General Management of Trauma

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A 40-year-old male patient hit by a car about 3 hours ago presented in the hospital. He had a labored breathing; his respiratory rate was 30/min with O_2 saturation of 95%. His heart rate was 132/min, blood pressure was 105/80 mmHg, and Glasgow coma score (GCS) was 8/15. After initial stabilization, the secondary survey revealed multiple rib injuries on the left side of the chest and fracture of the left femur.

Trauma is a major cause of death and disability in the first four decades of life. Improvement and organization of trauma care services are a cost-effective way of improving patient outcome. Proper organization of these systems reduces the time between injury and the definitive care, thereby reducing the morbidity and mortality.

Step 1: Preparation

- Alert the trauma team about the arrival of the injured patients and number of causalities so that rapid resuscitation can be initiated
- Trauma team includes the general/trauma surgeon, the emergency physician, the orthopedic surgeon and the critical care/anaesthesia specialist on call, and at least two trained nurses and two paramedics
- Besides the surgeon, the trauma team can also be led by an emergency medicine or critical care/anaesthesia specialist who is skilled in airway management
- Alert the imaging, laboratory services, blood bank and operating room personnel about arrival of a polytrauma patient
- Airway cart, crash cart, suction, monitors and IV cannula, warm IV fluids, and other equipment should be rechecked
- The team members should be ready with universal precautions by putting on mask, splash-resistant and lead gowns, eye protection, and gloves

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Step 2: Triage

- Triage is a process of determining the priority of treatment based on the patient's airway (A), breathing (B), and circulation (C) as well as availability of resources
- Injured patients can be categorized into five categories
  - The injured patient with compromised ABC who needs immediate treatment (red)
  - The injured patient with stable ABC whose treatment can wait (yellow)
  - Those with minor injuries (walking wounded), who need help less urgently(green)
  - The unsalvageable patients who are beyond help (blue or gray)
  - The injured patients who are already dead (black)
- A simple tool, which can be used for triage, is START (simple triage and rapid treatment) (Fig. 10.1)

Step 3: Primary Survey and Resuscitation

- The "ABCDE" of primary survey is, in essence, to identify injuries with immediate threat to life and institution of life-preserving therapies
- The management is concurrent with the assessment, resuscitation, and stabilization
- A 10 s assessment tool can rapidly assess patients ABCD. Ask the patient to identify himself and narrate the incident. A patient with normal and clear speech and normal level of consciousness, is unlikely to have a major compromise in ABCD, and unlikely to have a major event immediately
- Take history from the accompanying person about the following:
  - Mechanism of injury
  - Injuries suspected
  - Vital signs
  - Treatment en route to hospital
- Detailed history shouldn't interfere with primary survey, identification and treatment of life threatening injuries

ABCDE
Airway maintenance with cervical spine control
Breathing and ventilation
Circulation/hemorrhage control
Disability/neurological status
Exposure/environmental control

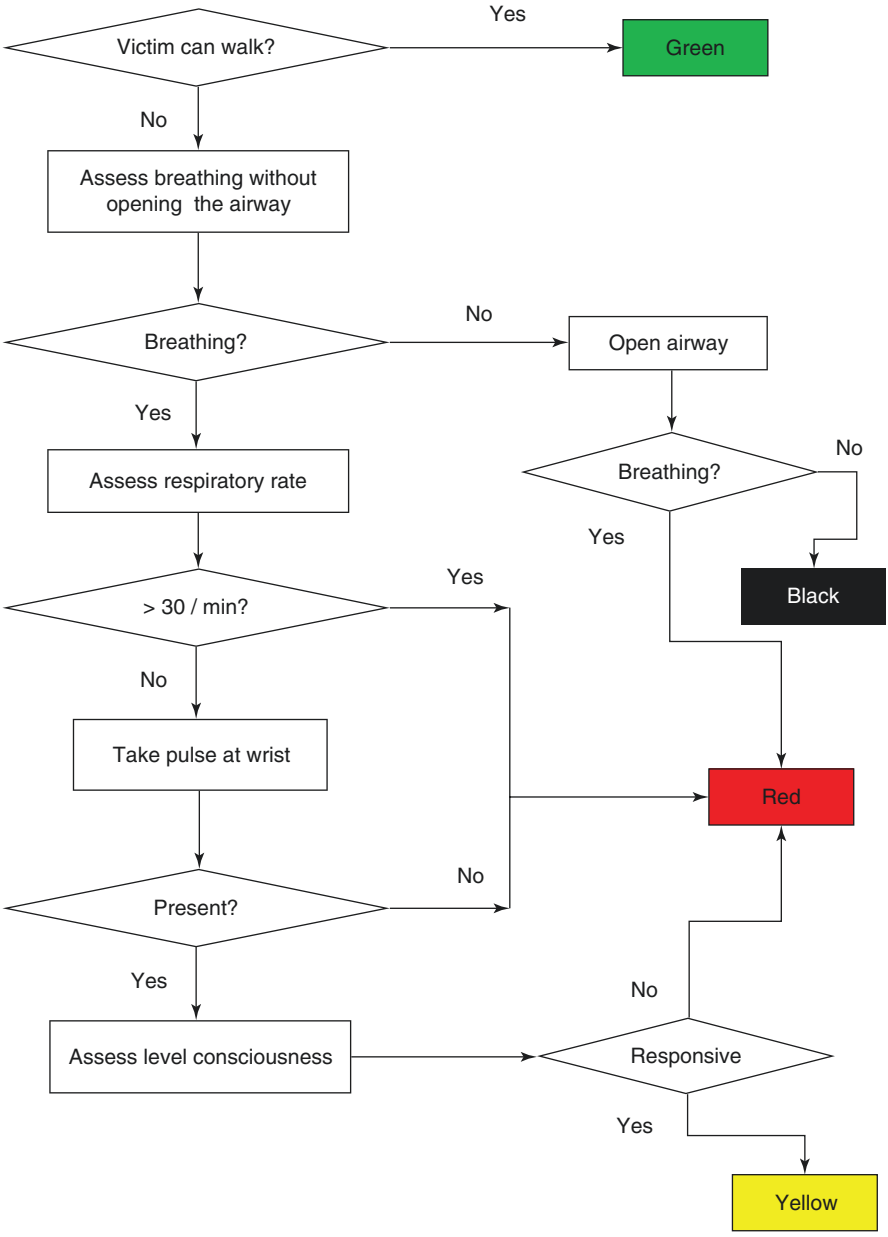

Fig. 10.1 Simple triage and rapid treatment

Airway with Cervical Spine Control

- Airway is assessed immediately for patency, protective reflexes, foreign body, secretions, and injury and burns
- The patency of the airway should be assessed with special attention to foreign body or maxillofacial fractures and laryngeal injuries that may result in airway obstruction
- Absence of response, stridor, confusion, or a hoarse reply may indicate airway compromise
- Chin-lift or jaw-thrust maneuver may be used to achieve airway patency, simultaneously protecting the cervical spine, either by a cervical collar or by manual restriction by team member
- Head tilt maneuver should be avoided in an injured patient while managing airway
- A definitive airway is required in the following conditions*:*
  - Inadequate ventilation and oxygenation
  - Impending or actual airway obstruction secondary to injury
  - Brain injury with a GCS of less than 8
  - Inability to adequately protect the airway from aspiration
  - Severe multisystem injury or hemodynamic instability
  - Facial burns or inhalation injury
  - Inability to closely monitor during ongoing resuscitation and investigation (e.g., angiography and CT scanning)
  - Uncooperative or combative behaviour
  - An infant or a child unable to cooperate with investigations
- Cervical spine protection (by application of cervical collar or manual restriction) during airway maneuvers should be done in all trauma patients unless specifically cleared for cervical spine injury preferably by a neurosurgeon.
- Three person intubation technique should be followed in all trauma patients
- Drug assisted intubation protocol should be followed in all trauma patients for securing airway
- Ketamine 1–2 mg/kg or Etomidate 0.2–0.3 mg/kg along with 1–2 mg/kg succinylcholine is used, depending on the hemodynamic stability
- Succinylcholine should be used with utmost caution in patients with pre-existing neuromuscular diseases, paralysis, renal failure, and in patients with major crush injuries, burns and electrical injuries as this can worsen potassium levels.
- Difficult or failed intubations
  - Call senior anesthesiologist or a more experienced person
  - Anticipate airway problems with the following:
    Injury to cervical spine
    Maxillofacial and neck trauma
    Facial and inhalational burns
    Obesity
    Variations in anatomy

- *Airway—management options with cervical spine control treatment include:*
  - Oxygen administration
  - Basic airway maneuvers: chin lift and jaw thrust (no head tilt)
  - Oropharyngeal or nasopharyngeal airway, with caution in bleeding and conscious patient
  - Adjuvants: Laryngeal mask airway, laryngeal tube airway and intubating LMA
  - Endotracheal intubation
  - Surgical airway, that is, cricothyroidotomy/tracheostomy
- Percutaneous tracheostomy is not recommended in emergency trauma situations

Breathing and Ventilation

- Chest wall mechanics are altered due to rib fractures and pulmonary contusions and cervical cord injury
- Breathing is assessed by determining the patient's respiratory rate and by subjectively quantifying the depth and effort of inspiration
- The patient's chest should be exposed to adequately assess chest wall excursion
- Identify injuries that hampers ventilation by rapid but thorough physical examination.
  - Flail Chest
  - Tension pneumothorax (hyper resonance on percussion with midline shift)
  - Hemothorax (dullness on percussion)
  - Tracheo-bronchial injuries (crepitus on palpation)
  - Open pneumothorax (sucking chest wound)
  - Cardiac tamponade (muffled heart sounds, Kussmaul's breathing)
- If tension pneumothorax is identified, immediate needle decompression in fifth intercostal space in mid axillary line should be performed, followed by intercostal tube drainage
- Needle decompression in second intercostal space in no longer recommended as a first choice
- Rapid respiratory effort, use of accessory muscles of respiration, hypoxia, hypercapnia, asymmetric chest wall excursions, and diminished or absent breath sounds will require treatment before proceeding further
- *Breathing—treatment options include:*
  - Endotracheal intubation and ventilation
  - Needle decompression
  - Intercostal tube drain
  - Pericardial drainage
  - Thoracotomy
  - Adequate analgesia

Circulation with Hemorrhage Control

- Hypotension in a trauma patient is always assumed to result from significant hemorrhage (>30% blood loss), once tension pneumothorax is ruled out
- Rapid and accurate assessment of the patient's hemodynamic status and identification of the site of hemorrhage is therefore essential
- It is critical to establish two large-bore short-length intravenous cannulas(16G or bigger) in a trauma patient, preferably in the upper extremities, and resuscitation should be started with warm crystalloids
- All patients with significant haemorrhage should receive Tranexemic acid within 3 h of trauma (1 g as a bolus followed by 1 g over 8 h)
- Blood and blood products transfusion should be done in patients with ongoing hemodynamic instability after initial fluid boluses, preferably in the ratio of 1:1:1 (PRBC:FFP:Platelets)
- Colloids should not be used in hemorrhagic shock
- All patients requiring massive transfusion should be identified early by using simple scores like Trauma Associated Severe Hemorrhage (TASH) and ABC score
- Point of care assessment for coagulopathy by thromboelastography (TEG) or other viscoelastic test should be done
- All steps to prevent hypothermia, acidosis and coagulopathy should be initiated
- Look for blood in five places: chest, abdomen, pelvis, long bones and floor (for missed bleeding source)
- Chest and pelvic radiographs and an extended focused assessment by sonography in trauma (eFAST) should be done in all trauma patients. Diagnostic peritoneal lavage (DPL) can be considered in select patients
- Diagnostic peritoneal lavage should not be considered in patients with morbid obesity, previous abdominal surgeries, coagulopathy and advanced liver cirrhosis
- Hemorrhage control by direct application of external pressure and/or careful application of tourniquet may be done in all patients. Tourniquets should be left in place till the bleeding is controlled surgically, but the time should be limited
- Pelvic ring should be closed using pelvic binders if the bleeding is suspected from an unstable pelvis
- Fractured long bones should be reduced, and traction splint applied if they are possible source of bleeding to decrease ongoing blood loss and pain as well as to prevent further local injury
- Damage control resuscitation should be considered in all hemodynamically unstable trauma patients due to hemorrhagic shock
- Repeated reassessment should be carried out to identify initial responders who would eventually become non responder
- *Circulation and hemorrhage control—treatment options include:*
  - Two large bore iv cannulas (16G or bigger)
  - Warm fluids (crystalloids)

- Warm blood and blood products
- Early use of tranexamic acid
- eFAST for early identification of source
- Arrest bleeding by direct local pressure and tourniquets
- Arrest bleeding by splinting pelvis and long bones
- Urinary catheter
- Surgery—laparotomy, thoracotomy, and/or pelvic fracture fixation should be undertaken to control bleeding
- Repeated assessments

Disability/Neurological Status

- A rapid neurological evaluation is carried out at the end of primary survey only after the resuscitation and stabilization have been achieved as mentioned above
- This assesses the patient's level of consciousness, pupillary size and reaction, and focal neurological deficit
- The level of consciousness may be described in terms of the GCS
- The GCS is used as a baseline determination of neurological function, and frequent reassessment is required to detect an early or previously missed injury
- Hypoglycemia, drug and alcohol intoxication should be considered for altered consciousness, but all trauma patients with altered GCS have brain injury unless proved otherwise
- A complete neurological examination is not appropriate at this time and should be performed during secondary survey
- *Disability—treatment options include:*
  - O_2 administration
  - Intubation (to ensure normal PO_2 and PCO_2)
  - Avoid hypotension and hypoxia to prevent secondary brain damage
  - Inotropes/vasopressors (to ensure adequate cerebral perfusion)
  - Head up, ensure venous drainage
  - Emergency imaging of the brain or spine
  - Early neurosurgical consultation

Exposure/Environmental Control

- The patient should be completely undressed to facilitate thorough examination and assessment in front and back
- At the same time, care should be taken to prevent hypothermia
- Remove wet or blood-soaked clothes, and use warm IV fluids (39 °C)
- Use blood warmers for transfusing and external warming (warmed blankets to all patients and forced, heated air, or radiant warmers as needed) to prevent hypothermia

Step 4: Adjuncts to Primary Survey and Resuscitation

(a) *ECG monitoring*
- The appearance of dysrhythmias may indicate blunt cardiac injury
- Pulseless electrical activity, the presence of cardiac rhythm without peripheral pulse, may indicate cardiac tamponade, tension pneumothorax, or profound hypovolemia
- Extreme hypothermia can also be the cause of cardiac rhythm disturbances

(b) *Urinary catheter*
- Urine output is a sensitive indicator of the volume status of the patient and reflects renal perfusion
- All trauma victims should be catheterized to enable monitoring of the urine output and to plan intravenous fluid therapy
- Transurethral catheterization is contraindicated in patients whom urethral transaction is suspected (presence of blood in meatus or perineal ecchymosis)

(c) *Gastric catheter*
- A nasogastric tube is indicated to reduce stomach distension and decrease the risk of aspiration. An orogastric is preferred in patients with skull base fracture.

(d) *X-rays and diagnostic studies*
- The chest and pelvis X-rays help in the assessment of a trauma patient
- The blood should be sent for crossmatching and arranging for packed cells, and important diagnostic parameters such as hemoglobin, coagulation profile, renal parameters, electrolytes, random blood sugar, and arterial blood gas (ABG) should be checked
- Pulse oximetry is a valuable adjunct for monitoring oxygenation and adequacy of peripheral circulation in injured patients

(e) *eFAST (extended focused assessment with sonography for trauma)*
- The FAST is a rapid, bedside, ultrasound examination performed to identify intraperitoneal hemorrhage or pericardial tamponade. FAST examines four areas for free fluid: perihepatic and hepatorenal space, perisplenic, pelvis, and pericardium
- eFAST helps in identifying pneumothorax and hemothorax

Step 5: Consideration for Interhospital Transfer

- Identify the early, potential need for transfer of the polytrauma patient to an institution where definitive care can be undertaken
- Transfer decision should be on the basis of known injuries and patterns of injury
- An effective communication including the condition of the patient, treatment given, and anticipated requirements during transfer should be made to the receiving hospital

Step 6: Admit in ICU

- Airway protection and mechanical ventilation
- Cardiovascular resuscitation
- Severe head injury
- Organ support
- Correct coagulopathy
- Invasive monitoring
- Active rewarming of hypothermic patients

Step 7: Secondary Survey

- Once the primary survey is accomplished—life-threatening conditions are managed and resuscitative efforts are underway—secondary survey is carried out
- This is a head-to-toe evaluation of the trauma patient, which includes a complete history and physical examination and reassessment of all the vital signs
- History includes the following:
  - A—Allergies
  - M—Medications currently taken
  - P—Past illness/pregnancy
  - L—Last meal
  - E—Events/environment related to the injury
- Each region of the body is completely examined
- The care should be continued with regular reevaluation of the patient for any deterioration and new findings so that appropriate measures can be taken

Reevaluation

- After the completion of the secondary survey, the patient should be reevaluated beginning with the ABCs and thorough physical examination and examined for any missed injury (tertiary survey) such as fractures
- Constant monitoring of the severely injured patient is required and may necessitate rapid transfer to the surgical intensive care unit, operating room, or to another centre having better specialized facilities
- Appropriate referral for specialists should be sent
- Adequate pain relief, tetanus prophylaxis, and antibiotic should be given
- Specific care should be taken to examine the possible missed injuries on the following:
  - Back of the head and the scalp
  - The neck, beneath semirigid collar
  - Back, buttocks, and flanks
  - Groin creases, perineum, and genitalia

Step 8: Sending Investigations

- Hemoglobin
- ABG
- Hematocrit
- Renal function tests and electrolytes
- Blood sugar
- Total leukocyte count
- Platelet count
- Liver function tests and coagulation tests
- Blood grouping and cross matching
- Urine pregnancy test (14–45 years)
- ECG
- Breath/blood alcohol

Radiological

- Plain radiographs
- CT scanning
- Contrast studies
- Angiography
- Ultrasound (including plain sonography echocardiography and color-flow Doppler)
- Endoscopy

Step 9: Tertiary Survey

- Tertiary survey consists of a repeat of the primary and secondary survey examinations, reassessment of the functions of all tubes and catheters, and review of all X-rays
- It is routinely performed in the morning after the patient's admission to detect any injuries not picked up earlier and to minimize the missed injuries

Suggested Reading

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