TRAUMA
BY: CONSULTANT SURGON EZZ ABDUL-SALAM

- Trauma is “the forgotten epidemic” & “the neglected disease of modern society”
- The 3rd most common cause of death overall.
- It is the leading cause of mortality and disability during the 1st 4 decades of life.
- It kills and disable hundreds of thousands of individuals annually.
Trauma

- For each trauma death, there are more than 10 persons that are seriously injured and some of these are permanently disabled.
- The direct cost for the society in caring for the victims of trauma is enormous (billions of dollars).
- Loss of productivity at work of the affected young individuals is immense.
Epidemiology

**Jordan:** 850 deaths

3000 disability each year (in 2002 & 2003)

**Worldwide:** - 5 million deaths (1990)

**USA:** - 2.5 millions injury, High risk group is the young adults

- 150,000 deaths
- 40% 25-45 yrs.
- 20% 15-24 yrs.
- 80% below 45 yrs.
Leading Causes

- Road traffic accidents
- Falls from a height
- Crimes and acts of violence
- Domestic injury – Burn
- Industrial injury
Biomechanics of Injury

The traumatic agent & the way in which the body can be damaged is so enormous, it leads to severe deformation of tissues beyond a threshold that results in severe structural damage

It is either
- Blunt; RTA, fall---etc.
- Penetrating; stab & gunshots.
Energy Transfer

Severity of damage is proportional to the amount of kinetic energy (KE)

\[ KE = \frac{1}{2} M \times V^2 \]

\( M = \text{Mass}, \quad V = \text{Velocity} \)

And the area over which it is applied.

The primary determinant being velocity rather than mass
Cavitation

- Tissue displacement due to transfer of kinetic energy in shock waves radiate from the track of bullet or trauma. In high velocity missile injuries, the energy may be dissipated over a wide area.

- The extent of cavitation depends upon the density & the elasticity of the target organ and it is associated with tissue injury many centimeters around the missile track.
Gunshot inlet
Gunshot outlet
Inlet
Outlet
Shotgun in the abdomen
Road Traffic Accidents

Passenger:
- The passenger is thrown against the interior of the vehicle.
- Crushed by vehicle deformation or
- Ejected outside with sudden deceleration when it strikes the ground or another vehicle.
- Air bags prevent the initial collision of passenger & the interior in frontal impact.
Frontal impact
Lateral impact
Lateral -T- 2 cars + tree
Head on collision
Roll over & ejection
Seat belt injury;

- It has saved many lives.
- It reduced the incidence & severity of injury,
- Trauma may be produced by inertia against the strap as the car rapidly decelerates in crash e.g. fracture cervical spines, fracture sternum & ribs with pulmonary or cardiac contusion
Seat belt injury
GLASGOW COMA SCALE

1. Eye Opening

   Spontaneous  4
   To voice     3
   To pain      2
   None         1
2. Verbal Response

Oriented 5
Confused 4
Inappropriate words 3
Incomprehensible sound 2
None 1
3. Motor Response

- Obeys commands: 6
- Localizes pain: 5
- Withdraws (pain): 4
- Flexion (pain): 3
- Extension (pain): 2
- None: 1

**Totals GCS: 15**
Total GCS in trauma score

- 14-15 = 5
- 11-13 = 4
- 8-10 = 3
- 5-7 = 2
- 3-4 = 1

Total Trauma Score = 1-16
MCQ

- A 25-year-old female was admitted to hospital after RTA with eye opening to pain, inappropriate words in verbal response and withdraws to painful stimuli. His Glasgow coma scale is:
  - A. 12
  - B. 11
  - C. 10
  - D. 9*
  - E. 8
ISS/A1S (Anatomical scoring system)

The severity of injury is assessed in six different areas on a scale from 0 to 5.

1. External-contusions, burns 0-----5
2. Extremities fractures 0-----5
3. Abdomen 0-----5
4. Thorax 0-----5
5. Face 0-----5
6. Head/Neck 0-----5
AIS for Abdominal Injuries

<table>
<thead>
<tr>
<th>Score</th>
<th>Injury examples</th>
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<tbody>
<tr>
<td>1</td>
<td>Abdo-wall abrasion</td>
</tr>
<tr>
<td>2</td>
<td>Contusion-Liver, mesentery</td>
</tr>
<tr>
<td>3</td>
<td>Minor Laceration-Liver, Bowel</td>
</tr>
<tr>
<td>4</td>
<td>Major Laceration-Liver, Bowel</td>
</tr>
<tr>
<td>5</td>
<td>Major Laceration with tissue loss</td>
</tr>
<tr>
<td>Parameter</td>
<td>Status</td>
</tr>
<tr>
<td>---------------------------</td>
<td>----------------</td>
</tr>
<tr>
<td>Respiratory Expansion</td>
<td>Normal</td>
</tr>
<tr>
<td></td>
<td>Retractive/None</td>
</tr>
<tr>
<td>Capillary Refill</td>
<td>Normal</td>
</tr>
<tr>
<td></td>
<td>Delayed</td>
</tr>
<tr>
<td></td>
<td>None</td>
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## Systolic Blood Pressure

<table>
<thead>
<tr>
<th>Blood Pressure</th>
<th>Count</th>
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<tbody>
<tr>
<td>90 mm Hg or greater</td>
<td>4</td>
</tr>
<tr>
<td>70-89 mm Hg</td>
<td>3</td>
</tr>
<tr>
<td>50-69 mm Hg</td>
<td>2</td>
</tr>
<tr>
<td>0-49 mm Hg</td>
<td>1</td>
</tr>
<tr>
<td>No Pulse</td>
<td>0</td>
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</table>
# Trauma score

<table>
<thead>
<tr>
<th>Respiratory rate</th>
<th>Score</th>
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<tbody>
<tr>
<td>10-24/min</td>
<td>4</td>
</tr>
<tr>
<td>25-35/min</td>
<td>3</td>
</tr>
<tr>
<td>36/min or greater</td>
<td>2</td>
</tr>
<tr>
<td>1-9/min</td>
<td>1</td>
</tr>
<tr>
<td>None</td>
<td>0</td>
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</table>
# Injury Assessment (Scoring Systems)

## Revised trauma score

<table>
<thead>
<tr>
<th>Glasg. CS.</th>
<th>Sys BP</th>
<th>RR</th>
<th>Coded value</th>
<th>total</th>
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<tbody>
<tr>
<td>13-15</td>
<td>&gt;89</td>
<td>10-29</td>
<td>4</td>
<td>12</td>
</tr>
<tr>
<td>9-12</td>
<td>76-89</td>
<td>&gt;29</td>
<td>3</td>
<td>09</td>
</tr>
<tr>
<td>6-8</td>
<td>5075</td>
<td>6-9</td>
<td>2</td>
<td>06</td>
</tr>
<tr>
<td>4-5</td>
<td>1-49</td>
<td>1-5</td>
<td>1</td>
<td>03</td>
</tr>
<tr>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>00</td>
</tr>
</tbody>
</table>
A 30 year old male patient was admitted to hospital after a RTA with Glasgow coma score 7, systolic BP 60 mmHg and a respiratory rate of 8/min. His revised trauma score is:

- A. 9
- B. 8
- C. 7
- D. 6*
- E. 5
Triage

- A senior doctor is usually in charge
- It is simply the sorting out of patients in major incidents
- To ease the pressure of sudden influx of large number of casualties
Triage

The patients are divided into:
Critical - Resuscitate – ICU
Serious – Monitor – surgical ward
Slight – Not admitted to hospital
According to trauma scores & ISS
Classification of Injured

Dead - CPR on site
Critical - who may die
- who may survive
Serious
Slight
Sorrowful
Pattern of trauma deaths

Immediate deaths (50%) occurs at the scene of injury or within the first few minutes of injury.

- Caused by a fatal disruption of great vessels, heart, lung & brain or spinal cord injuries.
- Only prevention of accidents or measures to reduce the severity of injury e.g. seat belt or balloon, road safety & education for pedestrians
Trauma deaths

**Early deaths** (30%) occurs 15 minutes – 6h or within the 1st day.

- Due to collection of blood within the chest, abdomen, fracture pelvis & intra cranial hemorrhage.
- It is controlled by organized system of trauma care.
Trauma deaths

Late deaths (20%) occurs from days to weeks after injury.

- Due primarily to sepsis & multi organ failure.
- It is averted by critical care.
Initial evaluation

Objectives:

- 1. To stabilize the trauma patient.
- 2. To identify life threatening injuries & to initiate adequate supportive therapy.
- 3. To efficiently & rapidly organize either definitive therapy or transfer definitive therapy center.
The protocol of Initial evaluation (ATLS)

- Primary survey (cABCDE). Identify the injury
- Resuscitation; treat (ventilation, I.V. fluids & blood)
- Secondary survey (a thorough head to toe exam)
- Definitive treatment or transfer to trauma center (imaging, lab studies & surgeries)
- This is the essence of Advanced Trauma Life Support (ATLS). Early identification & effective treatment for injury mainly in early deaths it also decreases the No of late deaths (Preventable deaths)
Pre hospital management

The initial assessment is.

- Protection “during transport & treatment” from secondary injury to the spines or the cord, hypoxia, hypotension and hypercarbia (*second accident*)
- Early airway control in patients with a GCS of less than 8 is essential.
Pre hospital management

- Management can be carried out as
- A ‘Scoop & run’ policy for rapid & smooth transfer of pt. from the scene of accident to a well equipped and staffed hospital. It is best where transfer time to hospital is short, in the way apply life saving ABC measures.
- A ‘Stay & play’ policy if transfer time will be prolonged, entrapment or delayed extrication. Apply ATLS if trained personnel and facilities are available.
Pre hospital helicopter rescue
Helicopter rescue 2
First aid principals

- Assign priorities
  - Save life; CABCDE…etc.
  - Limit & repair the damage; quality of life in regard to function & structure.
  - Relieve symptoms.
- Introduce calm & order.
- The least possible disturbance of the patient position should take place during diagnosis.
First aid

- CT & XR tests should be discouraged before resuscitation has been initiated.
- Check chronic diseases, drugs, alcohol & smoking.
Primary survey

- The primary survey aims to identify and treat immediately life-threatening injuries. “ABCDE”
- Airway control, *stabilize the cervical spine*.
- Breathing (work and efficacy).
- Circulation with control of external bleeding.
- Disability or neurologic status.
- Exposure (undressing of the patient).
- Protect the patient from hypothermia.
I- Airway with C-spine control

- Assess the airway.
- Maintain the cervical spine in the neutral position. A hard collar or sandbags and tape.
- A chin lift, a jaw thrust, or an oropharyngeal airway to overcome upper airway obstruction. Suction of secretions & vomitus.
- Cricothyroidectomy or emergency tracheostomy.
II- Breathing

Assess the work of breathing and its efficacy by conducting the following:

- **Inspection**
  - Distressed, tachypneic, grunting or wheezing
  - Are signs of disruption to the chest wall evident or using accessory muscles?
  - Does paradoxical movement occur (flail chest)?
CATEGORIES OF CHEST WOUNDS

• OPEN
  - Tension pneumothorax
  - Sucking chest wound
  - Hemothorax
  - Impaled object

• CLOSED
  - Tension pneumothorax
  - Hemothorax
  - Flail chest
  - Rib fractures
TENSION PNEUMOTHORAX

• 33% of *preventable* combat deaths
• Injured chest or lung acts as one-way valve
• Air becomes trapped between the lung and chest wall causing the lung to collapse
• The heart is pushed to the other side causing blood vessels to kink
• Death will result if not quickly recognized and treated with needle decompression
• May occur in open and closed chest wounds
TENSION PNEUMOTHORAX
Tension Pneumothorax

Air between lung and chest wall

Air collapses lung and pushes heart to other side

Blood return to heart restricted by kinked vessels, heart unable to pump
TACTICAL FIELD CARE: TENSION PNEUMOTHORAX

- Progressive severe respiratory distress in setting of unilateral penetrating chest trauma
- Do not rely on typical signs as breath sounds, tracheal shift, and hyperresonance on percussion
- Decompress immediately with 14-gauge catheter
OTHER SIGNS AND SYMPTOMS OF TENSION PNEUMOTHORAX

- Difficulty breathing
- Chest pain
- Unilateral decreased/absent breath sounds
- Anxiety or agitation
- Increased pulse
- Tracheal deviation
- Jugular venous distention (JVD)
- Cyanosis
TRACHEAL DEVIATION AND JVD

- The trachea is shifted away from the collapsed lung
- The jugular veins become engorged from restricted blood return to heart
- LATE SIGNS!
NEEDLE CHEST DECOMPRESSION

• Locate 2d intercostal space at midclavicular line
• Insert 14-gauge catheter-over-needle into chest cavity over superior edge of rib
• Listen for gush of air and observe for improvement of symptoms
• Tape catheter in place with cap or valve in place to prevent re-entry of air
• May also place Asherman chest seal over catheter
• Dress open chest wound if present
NEEDLE CHEST DECOMPRESSION
NEEDLE CHEST DECOMPRESSION
NEEDLE CHEST DECOMPRESSION
SUCKING CHEST WOUND
(OPEN PNEUMOTHORAX)

- Open chest wound allows air entry into chest and escape
- Although lung is collapsed (pneumothorax), pressure is relieved by air escape and tension pneumothorax is avoided
- Tension pneumothorax may develop later
- Continually reassess the casualty for signs and symptoms of tension pneumothorax
OPEN CHEST WOUND
SUCKING CHEST WOUND

Open (Sucking) Pneumothorax

Pathophysiology

Inspiration

Expiration
SIGNS AND SYMPTOMS OF SUCKING CHEST WOUND

- Penetrating chest wound
- A “sucking” or “hissing” sound with inhaling
- Difficulty breathing
- Impaled object in chest
- Froth or bubbles around injury
- Coughing up blood or blood-tinged sputum
- Pain in chest or shoulder
MANAGEMENT OF SUCKING CHEST WOUND

• Expose the wound
• Check for exit wound
• Seal the wounds with airtight material, covering the larger wound first
• Cover wound completely and tape down 3 sides to provide flutter-type valve for air escape
• May use Asherman chest seal
• NOTE: Treat ALL penetrating chest wounds in this manner
• Continually reassess for tension pneumothorax and shock
SUCKING CHEST WOUND

- Upon exhaling, air in the chest escapes through the flutter-type valve created by taping 3 sides only.
- With inhaling, the patch should suck against the skin, preventing air entry.
HEMOTHORAX

• Blood accumulation in chest cavity
• May occur slowly or rapidly depending on size of disrupted blood vessel
• May occur due to penetrating or blunt trauma
• In massive hemothorax, blood loss is complicated by low oxygen levels in blood (hypoxia)
SIGNS AND SYMPTOMS OF HEMOTHORAX

• Usually open chest wound
• Chest pain and tightness
• Shock
• Cyanosis
• Dullness to percussion
• Coughing up frothy red blood
TREATMENT OF HEMOTHORAX

• Cover and dress open chest wounds
• Tension pneumothorax may also be present, therefore treat with needle chest decompression if suspected
• If massive hemothorax, must be treated with IV fluids for shock
• Immediate evacuation to surgical assets
FLAIL CHEST

• Three or more ribs fractured in two or more places or a fractured sternum
• Severe pain at site
• Rapid shallow breathing
• Paradoxical respirations (may be difficult to detect initially)
• Pneumothorax may be present
• Possible underlying contusion to lung could lead to hypoxia
FLAIL CHEST

FRACTURE OF SEVERAL ADJACENT RIBS IN TWO PLACES

DEPRESSION ANTERIOR CHEST WALL
PARADOXICAL RESPIRATIONS
MANAGEMENT OF FLAIL CHEST AND FRACTURED RIBS

• Stabilize the flail segment
  – Apply manual pressure
  – Tape a field jacket or poncho in place
  – Place casualty on injured side

• Pain control
III- Circulation and hemorrhage control

- Urgent treatment of exsanguinating hemorrhage or shock is lifesaving.
- It includes identifying and managing external hemorrhage.
- This priority can be controlled with a pressure dressing.
Circulation & Hemorrhage

- Insert 2 large-bore peripheral lines (14-gauge), obtaining relevant blood samples.
- Start volume resuscitation. The ATLS advice a 2000-cc crystalloid volume challenge.
- If hypotension is unresponsive to this fluid challenge it implies massive hemorrhage.
- It is a trigger for blood, packed RBCs or un cross-matched blood transfusion and immediate surgical intervention.
IV- Disability

- During the resuscitation of a trauma victim, a brief assessment of neurologic status should be performed. This assessment should include the patient’s posture (i.e. normal, symmetrical, decerebrate, decorticate),
- Pupil asymmetry, pupillary response to light, and a global assessment of patient responsiveness.
V- Exposure

-Patients should be completely undressed during the initial assessment to ensure that significant injuries are not missed.

-Prevent significant hypothermia, using a warm ambient room (28-30°C), overhead heating, and warmed IV fluids, the temp. is monitored & maintained at 37°C.
Secondary survey

- It includes; history, physical exam, angio-gram, DPL, CT scans, and other lab. tests.

- The FAST (Focused assessment with sonography for trauma) examination can be a part of the primary survey.

- Prompt definitive treatment for identified injuries should start without delay.
Log roll

- It refers to the slow controlled turning of the patient to assess his back, he might have an unstable injury. This includes the head, neck, back, and buttocks.
- Criticized because it may destabilize clot formation.
Log roll

It is carried out by at least 4 or 5 persons:
- The 1st person to stabilize the head and neck.
- The 2nd and 3rd persons to turn the patient,
- The 4th to inspect and palpate the back.
- A 5th person could be responsible for guiding the feet and lower extremities.
Ongoing monitoring

Urinary catheters are mandatory, however, precautions are taken for pelvic trauma and for those with blood at the urethral meatus.

Gastric tubes inserted into:
- All patients requiring endotracheal intubation.
- Children are prone to gastric dilatation, which can impair their respiration.
Reevaluation

- During the secondary survey, the patient's ABCDE should be constantly reevaluated.
- Ongoing diagnostic and therapeutic plan should be formulated and updated as required.
THE VERY YOUNG
THE UNLUCKY
THE VERY CARELESS
SCOLD BURN
ELECTRICAL BURN
Skin

- Largest body organ

Functions

- Protection – (infection and trauma)
- Temperature regulation – (Hypothermia)
- Water tight seal – (Hypovoleemia)
- Sensory perception

As ethics and psychological importance.
Electrical burn

- Compartment syndrome & decompressive fasciotomies may be needed.
- Myoglobinuria, which can lead to acute renal failure if untreated.
- Continual cardiac monitoring because of myocardial injury
- Hyperkalemia arising from myonecrosis.
High-voltage electrical injuries

- It is a burn injuries with a different set of problems.
- Massive myonecrosis.
- Damage to soft tissue & bone concealed beneath skin
- Entrance and exit wounds.
First aid in Burn

- Stop the burning process.
- **Flame burn** - immerse in cold water 10-15 minutes.
- **Scald burn** - remove clothes & immerse in cold water 10-15 minutes.
- **Chemical burn** - copious water lavage, eye irrigation, remove all contaminated clothes.
- **Large burns** require large volumes of IV fluids crystalloid resuscitation & fasciotomy.
Inhalation injury in burn

Look for signs of inhalation
- Singed vibrissae
- Carbonaceous material in upper airway
- Edema or inflammatory changes

For inhalation injury early intubation and mechanical ventilation are indicated.
Inhalational injury

- Fires
- Closed space
- Singed nasal hair
- Carbonaceous material in nose & mouth
INHALATIONAL INJURY
Extent of Burn Wounds

[Diagram showing the extent of burn wounds using the rule of 9s.]

ANTERIOR

INFANT

POSTERIOR

PALMAR METHOD
(Patient’s palm)

1%
Extent of Burn Wounds

[Rule of 9’s]

ANTERIOR

INFANT

POSTERIOR

PALMAR METHOD
(Patient’s palm)
Lund and Browder Charts

![Lund and Browder Charts Diagram](image1)

![Burn Estimate and Diagram](image2)
# Fluid Therapy

**Objective**
- HR < 110/minute
- Normal sensorium (awake, alert, oriented)
- Urine output - 0.5-1 cc/kg/hr

**Crystalloids in the first 24 hours (R/L)**

<table>
<thead>
<tr>
<th>Parkland Formula</th>
<th>Adults (R/L)</th>
<th>Children (G½S)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1st Day</strong></td>
<td>%TBSA x Wt x 4</td>
<td>%TBSA x Wt x 3 + Maintenance</td>
</tr>
<tr>
<td><strong>2nd Day</strong></td>
<td>%TBSA x Wt x 1</td>
<td>%TBSA x Wt x 1 + Maintenance</td>
</tr>
</tbody>
</table>
Escharotomy

- Circumferential burns and the leathery eschar that can cause a decrease in chest wall expansion or circulatory compromise in the limbs.
- Non-circumferential burn does not rule out Escharotomy.
Escharotomy

- Chest: To allow respiratory movement
- Limb: To restore circulation in limb with excess swelling under rigid eschar
Limbs: Signs of Circulatory Obstruction

- Loss of distal circulation
  - pallor
  - coolness
  - absent pulse
  - loss capillary refill
  - decreased oxygen saturation
- Pain on passive extension
- Deep pain at rest
Cold injuries

- Rapid rewarming and immersion in water warmed to 40°C.
- Treat severe cold injuries with IV fluids only based on the patient's need (not on the wound size).
- In the case of severe hypothermia with cardiac arrest and/or apnea, do not stop CPR efforts until the patient's body is rewarmed.
Drowning & choking

Patient breathing;
♦ Make sure that the airways are clear
♦ Place the patient in Lt. Lat. position.

Patient not breathing;
♦ Clear airways by manual removal of choking bolus.
♦ Mouth to mouth ventilation.
♦ External cardiac message.
♦ Heimlich maneuver.
Drowning & choking

Unconscious patient;

- Bronchoscopy & suction, intubation & ventilation if necessary, steroids, antibiotics NG tube, fluid & electrolytes requirement and treat cerebral, pulmonary & cardiac complications.

**Heimlich maneuver;** the operator places his arms around the choking individual from behind, grasps the fist of one hand in the other hand and brings both hands up in the subxiphoid area briskly to apply pressure to the diaphragm. It increases the intra thoracic pressure and may expel the FB.
Venomous snakes;
- Splint the limb, stop movement, incision & suction within 1 h.
- Apply ice & Tourniquet ‘loose to obstruct veins and lymphatics’; venom is absorbed by the lymphatics, it is removed after a; IV line. b; antivenin is given, c; not in shock
Snake bite

- If shocked;
- Assisted respiration if patient stops breathing
- General resuscitation & antibiotics.
- Transfer to hospital & tetanus toxoid
- Venous constrictive bandage proximal to the bite for not <1h. Apply ice to the wound
Stings

- Spider; ‘Black widow’ neurotoxic leads to severe muscle spasm treated with Ca gluconate 10ml 10%
- Bee; remove sting sideways, alkali locally.
- Wasp; vinegar locally.
Animal & human bites:

- debride, TT, TIG, anti-biotics and rabies vaccine if indicated

General resuscitation; clear airways & O2.
- IV fluids, adrenaline & antihistamines
- Assisted ventilation if needed.
46. All of the following statements regarding electrical burns are true **Except:**

- a. They are usually deeper and more severe than indicated by surface appearance
- b. Bone has the lowest resistance to electrical current
- c. Muscle necrosis may be markedly underestimated
- d. All patients with high voltage electrical injury need continuous cardiac monitoring

**e. Mannitol may be used to maintain high level urine output, especially with myoglobinurea**
MCQ

- <Q>All the following first aid measures are used for soft tissue injury of a limb Except
- <C> Rest
- <C> elevation of the affected limb above the heart
- <C> compression should not be tight or prolonged
- <C+> Ice should be applied directly to the skin over it
- <C> Simple oral analgesia often provides effective pain relief