Chapter 1

Management of Trauma

The student should be able to:

OR1.1 Describe and discuss the principles of pre-hospital care and causality management of a trauma victim including principles of triage.

Trauma is the leading cause of death in young adults. The injuries due to trauma may range from small lesions to life-threatening multi-organ injury. In order to achieve the best possible outcomes, the management of trauma patients requires a highly systematic approach. The main stages (or levels) of management of trauma are:

- Pre-hospital care by emergency services personnel
- Field triage
- Extricate and immobilize
- Transport to hospital
- Primary survey
- Transfer to specialized trauma center
- Secondary survey
- Tertiary survey

PRE-HOSPITAL CARE

Pre-hospital care involves first aid and basic life support administered by emergency services personnel at the site of trauma. Most of the emergency medical systems (EMS) utilize some sort of a multi-tier approach, in which basic medical providers rush to the site of trauma, and more skilled and trained personnel arrive shortly after. The EMS in most countries is based on ambulance crew who include emergency medical technicians (EMTs) or paramedics with support from pre-hospital emergency medicine doctors. The first responders with basic training perform early simple techniques such as chest compressions, automatic defibrillation or basic airway management until advanced interventions can be performed by either paramedics or emergency physicians at the scene.

- Pre-hospital care of trauma patients is situation-dependent and centered on stabilization of the patient and prompt transport to a hospital.
- Emergency services personnel perform basic version of the primary survey (as detailed below).
- Low-threshold interventions that may be performed by emergency personnel prior to transport to a hospital include:
  - Placement of a cervical collar—if cervical spine injury is suspected.
  - Oxygen delivery through nasal cannula or by intubation—if respiratory distress or altered mental status is suspected.
  - Administration of intravenous fluid (in cases of severe hemorrhage or hypo-tension).
  - Placement of tourniquets or pressure bandages for control of bleeding.

Table 1.1: Triage colour codes

Triage category	*Priority*	*Colour*	*Conditions*
Immediate	1	Red	Chest wounds, open fractures, shock, 2–3 degree burns
Delayed	2	Yellow	Stable abdominal injuries, eye and CNS injuries
Minimal	3	Green	Minor fractures, minor burns, minor bleeding
Expectant	4	Black	Unresponsive, high spinal cord injuries

TRIAGE

Triage (also known as 'field triage') is a system of medical sorting to identify the severity of the injuries in an injured at the site of trauma in an order of priority for transport and treatment.

- The field triage is used when the numbers of casualties are more and cannot be managed simultaneously in the facilities available.
- There are two stages of triage in the pre-hospital care: A triage sieve and a triage sort.
- The triage sieve is a quick method based on simple clinical observation of the injured to walk, breathe and maintain peripheral perfusion. The ambulance unit is able to perform the triage sieve. They are also able to provide pre-hospital care such as application of tourniquets and homeostatic dressings for severe hemorrhage, etc.
- The triage sort is done by personnel with clinical training and use physiological measurements to score the injured and prioritize them. Both triage systems place casualties into four colour-coded (Table 1.1) priority categories.
- ***Red*** (immediate): Severe injuries but high potential for survival with treatment; taken to the facility first.
- ***Yellow*** (delayed): Serious injuries but not immediately life-threatening.
- ***Green*** (walking wounded): Minor injuries.
- ***Black*** (deceased/expectant): Injuries incompatible with life or without spontaneous respiration; should not be moved forward to the facilities first.

GUIDELINES FOR FIELD TRIAGE

The American College of Surgeons Committee on Trauma (ACS-COT) has provided guidance for the field triage process through "Field Triage Decision Scheme." This involves four steps:

Step One: Physiologic Criteria

Following are the significant predictors of severe injury and need for a high level of trauma care.

- Glasgow Coma Scale ≤13, or
- Systolic blood pressure of <90 mmHg, or
- Respiratory rate of <10 or >29 breaths per minute (<20 in infant aged <1 year), or need for ventilatory support.

Step Two: Anatomic Criteria

Step two of the guidelines recognizes that certain patients may have normal physiology at the initial presentation at the site of trauma but have an anatomic injury that might require the highest level of care within the defined trauma system.

Following are considered to be severe injuries requiring immediate care:

- All penetrating injuries to head, neck, torso, and extremities proximal to the elbow or knee;
- Chest wall instability or deformity (e.g., flail chest);
- Two or more proximal long-bone fractures;
- Crushed, degloved, mangled, or pulseless extremity;
- Amputation proximal to the wrist or ankle;
- Pelvic fractures;
- Open or depressed skull fractures; or
- Paralysis.

Step Three: Mechanism of Injury

An injured patient who does not meet step one or step two should be evaluated in terms of mechanism of injury (MOI) to determine

if the injury might be severe but occult. It is recommended to transport the injured to the hospital if any of the following are present:

- Falls
  - Adults: >20 feet (one story = 10 feet)
  - Children: >10 feet or two to three times the height of the child
- High-risk auto crash
  - Intrusion, including roof: >12 inches occupant site; >18 inches any site
  - Ejection (partial or complete) from automobile
  - Death in the same passenger compartment
  - Vehicle telemetry data consistent with a high risk for injury
  - Automobile versus pedestrian/bicyclist thrown, run over, or with significant (>20 mph) impact; or
  - Motorcycle crash >20 mph

Step Four: Special Considerations

In step four, the injured persons who have not met physiologic, anatomic, or mechanism steps have underlying conditions or comorbid factors that place them at higher risk of injury or that aid in identifying the seriously injured patient. Persons who meet step four criteria might require trauma center care.

- Older adults
  - Risk for injury/death increases after age 55 years.
  - Systolic blood pressure <110 might represent shock after age 65 years
  - Low impact mechanisms (e.g., ground-level falls) might result in severe injury
- Children
  - Should be triaged preferentially to pediatric capable trauma centers
- Anticoagulants and bleeding disorders
  - Patients with head injury are at high risk for rapid deterioration
- Burns
  - Without other trauma mechanism: Triage to burn facility
  - With trauma mechanism: Triage to trauma center
- Pregnancy >20 weeks

EXTRICATION AND IMMOBILIZATION

- When an injured person is entrapped in the wreckage, releasing the injured from it without causing further damage is a priority. This is done before triage.
- Extrication is done with due care and attention is given to protect the spinal cord, which might have been injured. The fractured limbs should be carefully released and splinted in anatomical position to preserve the neurovascular function.
- The cervical spine has to be immobilized using a hard cervical collar and a long spinal board is used to minimize movement of the spinal column.
- The fractured limbs and joint dislocations are reduced if possible and the limb is immobilized as much as possible to its anatomical position with gentle traction and straightening. The limb is then immobilized with traction, gutter or vacuum splints as appropriate. This may reduce the pain and hemorrhage, and minimizes neurovascular damage. Sedation and analgesia may be required for this.
- The pelvic fractures may cause uncontrollable retroperitoneal bleeding. Blood loss can be minimized by stabilizing the fracture, using pelvic compression devices (pelvic binders).

TRANSPORT TO THE HOSPITAL

The transport of the seriously injured patient is associated with risk and requires expertise and attention.

At the site of trauma, the interventions are to be limited to life-saving measures and prolonged attempts of complex management are to be avoided. The airway must be secured, and life-threatening chest injuries such as tension pneumothorax and catastrophic external hemorrhage are attended before the transfer of the injured.

- Primary transfer is the movement of the trauma patient from the scene of the trauma to a hospital.

- Trauma services aim to achieve primary transfer to a trauma centre as early as possible (normal cut off transfer time is 45 minutes)
- Secondary transfer is the movement of patients from one facility to another. Transfer between centers is associated with increased mortality but is inevitable in some instances.

GROUND AMBULANCE TRANSFER

Ground transfer of the injured using ambulances on the road is the traditional method and is commonly used in most of the countries. It is possible to use the ground ambulance to transfer the injured from remote places with minimum facilities. It is faster and suitable for short distance transfers. Ground ambulances are not dependent on weather. Modern day ambulances have the basic life-saving facilities.

Advanced life support (ALS) ambulances are well equipped, with trained people along with the equipment they need to save or stabilize patients. They have basic diagnostic instruments, emergency life-saving medicines, IV fluids, oxygen cylinders, AMBU bags, pulse oximeter, cardiac monitors, defibrillators, infusion pumps, etc. They are capable of handling critical cases until they can be moved to more permanent facilities. They also have paramedics or EMS personnel trained in providing basic care to trauma victims.

However, road transfer is not suitable for long distance transfers and movement of the ambulance is also dependent on the traffic. The medical interventions may be difficult in the road ambulances.

AIR AMBULANCE TRANSFER

This method of transfer is using helicopters. It has the advantage for long-distance transfers from remote and rough terrain. The destination hospital is chosen depending on the severity of the injuries, and this may be by bypassing small centers that do not have the adequate facilities. The injured are assessed using triage tool, and more seriously injured are transferred directly to a major trauma center. During the transfer, the vital signs of the injured are monitored.

The helicopter emergency medical service (HEMS) offers significant advantages but is expensive. The cramped cabin space results in poor access to the patient in the helicopter resulting in restricted patient intervention. The helicopters are noisy and vibration makes it difficult to monitor patient's condition. Therefore, the patient is adequately stabilized and immobilized prior to air transfer.

HOSPITAL MANAGEMENT: ADVANCED TRAUMA LIFE SUPPORT

Advanced trauma life support (ATLS) is a protocol developed to standardize the initial evaluation and management of injured patients and to avoid omission of potentially life-saving interventions. ATLS serves as the standard for initial management of injured patients and has helped in reducing morbidity and mortality of the victims after injury.

Care during the 'golden hour' is the primary focus of ATLS, with an aim of rapid assessment, resuscitation, and often operative intervention to improve the survival and decrease the associated morbidity.

Primary Survey

The first part of the assessment of patients presenting with trauma is called the primary survey. During this time, life-threatening injuries are identified and simultaneously resuscitation is begun. A simple mnemonic, ABCDE, is used for the order in which the assessment and management is done.

a. ***Airway maintenance with cervical spine protection:*** The first stage of the primary survey is to assess the airway.
   - If the patient is able to talk, the airway is likely to be clear. If the patient is unconscious, he/she may not be able to maintain his/her own airway. The

airway can be opened using a chin lift or jaw thrust.
- If the airway is blocked (e.g., by blood or vomit), the material must be cleaned out of the patient's mouth by the help of suctioning instruments.
- In case of obstruction, an endotracheal tube has to be passed.

b. ***Breathing and ventilation***
- The chest must be examined by inspection, palpation, percussion and auscultation.
- The life-threatening thoracic conditions looked for: i) Airway obstruction; ii) Tension pneumothorax; iii) Open pneumothorax; iv) Massive haemothorax; vi) Flail chest; vii) Cardiac tamponade.

c. ***Circulation with bleeding control:*** Hypovolemic shock is caused by significant blood loss. Occult blood loss may be into the chest, abdomen, pelvis or from the long bones like femur
- External bleeding is controlled by direct pressure.
- Two large-bore intravenous lines are established and crystalloid solution is started at once.
- An immediate arrangement for blood transfusion has to be initiated.

d. ***Disability/neurologic assessment:*** During the primary survey a basic neurological assessment is made.
The Glasgow Coma Scale is a quick method to determine the level of consciousness, and is predictive of patient outcome.

e. ***Exposure and environmental control:*** The patient should be completely undressed, usually by cutting off the garments. The patient is covered with warm blankets to prevent hypothermia.

Secondary Survey

The secondary survey is done after the injured is stabilised by resuscitation with the normal vital signs.
- The secondary survey is a head-to-toe evaluation of the injured, including the reassessment of all vital signs.
- Each region of the body must be fully examined for any injury.
- Radiographs indicated by examination are obtained. Full body CT scans are the modern method of assessment.

Tertiary Survey

Missed injuries are recognized by a careful and complete examination.

Glasgow Coma Scale (GCS)

The Glasgow coma scale (GCS) is used to assess the extent of impaired consciousness in all types of acute medical and trauma patients. The scale assesses patients according to three aspects of responsiveness: Eye-opening, motor function and verbal responses.

The findings in each component of the scale can aggregate into a total Glasgow Coma Score and provide a useful summary of the overall severity.

The score expression is the sum of the scores as well as the individual elements. For example, a score of 10 might be expressed as GCS10 = E3V4M3.

Scoring and Parameters
- The Glasgow Coma Scale divides into three parameters: Best eye response (E), best verbal response (V) and best motor response (M).
- The levels of response in the components of the 'Glasgow Coma Scale' are 'scored' from 1, for no response, up to normal values of 4 (eye-opening response), 5 (verbal response) and 6 (motor response). The total coma score thus has values between 3 and 15, three being the worst and 15 being the highest.
- Best eye response (4)
  1. No eye opening
  2. Eye opening to pain

3. Eye opening to sound
4. Eyes open spontaneously

- Best verbal response (5)
  1. No verbal response
  2. Incomprehensible sounds
  3. Inappropriate words
  4. Confused
  5. Orientated
- Best motor response (6)
  1. No motor response.
  2. Abnormal extension to pain
  3. Abnormal flexion to pain
  4. Withdrawal from pain
  5. Localizing pain
  6. Obeys commands

Clinical Significance

- The assessment of responsiveness with the Glasgow Coma Scale is used to guide early management of patients with head injury or other kind of acute brain injury.
- In more severely impaired patients, GCS is used for emergency management such as securing the airway and triage to determine patient transfer.
- Serial Glasgow Coma Scale assessment helps in monitoring the clinical course of the patient and guiding changes in management.

Limitations

The Glasgow Coma Scale does not accurately measure traumatic brain injury in children less than 5 years of age. The aptly-named 'Pediatric Glasgow Coma Scale (PGCS)' includes modifications for children.

The GCS requires observation of a verbal score (which is often unavailable in the ICU). It is difficult to interpret in cases of concurrent sedation, or in patients with subtle derangements of consciousness (such as delirium).

Points to Remember

- **Pre-hospital care:** It involves first aid and basic life support administered by emergency services personnel at the site of trauma.
- **Field triage:** It is a system of medical sorting to identify the severity of the injuries in an injured at the site of trauma in an order of priority for transport and treatment.
- **Extrication and immobilization:** This is done when an injured person is entrapped in the wreckage, releasing the injured from it without causing further damage is a priority.
- **Transport to hospital:** Primary transfer is the movement of the trauma patient from the scene of the trauma to a hospital with trauma services.
- **Advanced trauma life support (ATLS)** is a protocol developed to standardize the initial evaluation and management of injured patients and to avoid omission of potentially life-saving interventions.
- **Primary survey:** This is the first part of the assessment of patients presenting with trauma.
- **Transfer** to specialized trauma center
- **Secondary survey:** The secondary survey is done after the injured is stabilized by resuscitation with the normal vital signs.
- **Tertiary survey:** Missed injuries are recognized by a careful and complete examination.