Trauma (ATLS)

Amer Salamat
INTRODUCTION

• Trauma, or injury, is defined as cellular disruption caused by an exchange with environmental energy that is beyond the body’s resilience which is compounded by cell death due to ischemia/reperfusion.

• It is a major public health problem and represents the most common cause of death among patients aged 1-44 years and is the third most common cause of death regardless of age.

• It is also the leading cause of years of productive life lost.
• Unintentional injuries: 110,000 deaths per year, with motor vehicle collisions accounting for over 40%.
• Homicides, suicides, and other causes are responsible for another 50,000 deaths each year.
• However, death rate under-estimates the magnitude of the societal toll. For example, in 2004 there were approximately 167,000 injury-related deaths, but 29.6 million injured patients treated in emergency departments (Eds).

• Global trauma related dollar costs exceed $500 billion annually. These costs are much higher if we consider lost wages, medical expenses, insurance administration costs, property damage, fire loss, employer costs, and indirect loss from work-related injuries.
The Advanced Trauma Life Support (ATLS) course of the American College of Surgeons Committee on Trauma was developed in the late 1970s, based on the premise that appropriate and timely care can significantly improve the outcome for the injured patient.

ATLS provides a structured approach to the trauma patient with standard algorithms of care; it emphasizes the “golden hour” concept that timely, prioritized interventions are necessary to prevent death and disability.

Advance trauma life support is the initial assessment of any trauma patient.
• The frequency of deaths after injury follows a trimodal distribution:

1) The first peak occurs within seconds to minutes after injury. (immediate death)
   Due to devastating wounds such as: lacerations of the brain, brain stem, high spinal cord, heart, aorta, and other large blood vessels.
2) The second peak occurs within minutes to several hours after injury (early death).

Due to major intracranial (subdural and epidural hematomas), thoracic (hemopneumothorax), abdominal (ruptured spleen, lacerations of the liver), pelvic (pelvic fractures), and extremity injuries and/or other multiple injuries associated with significant blood loss.

So trauma resuscitation programs focuses primarily on this period.
The “first hour” of care after injury focuses on rapid assessment and resuscitation, which is the hallmarks of trauma evaluation and management. The concept of the “golden hour” emphasizes the urgency of successful management in order to optimize outcomes of the injured patient and is not intended to imply “fixed” time period of 60 minutes.

3) The third peak occurs within days to weeks after injury (late death)

...due to secondary complications (sepsis, acute respiratory distress syndrome, or multiple organ dysfunction/failure).
Trimodal death Distribution
Concepts of Initial Assessment

1. Preparation
2. Triage
3. Primary Survey (ABCDEs)
4. Resuscitation
5. Adjuncts to primary survey
6. Secondary Survey (head to toe evaluation & patient history)
7. Adjuncts to secondary survey
8. Continued post-resuscitation monitoring and re-evaluation
9. Definitive care
Concepts of Initial Assessment
Initial Assessment and Management

The initial management of seriously injured patients consists of phases that include:
1. Preparation:

Include two phases:
1) prehospital phase

- ask for help
- Immediate transport the patient to closest appropriate facility (trauma center)
- Notify receiving hospital before transport
- Airway maintenance
- Control of external bleeding and shock
- Patient immobilization
2) In-Hospital phase
- Airway equipment
- Warmed IV solutions
- Call the blood bank (warming blood)
- Monitoring devices
- Ancillary departments (Ex. Vascular surgeon)
- Wear standard precaution devices
2. TRIAGE

- It is sorting out patients in hospital based on:

  1) patients needs for treatment and Injury is severe

  2) The available resources

  3) Salvageability
• Sorting out patients in the field to make a decision where to send them.

• GLASGO COMA SCORE

<table>
<thead>
<tr>
<th>GLASGOW COMA SCORE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Eye(s) Opening</strong></td>
</tr>
<tr>
<td>Spontaneous</td>
</tr>
<tr>
<td>To speech</td>
</tr>
<tr>
<td>To pain</td>
</tr>
<tr>
<td>No response</td>
</tr>
<tr>
<td><strong>Verbal Response</strong></td>
</tr>
<tr>
<td>Oriented to time, place, person</td>
</tr>
<tr>
<td>Confused/disorientated</td>
</tr>
<tr>
<td>Inappropriate words</td>
</tr>
<tr>
<td>Incomprehensible sounds</td>
</tr>
<tr>
<td>No response</td>
</tr>
<tr>
<td><strong>Best Motor Response</strong></td>
</tr>
<tr>
<td>Obeying commands</td>
</tr>
<tr>
<td>Moves to localised pain</td>
</tr>
<tr>
<td>Flexion withdraws from pain</td>
</tr>
<tr>
<td>Abnormal flexion</td>
</tr>
<tr>
<td>Abnormal extension</td>
</tr>
<tr>
<td>No response</td>
</tr>
<tr>
<td><strong>Best response</strong></td>
</tr>
<tr>
<td>Comatose patient</td>
</tr>
<tr>
<td>Totally unresponsive</td>
</tr>
</tbody>
</table>
3. The primary survey

Consists of a rapid, systemic evaluation of airway, breathing, circulation, disability, and exposure/environment, treating life-threatening conditions as they are discovered.

Primary survey and resuscitation of vital functions are done simultaneously using a team approach.
2) The secondary survey consists of a focused injury history and detailed physical examination, designed to pinpoint the exact nature of the injuries.

Secondary survey conducted simultaneously with reassessment of the patient’s ABCDEs.
• The primary and secondary surveys should be repeated frequently to identify any deterioration in the patient’s status.

• Any necessary treatment should be initiated at the time an adverse change is identified.

• This sequence is presented as an overview of a linear or longitudinal progression of events. In the actual clinical situation, many of these activities occur in parallel or simultaneously.

  So the linear or longitudinal progression allow doctor an opportunity to mentally review the progress of an actual trauma resuscitation while maintaining an order of priority related to the degree of life threat.
Primary survey

• Patients are assessed and their treatment priorities established based on the degree of life threat posed by their injuries, vital signs, and the injury mechanism.

• The priorities are the same for all patients (adults, pediatric, pregnancy, and geriatric patients)

• During the primary survey, life-threatening conditions are identified, and management is instituted simultaneously.
This process using the mnemonic “ABCDE” for trauma care and identifies life-threatening conditions by adhering to this sequence:

**A**irway maintenance with c-spine protection (A)

**B**reathing with life threatening chest injury management (B)

**C**irculation with hemorrhage control (C)

**D**isability: brief neurologic examination with intracranial mass lesion recognition (D)

**E**xposure / Environmental with maintenance of normal body temperature (E)
Quick assessment

Assess the patient within 10 seconds:
1) Identify yourself
2) Asking patient his/her name
3) Asking the patient what happened

An appropriate response suggests that the patient has:
A patent airway, sufficient air reserve to permit speech, sufficient perfusion to preserve cerebration, and clear sensorium.

An inappropriate response suggests urgent problems affecting A, B, C, or D requiring urgent intervention
Appropriate Response

(A) patent airway
(B) sufficient air reserve to permit speech
(C) sufficient perfusion to preserve cerebration
(D) clear sensorium
A. Airway maintenance with c-spine protection

- Ensuring a patent airway is the first priority in the primary survey.

- This rapid assessment for signs of airway obstruction should include inspection for foreign bodies and facial, mandibular, or tracheal/laryngeal fractures that may result in airway obstruction.
How do I know the airway is adequate?

- Patient is alert and oriented.
- Patient is talking normally.
- There is no evidence of injury to the head or neck.
- You have assessed and reassessed for deterioration.
Airway management

• Airway obstruction is identified and managed during the primary survey. Must be immediately recognized and promptly corrected.

• Snoring, gurgling, stridor, hoarseness, and rocking chest wall motions are indicative of airway obstruction.
Signs and symptoms of airway compromise

- High index of suspicion
- Change in voice / sore throat
- Noisy breathing (snoring and stridor)
- Dyspnea and agitation
- Tachypnea
- Abnormal breathing pattern
- Low oxygen saturation (late sign)
• Airway suctioning is then performed as necessary to clear excessive secretions, using a suction catheter.

• Particulate matter is removed, if present, using finger-sweep or forceps.
Protect the cervical spine during airway management!

• Basic techniques:

1) Chin-lift maneuver

To perform the head tilt: place one of your hands-on patient’s forehead and apply gentle, firm backward pressure using the palm of your hand.

Place the fingers of the other hand under the bony part of the chin.

Lift the chin forward and support the jaw helping to tilt the head back, This maneuver will lift the patient’s tongue away from the back of the throat and provide an adequate airway.
2) Jaw-thrust maneuver

- a bimanual technique performed by placing the index and middle fingers to physically push the posterior aspects of the mandible upwards while their thumbs push down on the chin to open the mouth.
Airway adjuncts

• May be necessary to maintain airway patency in patients who are unconscious and have lost their gag reflex.

• Basic adjuncts:
  1) Oropharyngeal airway: Some patients
  2) Nasopharyngeal airway: well tolerated

** Avoid in patients with mid-face fractures
If the patient is unable to maintain spontaneous respiration or patency of the airway, then a definitive airway is indicated.

**A definitive airway**: is a tube placed in the trachea with the cuff inflated below the vocal cords, the tube connected to some form of oxygen-enriched assisted ventilation, and the airway secured in place with tape.

Usually is obtained via the orotracheal route, with other techniques being applied as indicated. (Tracheostomy, Cricothyroidotomy)
**Cervical spine protection**

- While assessing and managing patient’s airway, great care should be taken to prevent excessive movement of the cervical spinal.

- The patient head and neck should not be hyperextended, hyperflexed, or rotated to establish and maintain the airway.

- Neurologic examination alone does not exclude a cervical spine injury.
• Protection of the patient’s spinal cord with manual inline immobilization followed by the application of appropriate immobilization devices should be accomplished.

• Immobilization devices (neck collar) used to protect the patient’s spinal cord should be left in place until cervical spine injury is excluded.

• Remember: Assume a cervical spine injury in any patient with multisystemic trauma, especially with an altered level of consciousness or a blunt injury above the clavicle.
Breathing with life threatening chest injury management

• Assess and ensure adequate oxygenation and ventilation

Oxygen should be administered to all trauma patients, using a high concentration mask with a reservoir.

• Ventilation: gas exchange: oxygenation & CO2 elimination (in the alveolar level).

• Breathing : gas flow (through the airway).
• No laboratory tests diagnose respiratory failure. The initial diagnosis is based on clinical appreciation of the presence of inadequate or ineffective ventilation and oxygenation

• Respiratory rate
• Chest movement
• Air entry (auscultation)
• Oxygen saturation
• The patient’s chest should be exposed to adequately assess chest wall excursion

• Auscultation should be performed to assure gas flow in the lungs.

• Adequacy of ventilation should be assessed through observation of chest wall mechanics. (accessory muscle use and ventilatory rate)

• Percussion may suggest the presence of air or blood in the chest.

• Visual inspection and palpation may detect injury to the chest wall that may compromise ventilation (Inspect position of trachea, symmetric chest wall excursion, palpate for emphysema, chest wall deformities)
• Injuries that may acutely impair ventilation are:
  1) Tension pneumothorax
  2) Flail chest
  3) Pulmonary contusion
  4) Massive hemothorax
  5) Open pneumothorax
• Simple pneumo- or hemothorax, fractured ribs, and pulmonary contusion may compromise ventilation to a lesser degree and are usually identified in the secondary survey.

• Tension and open pneumothorax are identified and controlled in the primary survey.

• If suspect tension pneumothorax, needle decompression should be accomplished immediately, followed later by chest tube insertion.

• Remember: Tension pneumothorax is a clinical diagnosis and not a radiologic diagnosis.
An open pneumothorax also compromise ventilation dramatically and acutely, and if suspected, the chest wall defect should be treated immediately with an occlusive dressing followed by a chest tube insertion.
Simple Pneumothorax

Appears as black line in the patient’s left lung extends vertically representing air in the pleural cavity.

It is ok to identify this type of pneumothorax by X-ray.

Hemothorax

Appears as opacity in the patient’s right side.

The patient is in supine position.
**NOTES**

✓ **Tension pneumothorax**
  ✓ Shifted mediastinum
  ✓ Valve like mechanism (leakage of air during inspiration into the pleural cavity & that air can’t go back to the lung during expiration) → increase in the pressure → Shift the mediastinum → compromising the airway + compromising of major blood vessels → decrease venous return → shock
  ✓ Management: needle decompression at 2nd intercostal space then chest tube
  ✓ Should be diagnosed clinically not by X-ray
  ✓ Diagnosed by P/E:
    1. Inspection: No air entry
    2. Percussion: Hyper-resonance
    3. Palpation: Shift in the trachea
    4. Vital signs: Hypotension, congested neck veins
Widened mediastinum

Indicating major vascular injury.
flail chest

two separate fractures in three or more consecutive ribs (at least 2 ribs with 2 sides fractures) so there is a free segment that move paradoxically during breathing .(sucks in with inspiration and pushes out with expiration opposite the rest of chest wall ) .

it is significant because it compromises breathing and ventilation and usually there is underlying lung contusion due to insertion of fractured rib to inside .

Summary box 24.5

Breathing
- Give 100 per cent oxygen at high flow
- Inspect/percuss and auscultate chest
- Check for tension pneumothorax and immediately decompress if suspected
- Insert chest drain for haemothorax/pneumothorax
- Major vessel bleeding within the chest needs to be controlled
Circulation with hemorrhage control

- Assess for organ perfusion

- Shock in the trauma may be hemorrhagic or nonhemorrhagic.

- Hemorrhagic is the most common and is the predominant cause of postinjury death.

- All patient considered to be in hemorrhagic shock until proven otherwise.
How do we control bleeding?

• External bleeding is controlled by direct pressure

• Internal hemorrhage may require operative intervention

• Internal source if hemorrhage may be the chest, abdomen, pelvis, retroperitoneum, or long bones like in the thighs (femur fracture the patient may lose up to 2 L even if there is no external bleeding)
Hypovolemia

• Main clinical signs of hypo-volemia:
  1. Level of consciousness: altered if cerebral perfusion is impaired
  2. Skin color: hypovolemic patients have pale extremities, gray facial skin
  3. Pulse: rapid thready pulse is a sign of hypovolemia

  - A normal pulse rate does not necessarily indicate normovolemia.
  - Check pulse in easily accessible central areas (carotid or femoral).

Summary box 24.6

Circulation
- Check pulse and blood pressure
- Secure two large-bore cannulae, take bloods and commence fluid resuscitation
- Examine for evidence of blood loss and treat accordingly
We classify hemorrhagic shock depending on the amount of bleeding (we estimate it during examination) into 4 classes:

<table>
<thead>
<tr>
<th>Signs and Symptoms of Advancing Stages of Hemorrhagic Shock</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td>Blood loss (mL)</td>
</tr>
<tr>
<td>Blood loss (%BV)</td>
</tr>
<tr>
<td>Pulse rate</td>
</tr>
<tr>
<td>Blood pressure</td>
</tr>
<tr>
<td>Pulse pressure (mmHg)</td>
</tr>
<tr>
<td>Respiratory rate</td>
</tr>
<tr>
<td>Urine output (mL/h)</td>
</tr>
<tr>
<td>CNS/mental status</td>
</tr>
</tbody>
</table>
Disability: brief neurologic examination with intracranial mass lesion recognition

• Level of consciousness: GLASGO COMA SCORE

• How we could know that the patient is disabled or not?
By sensory motor examination if the patient is conscious.

• But if the patient was unconscious?
You should check pupillary reflex and signs of spinal injury level.

• Digital Rectal examination??
• Causes of decreased level of consciousness:
  1. Decreased cerebral oxygenation &/or perfusion
  2. Direct cerebral injury
  3. Hypoglycemia
  4. Alcohol, narcotics
Exposure / Environmental with maintenance of normal body temperature

- Patient should be undressed for a complete assessment (to visualize any other traumatized part of the body).

- You should do this very quickly and do “log roll maneuver”.

- Once you have finished that you have to cover the patient again.

“log roll maneuver “:
- Multiperson maneuver—one for stabilization of the neck, other for the chest, lower limbs and elevate the side of patient in order to see the back.
• Hypothermia is a big enemy for trauma patient:
  • proteins and most reactions in the body need certain PH and certain body temperature, when these 2 parameters when increased or decreased in its value the proteins will be denatured.

• All clotting factors are composed of proteins, if become nonfunctioning that means your patient is getting coagulopathic (no clotting > bleeding get worse).
<table>
<thead>
<tr>
<th>Immediately Life-Threatening Injuries to Be Identified during the Primary Survey</th>
</tr>
</thead>
<tbody>
<tr>
<td>Airway</td>
</tr>
<tr>
<td>Airway obstruction</td>
</tr>
<tr>
<td>Airway injury</td>
</tr>
<tr>
<td>Breathing</td>
</tr>
<tr>
<td>Tension pneumothorax</td>
</tr>
<tr>
<td>Open pneumothorax</td>
</tr>
<tr>
<td>Flail chest with underlying pulmonary contusion</td>
</tr>
<tr>
<td>Circulation</td>
</tr>
<tr>
<td>Hemorrhagic shock</td>
</tr>
<tr>
<td>Massive hemothorax</td>
</tr>
<tr>
<td>Massive hemoperitoneum</td>
</tr>
<tr>
<td>Mechanically unstable pelvis fracture</td>
</tr>
<tr>
<td>Extremity fractures</td>
</tr>
<tr>
<td>Cardiogenic shock</td>
</tr>
<tr>
<td>Cardiac tamponade</td>
</tr>
<tr>
<td>Neurogenic shock</td>
</tr>
<tr>
<td>Cervical spine injury</td>
</tr>
<tr>
<td>Disability</td>
</tr>
<tr>
<td>Intracranial hemorrhage/mass lesion</td>
</tr>
</tbody>
</table>
4. Resuscitation

• AIRWAY:
  - Try Cleaning the airway from obstructing objects if possible.
  - Jaw thrust & chin lift may be good enough as an initial intervention.
  - Establish a definitive airway if in doubt about patient ability to maintain airway.
  - Establish a surgical airway if intubation is not feasible.

• CIRCULATION & HEMORRHAGE CONTROL:
  - Definitive control of bleeding is essential along with appropriate replacement of intravascular volume.
  - Insert two peripheral large caliber IV catheters, send blood samples: In order to do blood grouping and cross match.
  - Blood stored on a temperature of 4C. so we should warm the blood before transfusion.
• - Crystalloids can be warmed in fluid warmer or microwave oven
  - Blood products cannot be warmed in microwave oven.
(Begin volume resuscitation with liter boluses of **crystalloid** for **class I or II** hemorrhage, crystalloid and blood for class III or IV hemorrhage)

“3:1 rule” 3cc crystalloid for every 1cc of blood loss (every 1000 blood loss give 3 l of iv fluid).

Definitive control of bleeding includes:

- Surgery
- Angio-embolization
- Pelvic stabilization
Resuscitation

1. Protect and secure airway

2. Ventilate and oxygenate

3. Stop the bleeding!

4. Crystalloid / blood resuscitation

5. Protect from hypothermia
5. Adjuncts to primary survey

- ECG monitoring
- Urinary catheter
- Gastric catheter
- ABGs
- Pulse oximetry
- Blood pressure
- X-rays: cervical spine, AP chest and AP pelvic films.
Diagnostic Tools

FAST

DPL
IMAGING — ULTRASOUND

- Quick
- Can be performed at bedside

**FAST Exam**

- FAST: Focused Assessment with Sonography for Trauma, done by trauma surgeon or ER physician
- Rapid examination to identify free intraperitoneal fluid and/or pericardial fluid
- 4 views:
  1. Cardiac (pericardium): fluid in case of trauma = tamponade, not effusion “effusion is a chronic medical condition and the fluid presents chronically”
  2. RUQ: mainly Morrison’s pouch btw the liver and the right kidney
  3. LUQ: pouch btw the spleen and the left kidney
  4. Suprapubic: Douglas pouch
- Goal: evaluate for free fluid (blood)
6. Secondary survey:

1. Does not begin until the primary survey (ABCDEs) is completed, resuscitative efforts are well established & the patient is demonstrating normalization of vital sign.

2. Head to Toe evaluation & reassessment of all vital signs.

3. Complete history & physical exam for each region of the body.

4. A complete neurological exam is performed including a GCS score.
• History
A : Allergies.
M : Medication currently used.
P : Past illness/ Pregnancy.
L : Last Meal
E : Events/Environment related to the injury
• Mechanisms of injury.
Head

External exam
Scalp palpation
Comprehensive eye and ear exam (Include visual acuity)
Maxillofacial

Bony crepitus
Deformity
Malocclusion
Neck (Soft Tissues)

Mechanism:  Blunt versus penetrating

Symptoms:  Airway obstruction, hoarseness

Findings:  Crepitus, hematoma, stridor, bruit
Chest

Inspect
Palpate
Percuss
Auscultate
X-rays
Abdomen

Inspect / Auscultate
Palpate / Percuss
Reevaluate

Hollow viscus injury/ Retroperitoneal injury???
Perineum
Contusions, hematomas, lacerations, urethral blood

Rectum
Sphincter tone, high-riding prostate, pelvic fracture, rectal wall integrity, blood

Vagina
Blood, lacerations
Pelvis

Pain on palpation
Leg length unequal
Instability
X-rays as needed
Extremities

Contusion, deformity

Pain

Perfusion

Peripheral neurovascular status

X-rays as needed
Musculoskeletal System

- Potential blood loss
- Missed fractures
- Soft tissue or ligamentous injury
- Compartment syndrome
Neurologic: Brain

GCS
Pupil size and reaction
Lateralizing signs
Frequent reevaluation
Prevent secondary brain injury

Early neurological consult
Neurologic: Spinal Assessment

Whole spine
Tenderness and swelling
Complete motor and sensory exams
Reflexes
Imaging studies
7. Adjuncts to Secondary Survey

- Any other specialized diagnostic test (CT scans, MRI, x bronchoscopy, endoscopy, angiography)
8. RE-EVALUATION

Adult urine output 0.5ml/kg/hr.

Pediatric urine output (if older than 1 year) 1mg/kg/hr.

Pain relief -- IM should be avoid. (IV)
9. Definitive care

Transfer should be considered whenever the patient’s treatment needs exceed the capability of the receiving institution. (multisystem or complex injuries/ Patients with comorbidity or age extremes)

- When it becomes mandatory to transfer the patient from the initial receiving hospital, the patient must be hemodynamically and cardiovascular stable. (airway and ventilatory control).
References

• American College of Surgeons Committee.

• Schwartz principles of surgery

• The Washington Manual of Surgery