stabilization (provider manual). Texas (US): American Heart Association; 2007.
31. Peitzman AB, Rhodes M, Schwab CW, Yealy DM, Fabian TC. The Trauma Manual: Trauma and Acute Care Surgery. 3rd edn; Philadelphia (US): Lippincott Williams & Wilkins; 2008.
32. PHTLS: Prehospital Trauma Life Support 6th edn. Elsevier; Missouri (US), 2007.
33. Shaikh AB, Strcey S. Essentials of Anaesthetic Equipments. Churchill Livingstone Elsevier; Toronto, 2007.
34. Silverman J, Kurtz S, Draper J. Skills for communicating with patients. 2nd edn: Radcliffe publishing; Oxon (UK) 2008.
35. Totapally BR, Lee H, Naqvi S, Mayer K, Raszynski A. Status epilepticus in clinical practice. Internat Pediatr 2007;22(3):154-63.

36. Tsuei BJ. Assessment of the pregnant trauma patient. Injury Int J Care Injured 2006;27:367-73.
37. Vajda P. Prehospital care of the adult trauma patient. Brastisl Lek LIsty 2007;108(8):371-74.
38. Warren J, Fromm RE Jr, Orr RA, Rotello LC, Horst HM. Guidelines for the intra- and interhospital transport of critically ill patients. Crit Care Med 2004;32:256-62.
39. Wilmink AB, Samra GS, Watson LM, Wilson AW. Vehicle entrapment rescue and prehospital trauma. Injury 1996;27(1):21-25.
40. Yoong M, Chin RFM, Scott RC. Management of status epilepticus in children. Arch Dis Child Educ Pract 2009;94:1-9.

Index