Advanced Trauma Life Support

- The severely injured patient, with multiple injuries to different body systems, poses unique diagnostic and treatment challenges.
- The early assessment and management of severe trauma begins in the prehospital environment.
- Many of these patients will be easily identified at the scene of injury and forewarning the receiving hospital allows the activation of the trauma team to prepare for the patient's arrival.
- Key information in the pre-alert includes basic demographic information (age and gender), mechanism of injury, injuries identified and vital signs, including respiratory rate, pulse, blood pressure and Glasgow Coma Scale (GCS).
- Patients that are identified prehospital as sustaining, or at high risk of sustaining, severe multisystem trauma should generate trauma team activation in the receiving hospital.

- All hospitals managing severe trauma should have a dedicated trauma team, who are available immediately to attend and manage patients presenting with severe trauma.
- The composition of the team involve doctors from the emergency department, anaesthetics and/or critical care, orthopaedics and general surgery.
- Increasingly, radiology and haematology doctors are contributing to the trauma team, as part of the patient's initial assessment and management.

- **The role of the trauma team is to apply the principles of Advanced Trauma Life Support (ATLS) to rapidly identify and treat life-threatening injuries during the primary survey.**
- The principle advantage of a trauma team is that this **activity can occur concurrently instead of sequentially**; while the anesthetist may be assessing and managing the patient's airway, another team member can be assessing and managing the patient's breathing, etc.
- The importance of the trauma team leader cannot be overemphasized: they brief and prepare the team, coordinate these sequential activities, manage time, interpret findings and plan the next move.

- Increasing recognition of the importance of this role has led to the development of postgraduate training courses designed to teach both the technical and non-technical skills required.
- Generally, the trauma team leader and most senior clinicians should be standing back from the patient, looking at the bigger picture, in order to anticipate the next key decisions.

Initial Assessment and Management

- Patient assessment in trauma consists of,
  1. Primary survey and with simultaneous resuscitation
  2. Adjuncts to the primary survey
  3. Re-evaluation
  4. Secondary survey
  5. Adjuncts to the secondary survey

1. Primary Survey with Simultaneous Resuscitation

- Patients are assessed, and their treatment priorities are established, based on their injuries, vital signs, and the injury mechanisms.
- Logical and sequential treatment priorities are established based on the overall assessment of the patient.

- The patient’s vital functions must be assessed quickly and efficiently.
- Management consists of a rapid primary survey with simultaneous resuscitation of vital functions, a more detailed secondary survey, and the initiation of definitive care.

The primary survey encompasses the cABCDEs of trauma care and identifies life-threatening conditions by adhering to this sequence:

cControl of massive external haemorrhage

Airway maintenance with restriction of cervical spine motion

Breathing and ventilation

Circulation with hemorrhage control

Disability(assessment of neurologic status)

Exposure/Environmental control

- The above prioritized sequence is based on the degree of life threat, the abnormality posing the greatest threat to life is addressed first.

c: Control of massive external hemorrhage

- Experience from war zones over the past 20 years has shown that exsanguinating external hemorrhage from massive arterial bleeding needs to be controlled even before the airway is managed (see Chapter 30).
- Most of these injuries are due to gunshot wounds or blasts and are mainly seen in military practice.
- However, they are encountered in civilian practice.
- Bleeding must be controlled immediately by the application of packs and pressure directly onto the bleeding wound and artery.
- Hemostatic dressings that contain agents that augment local coagulation are now available.

- Failure to control bleeding in the limb by direct pressure should be followed by the application of a tourniquet proximal to the wound.
- In the field, simple tourniquets can be improvised if pneumatic tourniquets are not available.
- It is vital to appreciate that once a tourniquet is applied the limb becomes ischaemic – the time for which the tourniquet is applied must be recorded on the patient and the patient requires **urgent** surgical control of the bleeding in order to reperfuse the limb.

A: Airway with cervical spine control

- All trauma patients should have their cervical spine immobilized and protected throughout.
- An immediate assessment of the patient's airway is made.
- A compromised airway requires a stepwise progression, first clearing the airway by suctioning secretions or blood, followed by simple airway manoeuvres such as a jaw thrust, chin lift and insertion of an oropharyngeal or nasopharyngeal airway.
- Advanced airway manoeuvres necessitate the insertion of a cuffed endotracheal tube.
- This may require an anaesthetic with rapid sequence induction or a surgical airway.

- Emergency intubation of the severely injured trauma patient is a difficult and demanding skill – standardized and rehearsed procedures should be in place for failure to intubate.
- Equipment and expertise for achieving a surgical airway must be readily available.

Impending or potential compromise of the airway can be suspected in,

- Inhalation injury
- Facial fractures
- Retropharyngeal hematoma
- Sustained seizure activity
- Closed head injury (GCS < 8)
- Inability to maintain adequate saturation by face mask oxygen

B: Breathing and ventilation

- All patients should receive high-flow oxygen.
- Life-threatening chest pathology such as tension pneumothorax, massive haemothorax and flail segment should be diagnosed and managed immediately.
- Equipment and expertise for rapid insertion of intercostal chest drains should be available.

C: Circulation and haemorrhage

- All patients require adequate intravenous access with at least two large-bore intravenous (IV) cannulae.
- Equipment and expertise for insertion of central or intraosseous venous access should be available where peripheral access is not easily obtainable.
- Blood should be taken for cross-match and laboratory assessment, including haemoglobin and venous lactate.
- An assessment of the haemodynamic status should be made to identify shocked patients: the skin may be pale, cool and sweaty, the pulse rate raised to over 100 per minute and the blood pressure low.

TABLE 3-1 SIGNS AND SYMPTOMS OF HEMORRHAGE BY CLASS

PARAMETER	CLASS I	CLASS II (MILD)	CLASS III (MODERATE)	CLASS IV (SEVERE)
Approximate blood loss	<15%	15–30%	31–40%	>40%
Heart rate	↔	↔/↑	↑	↑/↑↑
Blood pressure	↔	↔	↔/↓	↓
Pulse pressure	↔	↓	↓	↓
Respiratory rate	↔	↔	↔/↑	↑
Urine output	↔	↔	↓	↓↓
Glasgow Coma Scale score	↔	↔	↓	↓
Base deficit[a]	0 to –2 mEq/L	–2 to –6 mEq/L	–6 to –10 mEq/L	–10 mEq/L or less
Need for blood products	Monitor	Possible	Yes	Massive Transfusion Protocol

[a] Base excess is the quantity of base (HCO_3^-, in mEq/L) that is above or below the normal range in the body. A negative number is called a base deficit and indicates metabolic acidosis.

- A pelvic binder should be applied to all haemodynamically unstable patients following blunt trauma and not removed until after a pelvic fracture has been excluded.
- Hypotensive trauma patients are treated as hypovolaemic until proven otherwise.
- The priority is now simultaneous fluid resuscitation and identification of the source of the haemorrhage.

- Severely injured hypovolaemic patients should be resuscitated with blood and blood products, not crystalloid/colloid fluids.
- These must be warmed. All hospitals managing severe trauma should have a massive transfusion protocol which aims to provide blood and blood products in a ratio of 1 packed red cells:1 fresh frozen plasma:1 platelets.

Tranexamic Acid

- Tranexamic acid is an antifibrinolytic drug that reduces the risk of mortality from bleeding in both blunt and penetrating trauma.
- One gram is given intravenously over 10 minutes, followed by a further 1 g dose over 8 hours.
- Tranexamic acid should be given to all trauma patients suspected to have significant haemorrhage, including those with a systolic blood pressure of <110 mmHg or a pulse of over 110 per minute.
- It needs to be administered within 3 hours of injury.

- The sites of major haemorrhage in trauma patients are the chest, abdomen, pelvis, long bones and external haemorrhage.
- Blunt trauma patients frequently have multiple sources of haemorrhage.
- Clinical examination and investigations should aim rapidly to confirm or exclude significant bleeding from each of these sites.

‘Whole body CT’ (WBCT)

- WBCT from the head to pelvis with IV contrast is the gold standard investigation of the severely injured adult blunt trauma patient.
- There is no role for selective scanning of body systems in these patients.
- WBCT scan is a time-critical investigation and should be obtained as early as possible in resuscitation of the severely injured patient.
- Any patient undergoing immediate trauma laparotomy after blunt trauma without a WBCT scan should have a pelvic binder applied and not removed until a pelvic fracture is excluded.
- Such patients should have an immediate pelvic radiograph either in the emergency department, or as they arrive in the operating room.

D: Disability and E: Exposure

- On admission, the GCS score should be calculated, the pupils assessed for size and reaction to light and the patient observed to determine whether they are moving all four limbs.
- The core temperature must be recorded.
- Patients are managed with cervical spine protection (cervical collar and blocks) and protection of the thoracolumbar spine using standard log roll techniques until a spinal injury has been excluded.

- Early WBCT scan will rapidly identify the majority of intracranial and spinal pathology.
- The patient must be adequately exposed to allow a thorough and systematic clinical examination during the secondary survey but they must be kept warm.
- Trauma patients are frequently hypothermic and this will further increase coagulopathy.
- Log-rolling patients with severe pelvic fractures may harm the patient by disturbing established blot clots.
- Log-rolling should not occur until a pelvic fracture has been radiographically excluded.
- If patients need to be moved during their primary survey, such as when moving on to the CT scanning gantry, a 20° roll with inline spinal stabilization should be used.
- Modern 'Scoop Stretchers' mean that there is no requirement to roll any patient more than 20° until a pelvic fracture has been excluded.

2. Adjuncts to the primary survey

- Adjuncts used during the primary survey include continuous electrocardiography, pulse oximetry, carbon dioxide (CO_2) monitoring, and assessment of ventilatory rate, and arterial blood gas (ABG) measurement.
- In addition, urinary catheters can be placed to monitor urine output and assess for hematuria.

- Gastric catheters decompress distention and assess for evidence of blood. Other helpful tests include blood lactate, x-ray examinations (e.g., chest and pelvis), FAST, extended focused assessment with sonography for trauma (eFAST), and DPL.

3. Re-evaluation

- Physiologic parameters such as pulse rate, blood pressure, pulse pressure, ventilatory rate, ABG levels, body temperature, and urinary output are assessable measures that reflect the adequacy of resuscitation.
- Values for these parameters should be obtained as soon as is practical during or after completing the primary survey, and **reevaluated periodically**.

4. Secondary Survey

- **The secondary survey does not begin until the primary survey (ABCDE) is completed, resuscitative efforts are under way, and improvement of the patient's vital functions has been demonstrated.**
- The secondary survey is a head-to-toe evaluation of the trauma patient—that is, a complete history and physical examination, including reassessment of all vital signs.
- Each region of the body is completely examined.
- The potential for missing an injury or failing to appreciate the significance of an injury is great, especially in an unresponsive or unstable patient.

- Such patients should have a ‘tertiary survey’ when extubated and alert, to identify any missed ‘minor’ injuries such as a scaphoid fracture in the wrist or a rotator cuff tear in the shoulder.
- These injuries have the potential to cause significant long-term disability.
- It is essential that the findings of the primary, secondary and tertiary surveys are clearly recorded in the patient case notes.

5. Adjuncts to the secondary survey

- Specialized diagnostic tests may be performed during the secondary survey to identify specific injuries.
- These include additional x-ray examinations of the spine and extremities; CT scans of the head, chest, abdomen, and spine; contrast urography and angiography; transesophageal ultrasound; bronchoscopy; esophagoscopy; and other diagnostic procedures.

Trauma patients must be reevaluated constantly to ensure that new findings are not overlooked and to discover any deterioration in previously noted findings.