

# TRAUMA CARE AND MANAGEMENT OF INJURIES

Trauma and its effects is the leading cause of death & disability in prime of life. It is aptly called the neglected disease of modern society. In addition to excess mortality, there is a tremendous burden of disability from extremity, head and spinal injuries in developing nations. The ever more tragic fact is that, injury is the 3rd most important cause of mortality amongst 1 - 40 years old. Therefore, trauma affects the productive youth of the country which is otherwise healthy and free from chronic diseases. Trauma care and management is provided as per the guidelines laid down by the Advanced Trauma Life Support protocol (ATLS).

## INITIAL MANAGEMENT AND CARE OF A TRAUMA PATIENT

### LEVEL 1: AT SOLO PHYSICIAN CLINIC

The components of primary care of trauma patients are:

- Prehospital phase: Patients with significant injuries benefit from immediate transfer to a hospital (Scoop and run) rather than waste time in prolonged resuscitative efforts at the site of accident (Stay and play). All patients with injuries to head and neck area should be assumed to have cervical spine injury unless proven otherwise and extrication of patient from the site of accident should be done keeping this in mind. It is important for all pre-hospital trauma care worker to remember the concept of 'Platinum ten minutes' for all untrapped casualties. Suffice to say that minimum time should be wasted and only the essentials of airway, breathing and circulation are to be done at the site and thereafter the patient evacuated to the nearest medical facility.
- Triage: The principle of Triage is based on the need for treatment and the available resources when encountered with a large number of patients requiring treatment as in mass casualty situations. Triage is performed at the site of injury, at the hospital and for transfer to a tertiary care level.

The injured should be evaluated for

1. Life threatening injuries involving the airway, circulation and central nervous system. **(Priority I)**
2. Serious but not immediately life threatening trauma, such as hemorrhage, fractures and soft tissue injuries. **(Priority II)**
3. Patients not requiring immediate attention. (Priority III)

The primary objective in management of a patient with trauma is to first recognize and treat injuries that are life threatening. This has been called the Primary survey. The Primary Survey is conducted simultaneously along with resuscitation measures (horizontal and not vertical chain of actions). Reassessment follows after resuscitative efforts have been established and vital functions normalized. This is known as the Secondary and tertiary survey.

The primary survey must be performed in no more than 2-5 minutes and if done correctly should identify life-threatening injuries such as:

- Airway obstruction
- Chest injuries with breathing difficulties
- Severe external or internal haemorrhage
- Abdominal injuries.

#### 1. Airway

Assess the airway. Can patient talk and breathe freely? If the patient can talk there is no airway obstruction. If obstructed, the steps to be considered are:

- Chin lift/jaw thrust (tongue is attached to the jaw); chin lift manoeuvre can be performed by placing two fingers under the mandible and gently lifting upward to bring the chin anterior. During this manoeuvre the neck should not be hyper extended. The jaw thrust is performed by manually elevating the angles of the mandible to obtain the same effect.

- Suction (if available)
- Guedel airway/nasopharyngeal airway intubation, but keep the neck immobilized in neutral position. The oral airway must be inserted into the mouth behind the tongue and is usually inserted upside down until the palate is encountered and is then rotated 180 degrees. Care should be taken in children because of the possibility of soft tissue damage. Nasopharyngeal airway is inserted via a nostril (well lubricated) and passed into the posterior oropharynx. It is well tolerated.

The signs of airway obstruction may include:

- Snoring or gurgling
- Stridor or abnormal breath sounds
- Agitation (hypoxia)
- Using the accessory muscles of ventilation/paradoxical chest movements
- Cyanosis.
- Be alert for foreign bodies. Consider need for advanced airway management

### **Airway obstruction requires URGENT treatment**

## **2. Breathing**

The second priority is the establishment of adequate ventilation. Breathing is assessed as airway patency and breathing adequacy are re-checked. If inadequate, the steps to be considered are:

- Decompression and drainage of tension pneumothorax/haemothorax
- Closure of open chest injury
- Give high flow oxygen using face-mask artificial ventilation.

**Inspection (LOOK)** of respiratory rate is essential. Are any of the following present?

- Cyanosis
- Penetrating injury
- Presence of flail chest
- Sucking chest wounds
- Use of accessory muscles?

### **Palpation (FEEL) for**

- Tracheal shift
- Broken ribs
- Subcutaneous emphysema

**Percussion** is useful for diagnosis of haemothorax and pneumothorax.

### **Auscultation (LISTEN) for**

- Pneumothorax (decreased breath sounds on site of injury)
- Detection of abnormal sounds in the chest.

### **Resuscitation action**

The chest is drained of air and blood by insertion of an intercostal drainage tube as a matter of priority and before transfer if respiratory distress exists.

Maintain the patient on oxygen until complete stabilisation is achieved.

If a tension pneumothorax is suspected, then one large-bore needle should be introduced into the pleural cavity through the second intercostal space, mid clavicular line to decompress the tension and allow time for the placement of an intercostal tube.

If intubation in one or two attempts is not possible a cricothyroidotomy should be considered priority. This depends on experienced medical personnel being available with appropriate equipment, and may not be possible in many places.

### **DO NOT persist with intubation attempts without ventilating the patient**

#### **3. Circulation**

The third priority is establishment of adequate circulation. Assess circulation, as oxygen supply, airway patency and breathing adequacy are re-checked. If inadequate, the steps to be considered are:

- Stop external haemorrhage
- Establish 2 large-bore IV lines (14 or 16 G) if possible
- Administer fluid, preferably crystalloids.

The diagnosis of shock is based on clinical findings: hypotension, tachycardia, tachypnoea, as well as hypothermia, pallor, cool extremities, decreased capillary refill, and decreased urine production. In circulatory resuscitation, the goal is to restore oxygen delivery to the tissues. As the usual problem is loss of blood, fluid resuscitation must be a priority. Adequate vascular access must be obtained. This requires the insertion of at least two large-bore cannulas (14-16 G). Peripheral cut down may be necessary. Infusion fluids (crystalloids e.g. N/Saline as first line) should be warmed to body temperature if possible (e.g. prewarm in bucket of warmed water).

Avoid solutions containing glucose.

Measure urine output as an indicator of circulation reserve. Output should be more than 0.5 ml/kg/hr. Unconscious patients may need a urinary catheter, if they are persistently shocked (check for meatal blood before insertion).

Injuries to the limbs: Tourniquets do not work. Besides, tourniquets cause reperfusion syndromes and add to the primary injury. The recommended procedure of “pressure dressing” is an ill-defined entity: Severe bleeding from high-energy penetrating injuries and amputation wounds can be controlled by subfascial gauze pack placement plus manual compression on the proximal artery plus a carefully applied compressive dressing of the entire injured limb. Splinting of any fractures will help in safeguarding any further bleed.

Injuries to the chest: The most common source of bleeding is chest wall arteries. Immediate in-field placement of chest tube drain plus intermittent suction plus efficient analgesia expands the lung and seal off the bleeding.

### **Reassessment of ABC's must be undertaken if patient is unstable**

#### **4. Disability**

Rapid neurological assessment (is patient awake, vocally responsive to pain or unconscious). There is no time to do the Glasgow Coma Scale so an AVPU system at this stage is clear and quick.

- Awake
- Verbal response
- Responds to pain
- Unresponsive

#### **5. Exposure & Environment Control**

Undress patient and look for injury. If the patient is suspected of having a neck or spinal injury, in-line immobilization is important (e.g. use of cervical collar). The temperature of the room should be controlled to avoid extremes of temperature which adversely affect the physiology and the resuscitation. The patient has to be log rolled to examine the back. The proper log rolling technique should be part of basic skill training.

**Drugs:****Analgesia:**

The choice of analgesia varies as per availability. However, commonly available ones like:

- Inj Diclofenac 25 mg per ml; 50 mg i.m 8 hrly would suffice in most of cases.  
Avoid sedatives at this stage.

**Antibiotics:**

- For patients with minor trauma oral Ciprofloxacin 500 mg BD for 05 days
- For patients with major trauma a combination of injectable antibiotics are recommended.
  - Inj Cefotaxime 1 gm i.v 08 hrly
  - Inj Gentamicin 80 mg i.v 12 hrly
  - Inj Metronidazole 500 mg i.v 08 hrly

**Tetanus Toxoid:**

Half ml of tetanus toxoid is given to every patient with open wound.

**Referral criteria**

If patient is stabilized with resuscitative measures consider transferring to the next higher echelon or else immediately proceed to identify clinically the life threatening injuries system wise for initial stabilization and direct transfer to the tertiary care center. Such injuries will include:

- Severe Head injury not assessable with AVPU system
- Abdominal injuries - penetrating and blunt: with shock
- Chest injuries with massive haemo- pneumo thorax
- Limb injuries with neurovascular injuries or open contaminated fractures
- Complex pelvic fractures

*Caution: Never transport a patient with a suspected injury of cervical spine in the sitting or prone position. Always make sure the patient is stabilized before transferring*

**LEVEL 2: AT 6-10 BEDDED PHC**

The patient at this level may be received as either first instance or as part of transfer from lower echelon. In the former the resuscitation priorities remain unchanged from the previous level. At this level one has an additional advantage of basic laboratory and X ray facilities.

- Obtain AMPLE history (A - allergies, M- medications, P- past illness, L - last meal, E - events related to injury)
- Adjuncts to primary survey: The following are helpful:
  - Basic haematology and ABO Rh grouping
  - ECG monitoring
  - Blood Pressure monitoring
  - Imaging: Only 3 radiographs are necessary as part of primary survey:
    - Lateral view of Cervical Spine including T1 vertebra
    - AP view of Chest
    - AP view of pelvis
- Consider need for advanced airway management. Indications for advanced airway management techniques for securing the airway include:

- Persisting airway obstruction
- Penetrating neck trauma with haematoma (expanding)
- Apnoea
- Hypoxia
- Severe head injury
- Chest trauma
- Maxillofacial injury.
- When indications for intubation exist but the trachea cannot be intubated, direct access via a Surgical cricothyroidotomy may be achieved. This is indicated in any patient where intubation has been attempted and failed and the patient cannot be ventilated. The cricothyroid membrane is identified by palpation; a skin incision that extends through the cricothyroid membrane is made. An artery forceps is inserted to dilate the incision. A size 4-6 endotracheal tube (or small tracheostomy tube) is inserted.

### **Drugs:**

The recommendation of drugs remains similar to the previous level. However Inj Ketamine can be used for analgesia as well as minor operative procedures in the dosage of 0.2 mg/kg body wt.

### **Referral Criteria**

At this level the options available are to detain a low priority patient, to transfer a stable patient to next echelon or directly refer a high priority patient to a tertiary care centre for definitive care.

### **LEVEL 3: AT 30 BEDDED CHC**

The resuscitation priorities remain unchanged from the previous level. Subsequent to a ABCDE of trauma a Secondary survey is undertaken if the patient's ABC'S are stable. If any deterioration occurs during this phase then this must be interrupted by another Primary survey. The head-to-toe examination is now undertaken, noting particularly:

#### **Head examination**

- Scalp and ocular abnormalities
- External ear and tympanic membrane
- Periorbital soft tissue injuries.

#### **Neck examination**

- Penetrating wounds
- Subcutaneous emphysema
- Tracheal deviation
- Neck vein appearance.

#### **Neurological examination**

- Brain function assessment using the Glasgow Coma Scale (GCS)
- Spinal cord motor activity
- Sensation and reflex.

#### **Chest examination**

- Clavicles and all ribs
- Breath sounds and heart tones
- ECG monitoring

### Abdominal examination

- Penetrating wound of abdomen requiring surgical exploration
- Blunt trauma - a nasogastric tube is inserted (not in the presence of facial trauma)
- Rectal examination assessing:
  - Sphincter tone
  - Integrity of rectal wall
  - Blood in the rectum
  - Prostate position.

### Pelvis and limbs

- Fractures
- Peripheral pulses
- Cuts, bruises and other minor injuries.

### Chest Trauma

Approximately a quarter of deaths due to trauma are attributed to thoracic injury. Immediate deaths are essentially due to major disruption of the heart or of great vessels. Early deaths due to thoracic trauma include airway obstruction, cardiac tamponade or aspiration. The majority of patients with thoracic trauma can be managed by simple manoeuvres and do not require surgical treatment. Respiratory distress may be caused by:

- Rib fractures/flail chest
- Pneumothorax
- Tension pneumothorax
- Haemothorax
- Pulmonary contusion (bruising)
- Open pneumothorax
- Aspiration.

Haemorrhagic shock due to:

- Haemothorax
- Haemomediastinum.

**Rib fractures:** Fractured ribs may occur at the point of impact and damage to the underlying lung may produce lung bruising or puncture.

**Flail chest:** The unstable segment moves separately and in an opposite direction from the rest of the thoracic cage during the respiration cycle. Severe respiratory distress may ensue.

**Tension pneumothorax:** Develops when air enters the pleural space but cannot leave. The consequence is progressively increasing intrathoracic pressure in the affected side resulting in mediastinal shift. The patient will become short of breath and hypoxic. Urgent needle decompression is required prior to the insertion of an intercostal drain. The trachea may be displaced (late sign) and is pushed away from the midline by the air under tension.

**Haemothorax:** More common in penetrating than in non-penetrating injuries to the chest. If the haemorrhage is severe, hypovolaemic shock will occur and also respiratory distress due to compression of the lung on the involved side. Optimal therapy consists of the placement of a large chest tube.



### The extent of internal injuries cannot be judged by the appearance of a skin wound

- A haemothorax of 500-1500 ml that stops bleeding after insertion of an intercostal catheter can generally be treated by closed drainage alone.
- A haemothorax of greater than 1500-2000 ml or with continued bleeding of more than 200-300 ml per hour is an indication for further investigation e.g. thoracotomy.

**Pulmonary contusion:** is common after chest trauma. It is a potentially life threatening condition. The onset of symptoms may be slow and progress over 24 hrs post injury. It is likely to occur in cases of high-speed accidents, falls from great heights and injuries by high-velocity bullets. Symptoms and signs include:

- Dyspnoea (short of breath)
- Hypoxaemia
- Tachycardia
- Rare or absent breath sounds
- Rib fractures
- Cyanosis.

**Open or “sucking” chest wounds of the chest wall:** In these the lung on the affected side is exposed to atmospheric pressure with lung collapse and a shift of the mediastinum to the uninvolved side. This must be treated rapidly. A seal e.g. a plastic packet is sufficient to stop the sucking, and can be applied until reaching hospital. In compromised patients intercostal drains, intubation and positive pressure ventilation is often required.

### Abdominal Trauma

The abdomen is commonly injured in multiple trauma. The commonest organ injured in penetrating trauma is the liver and in blunt trauma the spleen is often torn and ruptured.

The initial evaluation of the abdominal trauma patient must include the A (airway and Cervical-Spine), B(breathing), C (circulation), and D (disability and neurological assessment) and E (exposure). Any patient involved in any serious accident should be considered to have an abdominal injury until proved otherwise. Unrecognised abdominal injury remains a frequent cause of preventable death after trauma.

There are two basic categories of abdominal trauma:

- Penetrating trauma where surgical consultation is important
- Non-penetrating trauma

About 20% of trauma patients with acute haemoperitoneum (blood in abdomen) have no signs of peritoneal irritation at the first examination and the value of repeated primary survey cannot be overstated. Blunt trauma can be very difficult to evaluate, especially in the unconscious patient. These patients may need a Focussed Assessment by Sonogram for Trauma (FAST). An exploratory laparotomy may be the best definitive procedure if abdominal injury needs to be excluded and facilities of FAST not available. The diagnostic peritoneal lavage (DPL) may be helpful in determining the presence of blood or enteric fluid contents due to intra-abdominal injury. The results can be highly suggestive, but it is overstated as an important diagnostic tool. If there is any doubt a laparotomy is still the gold standard.

The indications for DPL include:

- Unexplained abdominal pain
- Trauma of the lower part of the chest
- Hypotension, hematocrit fall with no obvious explanation
- Any patient suffering abdominal trauma and who has an altered mental state (drugs, alcohol, brain injury)
- Patient with abdominal trauma and spinal cord injuries
- Pelvic fractures.

The relative contraindications for the DPL are:

- Pregnancy
- Previous abdominal surgery
- Operator inexperience
- If the result does not change your management.

#### **Other specific issues with abdominal trauma:**

Pelvic fractures are often complicated by massive haemorrhage and urological injury.

- Examining the rectum for the position of the prostate and for the presence of blood or rectal or perineal laceration is essential
- X-ray of the pelvis (if clinical diagnosis difficult).

The management of pelvic fractures includes:

- Resuscitation (ABC)
- Transfusion
- Immobilisation and assessment for surgery
- Analgesia.

#### **Pelvic fractures often cause massive blood loss**

#### **Head Trauma**

Delay in the early assessment of head-injured patients can have devastating consequence in terms of survival and patient outcome. Hypoxia and hypotension double the mortality of head-injured patients. It is important to treat what you can with your expertise and resources and triage casualties carefully. Immediate recognition and early management must be made of the following conditions:

- Acute extradural haematoma - classically the signs consist of:
  - loss of consciousness following a lucid interval, with rapid deterioration
  - middle meningeal artery bleeding with rapid raising of intracranial pressure
  - the development of hemiparesis on the opposite side with a fixed pupil on the same side as the impact area.
- Acute subdural haematoma - with clotted blood in the subdural space, accompanied by severe contusion of the underlying brain. It occurs from tearing of bridging vein between the cortex and the dura. The management of the above is surgical and every effort should be made to do burr-hole decompressions.
- The conditions below should be treated with more conservative medical management, as neurosurgery usually does not improve outcome.
  - Base-of-skull fractures - bruising of the eyelids (Raccoon eyes) or over the mastoid process (Battle's sign), cerebrospinal fluid (CSF) leak from ears and/or nose
  - Cerebral concussion - with temporary altered consciousness
  - Depressed skull fracture - an impaction of fragmented skull that may result in penetration of the underlying dura and brain.
  - Intracerebral haematoma - may result from acute injury or progressive damage secondary to contusion.



**Alteration of consciousness is the hallmark of brain injury**

- The most common error in head injury evaluation and resuscitation are:
- Failure to perform ABC and prioritize management
- Failure to look beyond the obvious head injury
- Failure to assess the baseline neurological examination
- Failure to re-evaluate patient who deteriorates.

**Management of Head Trauma**

The Airway, Breathing and Circulation are stabilised (and the cervical-spine immobilised, if possible). Vital signs of important indicators in the patients' neurological status must be monitored and recorded frequently. Glasgow Coma Score (GCS) evaluation is undertaken:

**Remember:**

- Severe head injury is when GCS is 8 or less
- Moderate head injury is when GCS is between 9 and 12
- Minor head injury is when GCS is between 13 and 15.
- Deterioration may occur due to bleeding
- Unequal or dilated pupils may indicate an increase in intracranial pressure
- Head or brain injury is never the cause of hypotension in the adult trauma patient
- Sedation should be avoided as it not only interferes with the status of consciousness but will promote hypercarbia (slow breathing with retention of CO<sub>2</sub>)
- The Cushing response is a specific response to a lethal rise in intracranial pressure. This is a late and poor prognostic sign. The hallmarks are:
  - Bradycardia
  - Hypertension
  - Decreased respiratory rate.
- Basic medical management for severe head injuries includes:
  - Intubation and hyperventilation, producing moderate hypocapnia (PCO<sub>2</sub> to 4.5-5 Kpa). This will reduce both intracranial blood volume and intracranial pressure temporarily
  - Sedation with possible paralysis
  - Moderate IV fluid input with diuresis i.e. do not overload
  - Nurse head up 20%
  - Prevent hyperthermia.
  - Never assume that alcohol is the cause of drowsiness in a confused patient

**Spinal Trauma**

The incidence of nerve injury in multiple trauma is higher than expected. The most common injuries include damaged nerves to fingers, brachial plexus and central spinal cord. The first priority is to undertake the primary survey with evaluation of ABCDE scheme:

Examination of spine-injured patients must be carried out with the patient in the neutral position (i.e. without flexion, extension or rotation) and without any movement of his spine.

The patient should be:

- Log-rolled
- Properly immobilised (in-line immobilisation, stiff neck cervical collar or sandbags).
- Transported in a neutral position.

With vertebral injury (which may overlie spinal cord injury) look for:

- Local tenderness
- Deformities as well as for a posterior “step-off” injury
- Oedema (swelling).

Clinical findings indicating injury of the cervical spine include:

- Difficulties in respiration (diaphragmatic breathing - check for paradoxical breathing)
- Flaccid and no reflexes (check rectal sphincter)
- Hypotension with bradycardia (without hypovolaemia).
- Head injury patients are suspected to have cervical spine injury until proven otherwise

### Neurological assessment

Assessment of the level of injury must be undertaken. If the patient is conscious, ask the patient questions relevant to his/her sensation and try to ask him/her to do minor movements to be able to find motor function of the upper and lower extremities.

The following summarizes key reflex assessment to determine level of lesion:

| Motor response                    | Sensory response                    |
|-----------------------------------|-------------------------------------|
| Diaphragm intact level C3, C4, C5 | Anterior thigh L2                   |
| Shrug shoulders C4                | Anterior knee L3                    |
| Biceps (flex elbows) C5           | Anterolateral ankle L4              |
| Extension of wrist C6             | Dorsum great and 2nd toe L5         |
| Extension of elbow C7             | Lateral side of foot S1             |
| Flexion of wrist C7               | Posterior calf S2                   |
| Abduction of fingers C8           | Peri-anal sensation (perineum) S2S5 |
| Active chest expansion T11, T12   |                                     |
| Hip flexion L2                    |                                     |
| Knee extension L3L4               |                                     |
| Ankle dorsiflexion L5S 1          |                                     |
| Ankle plantarflexion S1S2         |                                     |

Loss of autonomic function with spinal cord injury may occur rapidly and resolve slowly

### Limb Trauma

Examination must include:

- Skin colour and temperature
- Distal pulse assessment
- Grazes and bleeding sites
- Limb's alignment and deformities

- Active and passive movements
- Unusual movements and crepitation
- Level of pain caused injury.

**Management of extremity injuries should aim to:**

- Keep blood flowing to peripheral tissues
- Prevent infection and skin necrosis
- Prevent damage to peripheral nerves.

**Special issues relating to limb trauma:**

- Stop active bleeding by direct pressure, rather than by tourniquet as it can be left on by mistake, and this can result in ischaemic damage.
- Open fractures. Any wound situated in the neighbourhood of a fracture must be considered as a communicating one.

**Principles of the treatment include:**

- Stop external bleeding
- Immobilise and relieve pain.
- Compartment syndrome is caused by an increase in the internal pressure of fascial compartments; this pressure results in a compression of vessels and peripheral nerves situated in these regions. Perfusion is limited, peripheral nerves damaged and the final result of this condition is ischaemic or even necrotic muscles with restricted function.

**Amputated parts of extremities should be covered with sterile gauze towels**

- Which are moistened with saline and put into a sterile plastic bag. A non-cooled amputated part may be used within 6 hours after the injury, a cooled one as late as after 18 to 20 hours.
- Deep penetrating foreign bodies should remain in situ until theatre exploration

**Limb Support:** Early Fasciotomy. The problem with compartment syndromes is often underestimated:

- Tissue damage due to hypoxemia: Compartment syndromes with increased intra muscular (IM) pressures and local circulatory collapse are common in injuries with intramuscular hematomas, crush injuries, fractures or amputations. If the perfusion pressure (systolic BP) is low, even a slight rise in IM pressure causes local hypoperfusion. With normal body temperature peripheral limb circulation starts to decrease at a systolic BP around 80 mmHg.
- The damage on reperfusion is often serious: If there is local hypoxemia (high IM pressure, low BP) for more than 2 hours, the reperfusion can cause extensive vascular damage. That is why decompression should be done early. In particular the forearm and lower leg compartments are at risk. When the bleeding source is controlled, we recommend in-field fasciotomy of forearm and lower leg compartments if the evacuation time is 4 hours or more. Fasciotomy should be done by any trained doctor or nurse under ketamine anaesthesia at the CHC location.

**Referral Criteria**

Definitive care

Referral to concerned speciality for definitive management.

**Documentation:** Is very important as most cases are Medico-legal cases. All records should be:

- Clear records
- Concise
- Chronological
- Consent for procedures should be taken when required.

#### SUGGESTED READING

1. RCG Russell, Norman S Williams and Christopher JK Bulstrode Bailey and Love's: Short Practice of Surgery. 24th edition. Arnold ; 2004.
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