Initial Management of Polytrauma Patient

Sandeep Jain

Introduction
Trauma is a leading cause of death and disability. With increasing vehicular population and urbanization it is becoming more prevalent. Management of a multiple injured or a polytrauma patient can challenge even an astute clinician. In India, Emergency Medical Services are still in a primitive state. Most of the times the trauma victim does not reach the hospital in time and in many of the hospitals there is a shortage of trained manpower and resources to handle them. Therefore, it is imperative for all medical and paramedical personnel to gain the knowledge of basic trauma management which can be provided with the available resources, so that the patient receives the immediate care before being shifted to a trauma centre.

Epidemiology
Trauma mostly affects the young productive population in the age group of 15 - 44 years. It not only kills an individual but paralyses the whole family. It is estimated that in India there is one road traffic accident every minute and every three minutes there is a death due to these. For every one death there are twenty disabled and fifty injured persons left in the society. In the year 2008, in India 3.42 lakh deaths were reported due to accidents, 93% of which were due to unnatural causes like road traffic accidents, falls from height, assaults, railway traffic injuries, burns, drowning etc. Road traffic accidents were responsible for 37.1% of these 1. Presently Road Traffic Accident (RTA) is the ninth most common cause of death amongst all diseases in world but as per WHO projections, by the year 2020 it will be the third in this list2.

Deaths from trauma have a trimodal distribution3. This refers to occurrence of death following trauma as a function of time. Accordingly these are classified as:

Immediate deaths: these occur within seconds to minutes after injury and are due to heart or major vascular rupture, brain stem injury or massive head injury.

Early deaths: these are the deaths which occur after few minutes to hours after injury. Usual causes are airway obstruction, tension pneumothorax, closed head injury or hypovolemic shock.

Late deaths: these are deaths occurring days after injury, in the intensive care units and are due to septicemia, coagulopathy and multiorgan failure.

Immediate deaths are non salvageable and only preventive measures like following traffic rules, using helmets etc. can save them. Early deaths are the preventable deaths where appropriate diagnosis and treatment can make a difference between survival and mortality. Late deaths are a consequence of injury severity and inappropriate initial care. Essential trauma care is all about preventing early and late deaths. Dr Adams R Cowley of Shock Trauma Centre at Baltimore, Maryland, USA found that the survival of the trauma patient was time dependent. The longer the time taken for providing appropriate care, the lower was the survival rate. He called this the “Golden Hour”; emphasizing the need for early treatment of these patients. The Golden hour starts from the time of injury and not when the first medical personnel have arrived4.

Initial Assessment and Management of Patient
A good pre hospital care is absolutely necessary for better survival. There is a need to shift the patient early to an appropriate trauma centre and continuous care should be given en route. This policy is called “Load and Go” or “Scoop and Run”, which is being practiced in India. Another concept of “Stay and Play” is in vogue in some countries in Europe which implies that the patient is treated and stabilized at site of accident before the transport. Before approaching the patient at site it is essential that the pre hospital team ensures that the place is safe for them to load the patient and they have their universal precautions in place. Always approach the patient from his front side and address him to elicit a response. A patient who is able to talk coherently - has an intact airway, sufficient oxygenation and adequate perfusion of brain tissue. The EMS team should also communicate with the receiving hospital so that the trauma team is ready to receive the patient.

The initial management is divided into two phases; primary survey and secondary survey. Primary survey deals with the management of immediate life threatening injuries while secondary survey is comprehensive management of all injuries.

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Primary Survey:
This can be summarized as first five letters of English alphabets (ABCDE) - Airway with cervical spine control, Breathing, Circulation, Disability and Exposure & Environment control.

1. Airway with Cervical Spine Control: Airway is assessed by talking to the patient. If he is able to talk coherently, his airway is clear. If he is unable to speak, is unconscious or is producing additional sounds like stridor, gurgles etc, his airway is threatened. The airway is cleared by opening the mouth with chin lift or jaw thrust maneuver. Fig.1 (Head tilt as taught in Basic Life Support courses is contraindicated in trauma).

![Fig.1: Jaw thrust maneuver](image)

After opening the mouth remove any foreign body or secretions by finger sweep or suctioning. Various airway adjuncts can also be used to maintain a patent airway.

A. Oral or nasopharyngeal airway: Oral airway is used in unconscious patients with no gag reflex. Nasopharyngeal airway is used in patients who have a persistent gag reflex or where it is difficult to introduce oral airway, as when the patient clenches his mouth. Contraindication of nasopharyngeal airway includes fracture base of skull - bilateral periorbital edema (panda sign), ecchymosis at mastoid (battle’s sign), rhinorrhea and otorrhea.

B. Laryngeal Mask Airway (LMA): This can be used in conditions of difficult or failed intubation. This can also be put in the field by paramedics without the need for laryngoscope. Since it does not prevent against aspiration, it is not a preferred technique.

C. Others could be esophageal tracheal combitube or esophageal obturator airways.

D. A definitive airway is endotracheal intubation. A definitive airway is defined as a tube in the trachea with cuff inflated, tube attached to oxygen enriched ventilation, and the airway secured in place. It is the gold standard for airway maintenance. However, it is difficult in trauma situations as the head always remains in neutral position.

E. In case of failed intubation surgical airways can be created at cricothyroid membrane by either needle cricothyrotomy or surgical cricothyrotomy. Emergency tracheostomy is more difficult, requires greater expertise and is associated with greater operative risk than cricothyrotomy. Hence it is now reserved for intensive care settings.

Cervical spine is always assumed to be injured until proven otherwise in all trauma patients.

It is imperative that a member of the trauma team immobilize the cervical spine by holding it with hands, called “in line manual stabilization” till airway has been secured. It is then augmented with the application of a semi rigid collar.

2. Breathing: Injuries of respiratory apparatus (rib cage and pleural cavity with its contents) are an important cause of preventable early deaths. These are grouped as lethal six (airway obstruction, tension pneumothorax, massive hemthorax, open pneumothorax, cardiac tamponade and flank chest) and hidden six (blunt cardiac injury, lung contusion, esophageal perforation, tracheobronchial disruption, diaphragmatic tear and blunt aortic injuries).

A. Tension pneumothorax: It is a condition which results from injury to lung parenchyma, tracheobronchial tree or chest wall. Collection of air under tension in pleural cavity leading to severe respiratory and hemodynamic compromise results in rapid mortality. As air in pleural cavity expands rapidly, many a times there is not enough time to perform radiography; hence in effect diagnosis is mostly clinical. Patients usually presents with breathing difficulty with unstable hemodynamic parameters. Examination will reveal distended neck veins, reduced or absent breath sounds on affected side with hyper resonant note on percussion.

Treatment starts with early diagnosis and performing needle decompression (needle thoracentesis). This is performed on the side of tension pneumothorax with a 14G venflon or angiocatheter inserted in 2nd intercostal space in midclavicular line. Most of the times it is difficult to exactly count the space, therefore a rough method is to palpate the midpoint of clavicle and the first palpable intercostal space below is the 2nd space. Alternatively draw an imaginary line joining the midpoint of clavicle and the ipsilateral nipple and midpoint of this line is 2nd space. Needle thoracentesis is a temporary method described mostly in the pre-hospital care setting for purchasing time to shift the patient to the hospital. If chest desdection is not performed insertion of chest tube in midaxillary line in 4th or 5th intercostal space. If there is a delay in getting the instruments or expertise for tube decompression, needle decompression is still life saving in rapidly deteriorating patient.

B. Massive hemothorax: Collection of more than 1.5 litres of blood in pleural cavity is termed as massive hemothorax although each hemothorax can contain up to 3 litres. The bleeding is mostly from intercostal or internal mammary vessels but could be from major vascular structures as well. The sign and symptoms are same like those of tension pneumothorax except that the percussion note changes to dull and neck veins can be flat secondary to hypovolemia. Since trauma chest X rays are supine films, classical crescent sign of pleural effusion will not be seen; rather a diffuse opacification of involved hemothorax will be the finding on X ray.

Treatment is tube decompression of pleural cavity with volume replacement. If initial collection is more than one litre or there is a continuous drainage of more than 200ml/hr for ≥ 2 hours, there is a high possibility of the need for thoracotomy. Therefore an early referral to a trauma or thoracic surgeon should be considered.
C. Open pneumothorax (sucking chest wound): This is a condition where there is an open wound on the chest wall communicating with the atmosphere. When the defect in the chest wall is more than two thirds the diameter of the trachea, air enters the pleural cavity preferentially through this defect, leading to serious hemodynamic and respiratory compromise. The treatment is closure of the defect with tube decompression. However in prehospital setting or in case of delay in chest tube decompression, a temporary closure of the defect by putting a barrier such as butter paper, plastic dressing or rubber glove and sealing it only on three sides will purchase some time. During the inhalation the barrier is sucked in due to creation of the negative intrathoracic pressure preventing any further ingress of air while during exhalation the barrier is lifted up and the open side allows the egress of the collected air.

D. Cardiac tamponade: collection of blood in the pericardial cavity prevents adequate cardiac function leading to severe hemodynamic compromise. This is suspected in patients with frontal collision and sternal or anterior chest wall injuries. Sign and symptoms are usually same as tension pneumothorax except that the air entry is equal. Classical Beck’s Triad (raised jugular venous pressure, muffled heart sounds and hypotension) is found in only 33% of patients. Pulsus paradoxus (fall in systolic blood pressure more than 10mm Hg during inspiration) is difficult to ascertain in trauma patient. Kussmaul’s sign (raised JVP during inspiration in spontaneously breathing patient) is a hard sign but again is difficult to interpret in polytrauma scenario. The treatment is pericardial decompression by sternotomy or thoracotomy. Diagnosis is usually confirmed by FAST (focused abdominal sonography for trauma). Needle pericardiocentesis is a temporizing measure to purchase time for shifting of patient for surgery.

E. Flail chest: It is defined as fracture of two or more ribs at two or more places. The flail segment produces paradoxical motion and hampers respiratory physiology. The major threat to life is not due to fractures or the paradoxical motion but due to the underlying tension pneumothorax/hemothorax and associated lung contusions. Hence a diagnosis of flail chest should alert the clinician to the need for finding the underlying injury. The treatment of flail chest is oxygen supplementation with good analgesia and chest physiotherapy; associated tension pneumothorax or hemothorax having been treated as discussed above. In case of failure to maintain oxygenation, intubation and positive pressure ventilation is the treatment of choice. In the modern era there is no place for any strapping or fixation of the fractures. The only indication of rib fracture fixation is concurrent thoracotomy for other causes.

3. Circulation: The aim of assessment of the circulatory volume in a polytrauma patient is to diagnose and manage shock early before decompensation. The shock can be hypovolemic (due to blood loss), neurogenic (spinal cord injury) or cardiac compressive (tension pneumothorax and cardiac tamponade).

Table 1: Comparison of clinical features of tension pneumothorax, massive hemothorax and cardiac tamponade

<table>
<thead>
<tr>
<th>Examination findings</th>
<th>Tension pneumothorax</th>
<th>Massive hemothorax</th>
<th>Cardiac tamponade</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Inspection</strong></td>
<td>• Respiratory distress</td>
<td>• Respiratory distress</td>
<td>• Respiratory distress</td>
</tr>
<tr>
<td></td>
<td>• Tachypnea</td>
<td>• Tachypnea</td>
<td>• Tachypnea</td>
</tr>
<tr>
<td></td>
<td>• Distended neck veins</td>
<td>• Neck veins may be flat</td>
<td>• Neck veins may be flat</td>
</tr>
<tr>
<td></td>
<td>• Unequal chest wall movements</td>
<td>• Unequal chest wall movements</td>
<td>• Unequal chest wall movements</td>
</tr>
<tr>
<td></td>
<td>• Contusion, abrasion or laceration on chest wall</td>
<td>• Contusion, abrasion or laceration on chest wall</td>
<td>• Contusion, abrasion or laceration on anterior chest wall</td>
</tr>
<tr>
<td><strong>Palpation</strong></td>
<td>• Tachycardia with hypotension</td>
<td>• Tachycardia with hypotension</td>
<td>• Tachycardia with hypotension</td>
</tr>
<tr>
<td></td>
<td>• Tracheal shift to opposite side</td>
<td>• Tracheal shift to opposite side</td>
<td>• Tracheal shift to opposite side</td>
</tr>
<tr>
<td></td>
<td>• Subcutaneous emphysema</td>
<td>• Subcutaneous emphysema</td>
<td>• Subcutaneous emphysema</td>
</tr>
<tr>
<td></td>
<td>• Palpable rib fractures</td>
<td>• Palpable rib fractures</td>
<td>• Palpable rib fractures</td>
</tr>
<tr>
<td><strong>Auscultation</strong></td>
<td>Reduced or absent air entry on affected side</td>
<td>Reduced or absent air entry on affected side</td>
<td>Air entry will be equal</td>
</tr>
<tr>
<td><strong>Percussion</strong></td>
<td>Hyperresonant note on affected side</td>
<td>Dull note on affected side</td>
<td>Both sides normal resonant note</td>
</tr>
</tbody>
</table>

In polytrauma patients shock is considered to be hypovolemic until proven otherwise.

The treatment is aimed at restoring organ and tissue perfusion. The classical signs of hypovolemic shock appear in only class III (Table 2). Therefore any trauma patient with tachycardia should be considered...
to be having some bleeding somewhere and active search for it should be performed till excluded. The management of shock encompasses control of bleeding and restoration of intravascular volume. The sources of blood loss can be overt (from major external wounds or vessels) or could be covert (intrathoracic, intra-abdominal, long bones, pelvis and retroperitoneum).

**Table 2: Classification of Hypovolemic Shock**

<table>
<thead>
<tr>
<th>Classification</th>
<th>Blood loss (% of total blood volume)</th>
<th>Pulse (per min)</th>
<th>SBP</th>
<th>Pulse pressure</th>
<th>RR (per min)</th>
<th>Urine Output (mL/hr)</th>
<th>Mental status</th>
<th>Fluids</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class I</td>
<td>&lt; 15%</td>
<td>&lt; 100</td>
<td>Normal</td>
<td>/ High</td>
<td>14-20</td>
<td>&gt;30</td>
<td>Anxious</td>
<td>Crystalloids</td>
</tr>
<tr>
<td>Class II</td>
<td>15-30%</td>
<td>100-120</td>
<td>Normal</td>
<td>Low</td>
<td>20-30</td>
<td>15-30</td>
<td>Irritable</td>
<td>Crystalloids</td>
</tr>
<tr>
<td>Class III</td>
<td>30-40%</td>
<td>120-140</td>
<td>Low</td>
<td>Low</td>
<td>30-40</td>
<td>5-15</td>
<td>Confused</td>
<td>Crystalloids + blood</td>
</tr>
<tr>
<td>Class IV</td>
<td>&gt;40%</td>
<td>&gt;140</td>
<td>Low</td>
<td>Low</td>
<td>&gt;40</td>
<td>Negligible</td>
<td>Lethargic</td>
<td>Crystalloids + blood</td>
</tr>
</tbody>
</table>

External bleeding is controlled with compression dressings; long bone fractures are stabilized with available splints. Unstable pelvis is diagnosed clinically by ability to compress or retract pelvis at iliac blades. This maneuver should be done only once and if found positive, a pelvic binder should be applied for stabilization. X rays of chest and pelvis along with FAST will help in diagnosing the cause of concealed hemorrhage.

Two wide bore cannulae (preferably 14G) should be inserted to start crystalloid infusion. A bolus dose of 1-2 litres of Ringer’s Lactate in adults and 20ml/Kg in pediatric population is initially given. Depending upon the response to this bolus dose the patients may be categorized into:

a) **Responders**: these respond to the bolus dose and maintain thereafter when the infusion rate is slowed down. These patients should be admitted in intensive care, monitored and further investigations undertaken.

b) **Transient responders**: these respond initially but when the infusion rate is slowed, start to deteriorate. These have a high chance of undergoing a surgical intervention and the surgical team along with blood bank should be alerted.

c) **Non Responders**: These patients show absent or minimal response to bolus dose. They are to be shifted immediately to OT for control of bleeding, with ongoing resuscitation. In this group of patients bedside CXR / Pelvis/ FAST only need to be done during resuscitation.

4. **Disability**:

Assess level of consciousness with the help of Glasgow Coma Scale (GCS) score (Table 3)

**Table 3: Glasgow Coma Scale**

<table>
<thead>
<tr>
<th>Score</th>
<th>Eye opening</th>
<th>Verbal response</th>
<th>Motor response</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>2</td>
<td>To pain</td>
<td>Incomprehensible sounds</td>
<td>Extensor (decerebration)</td>
</tr>
<tr>
<td>3</td>
<td>To command</td>
<td>Inappropriate words</td>
<td>Abnormal Flexion (decortication)</td>
</tr>
<tr>
<td>4</td>
<td>Spontaneous</td>
<td>Confused</td>
<td>Flexor Withdrawal</td>
</tr>
<tr>
<td>5</td>
<td>Oriented</td>
<td>Localizes pain</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Obey command</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

In prehospital care a simpler scale (AVPU) can also be used for assessment of level of consciousness

A – Alert
V – Responding to verbal commands
P – Responding to painful stimulus
U – Unresponsive

In addition the size and light reaction of both the pupils need to be assessed. Inequality of pupils or non reactivity to light is indicative of an underlying brain injury. As opposed to hypotension and tachycardia, in closed head injuries with raised intracranial pressure hypertension and bradycardia is found (Cushing’s reflex). Head injuries can be classified into primary and secondary brain injury. Primary injury occurs as a result of impact at the time of accident while secondary injuries are due to the factors involved after the accident. Clinically head injury is divided into minor (GCS 12-15), moderate (GCS 9-12) and severe (GCS 3-8).

In head injuries the initial management is directed towards maintaining the Cerebral Perfusion Pressure (CPP) which is defined as the difference between the Mean Arterial Pressure (MAP) and Intracranial Pressure (ICP).

\[
CPP = MAP – ICP
\]

Normal ICP is 10mm Hg and pressure more than 20mmHg is associated with poor outcomes. Therefore in head injuries when the intracranial pressure rises due to any mass lesion or diffuse cerebral edema, the mean arterial pressure has to be correspondingly raised to maintain CPP. Thus even in the presence of head injury the primary management is to keep the systolic blood pressure above 110mm Hg so as to maintain CPP above 60mm Hg. The aim in the initial management is to prevent secondary brain injury which could be due to hypoxia and hypovolemia.

**Hypotension and tachycardia in patients with suspected head injury should alert the clinician towards ongoing concealed hemorrhage elsewhere.**
5. Exposure and environmental control: This is an important facet of trauma management which if neglected could adversely affect the outcome. All serious trauma patients should be completely exposed to prevent incidence of missed injuries. After evaluation the patients also need to be covered and efforts are to be initiated to prevent hypothermia. In patients with hypovolemic shock, acidosis due to anaerobic metabolism, combined with dilutional coagulopathy in the presence of hypothermia sets up a vicious cycle, leading to high mortality. This triad of hypothermia, acidosis and coagulopathy is aptly called the “lethal triad of death”. Hypothermia inactivates the clotting enzymes in the coagulation cascade and alters the platelet function. This thrombasthenia makes bleeding control difficult, irrespective of infusion of any amount of blood and its products. Thus all care should be taken in the initial management of polytrauma patient to prevent setting of hypothermia.

Adjuncts to primary survey
During this phase investigations which can be done are bedside X rays of Chest and pelvis and Focused abdominal sonography for trauma (FAST). The focus in sonography for trauma is to find significant free fluid in abdomen mandating the need for early laparotomy, irrespective of the organ injured. This is a quick bedside examination which is easily performed by trauma surgeons and emergency physicians. In addition blood samples can be drawn for baseline hemoglobin, hematocrit, grouping and cross matching.

A nasogastric tube should also be put to decompress gastric contents (contraindicated in suspected basal skull fractures). Foley’s catheterization in the absence of signs of urethral rupture will help in monitoring of urine output during resuscitation.

CT scan of brain and cervical spine should only be performed when the patient is stabilized. No unstable patient should be shifted to CT room where resuscitation is often compromised. In fact CT room has been called as “graveyard of trauma patients”.

Secondary survey
Secondary survey is a head to toe examination for presence of other non life threatening injuries. Make note of abrasions, contusions, deformity, swellings, lacerations or any other sign of injury. Secondary survey should be done only after the patient has been stabilized. Many a times it is completed in the post operative period after control of bleeding. Alongside take the patient history, components of which can be remembered as a mnemonic (AMPLE)

A – Allergies
M - Current medications
P - Past illnesses / pregnancy
L – Last meal time
E - Events leading to accident

Transport of the patient
When the patient needs to be transported the following should be rechecked:

a. Airway is secured
b. Breathing is not compromised
c. Circulation is good enough to maintain cerebral perfusion
d. Patient is put on spine board after “log roll” and cervical collar application.
e. Any impaled object in the body is not removed

Trauma Training in India
Various trauma training courses are available in India at this moment. Some of them are listed below:

1. Fellowship of National Board of Examinations (FNB): This is a post doctoral two year fellowship program for post graduates in Surgery, Orthopedics, Neurosurgery and Anesthesia. (www.natboard.edu.in)
2. Advanced Trauma Life Support (ATLS): This is a three day course of American College of Surgeons for MBBS /BDS doctors (www.atls.in)
3. International Trauma Life Support (ITLS): This is a two day course of American College of Emergency Physicians, concentrating on pre-hospital trauma care. This is meant for doctors, nurses and paramedics. (www.itrauma.org)
4. National Trauma Management Course (NTMC): This is a two day course of Indian Academy of Traumatology. (www.indiatrauma.org)
5. Comprehensive Trauma Life Support (CTLS): This is a two day course of Trauma Care International. (www.ctsindia.org)

Summary
Survival of a trauma victim is time dependent. Availability of appropriate healthcare facility can reduce the rate of preventable deaths. Maintaining ABCDE of trauma does not involve great expenditure but can be taken care of with available resources and adequate training. Trauma care is a team work and therefore a lot of responsibility lies with doctors to train and lead their team of healthcare workers.

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5. The Trauma Manual, 2nd ed.2002, AB Peitzman et al. Lippincott Williams & Wilkins