

INTRODUCTION TO MECHANISMS OF TRAUMA AND TREATMENT PRIORITIES

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Mechanisms and Patterns of Injury “MCQs”

BLUNT

Classified into:

1. High energy transfer
e.g. Car Accident
2. Low energy transfer
e.g. Fall from a bicycle

- Associated with multiple widely distributed injuries because the energy is transferred over a wider area during blunt trauma.

PENETRATING

Classified into:

1. Stab wound
2. Gunshot wound
3. Shotgun

- Damage is localized to the path of the bullet or knife.

Pre Hospital Care:

The objective of pre-hospital care is to prevent further injury, initiate resuscitation and transport the patient safely and rapidly to the most appropriate hospital.

Most important things in pre hospital care :

- Airway control
- Fluid resuscitation

Transportation either by:

- Ground Ambulance ,or
- Helicopter

Initial Evaluation and Resuscitation of the Injured Patient

**In the ER:
Primary survey and secondary survey**

1. Primary Survey “the most important”

- ❑ The goal of primary survey is to identify and treat conditions that constitute an immediate threat to life
- ❑ 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.
- ❑ The ATLS Course refers to the primary survey as assessment of the “ABC” (Airway with cervical spine protection, Breathing and Circulation).—ABC
- ❑ Although the concepts within primary survey are presented in a sequential fashion in reality they often proceed simultaneously. Life-threatening

*Advanced Trauma Life Support.

**The first hours when the pt. reaches the ER.

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(A)

Airway Management with cervical spine protection

a) Conscious patient who do not show tachypnea and have normal voice do not require early attention to the airway.

b) Patients with penetrating neck injuries and

1. an expanding hematoma,
2. evidence of chemical or thermal injuries to mouth, nares or hypopharynx,
3. extensive subcutaneous air in the neck,
4. complex maxillofacial trauma
5. airway bleeding,

in these cases *elective intubation* should be performed. These patients may initially have a satisfactory airway but they may become obstructed if soft tissue swelling , hematoma formation, or edema progress.

c) Establishment of a definitive airway ,immediate intubation, (**i.e. endotracheal intubation**) is indicated in:

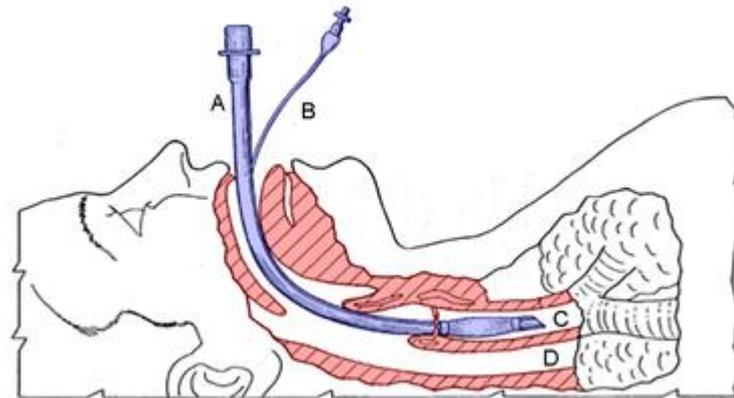
1. patients with apnea,
2. inability to protect the airway due to altered mental status,
3. impending airway compromise due to inhalation injury,
4. hematoma,
5. facial bleeding,
6. soft tissue swelling or aspiration, and
7. inability to maintain oxygenation.

MCQ: *Altered mental status is the most common indication for intubation in the ER for traumatic pt .*

Options for Endotracheal Intubation Include

1) **Nasotracheal intubation**: It can be accomplished **only** **in patients who are breathing spontaneously**. The primary application for this technique in Emergency Department (ED) is in those patients requiring emergent airway support in whom chemical paralysis cannot be used.

It is contraindicated in **extensive maxillofacial injuries**. Because it may make more injuries.



2) Orotracheal intubation: It is the most common technique used to establish a definitive airway.

- Because all patients are presumed to have cervical spine injuries, manual in-line cervical immobilization is essential especially in unconscious patients we should protect the cervical spines..
- Correct endotracheal placement is verified with:
 - Direct laryngoscopy, you see the tube going to the vocal cords.
 - Capnography, if u connect the pt. on the ventilator you will see high CO2..<< at least it's in the trachea.
 - clinically: Audibility of bilateral breath sounds, by auscultation.
 - And finally Chest X-Ray, only when the pt. is stable.

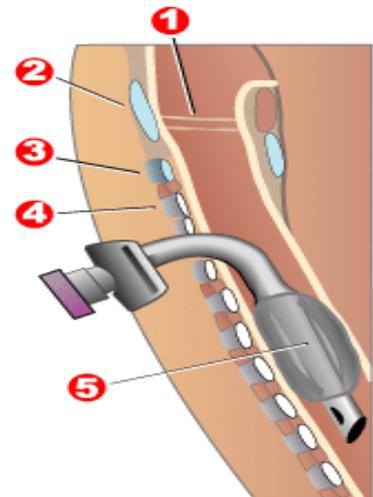
3) Surgical Routes:

a) **Cricothyroidotomy:** Patients in whom attempts at intubation have failed or who are precluded from intubation due to extensive facial injuries.

no complication that affect the vessels because you go to the membrane directly >> no stenosis

b) **Emergent Tracheostomy:** Is indicated in a patient with extensive laryngeal injury

it may cause complications that damage the vessels >>Stenosis .



(B) Breathing and Ventilation

Once a secure airway is obtained, adequate oxygenation and ventilation must be assured. All injured patients should receive supplemental oxygen and be monitored by pulse oximetry.

The following conditions constitute an immediate threat to life due to inadequate ventilation and should be recognized during the primary survey .. **the main 3 conditions that you should take care of it :**

1. Tension pneumothorax
2. Open pneumothorax
3. Flail chest with underlying pulmonary contusion

1. Tension Pneumothorax

Tension pneumothorax: is the accumulation of air in the pleural cavity with lung making a one way valve ,allowing the air to enter without going out..

Diagnosis: Respiratory distress and hypotension in combination with any of the following physical signs in patients with chest trauma.

- Tracheal deviation away from the affected side e.g accumulation of air in the rt lung will deviate the trachea to the opposite side .
- Lack or decreased breath sounds on the affected side this is most IMP .
- Subcutaneous emphysema on the affected side
- Distended neck veins due to impendence of superiorvena cava, but the neck veins may be flat due to systemic hypovolemia.

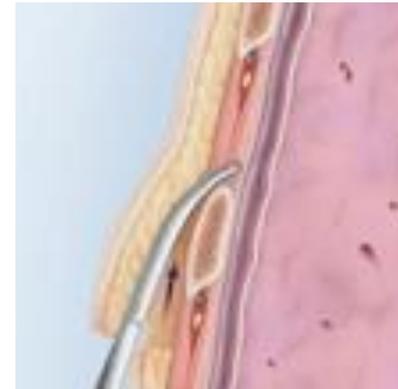
e,g. if there is a tension pneumothorax on the right side, this will push the heart to the left and twist the SVC and then congestion of the face and upper limbs and distension of neck veins b/c there is obstruction of venous return.

But if the pt. is hypovolemic, the veins will not distended because of losing of blood ..

1. **In cases of tension pneumothorax**, the parenchymal tear in the lung act as a one-way valve, with each inhalation allowing additional air to accumulate in the pleural space.
2. The normally negative intrapleural pressure becomes positive which depresses the ipsilateral hemidiaphragm and shift the mediastinal structures into the contralateral chest.
3. Subsequently the contralateral lung is compressed and the heart rotates about the superior and inferior vena cava, this decreases venous return and ultimately decreases cardiac output which results in **cardiovascular collapse**.

Treatment:

- **Immediate needle thoracostomy** decompression with a 14 gauge angiocatheter in the second intercostal space in the midclavicular line
- **Tube thoracostomy (chest tube)** in the fifth intercostal space in the midaxillary line immediately in the emergency department before the chest radiograph.



2. Open Pneumothorax (or sucking chest wound).

This occurs with full-thickness loss of the chest wall, permitting free communication between the pleural space and the atmosphere.

This compromises ventilation due to equilibration of atmospheric and pleural pressures which prevents lung inflation and alveolar ventilation and result in hypoxia and *hypercarbia

*Hypercarbia = high level of CO₂

Treatment:

Closure of the chest wall defect **if its' small** and tube thoracostomy **if it's large defect.**

3. Flail Chest.

- It occurs when three or more contiguous ribs are fractured in at least two locations
- Paradoxical movement of this free-floating segment of chest wall . **IMP**
- Rarely the additional work of breathing and chest wall pain caused by the flail segment is sufficient to compromise ventilation.
- Resultant hypoventilation and hypoxemia may require intubation and mechanical ventilation.
- This flail chest most of the time it associated with contusion of the lung underlying the trauma..

Note

- It occurs when multiple adjacent ribs are broken in multiple places, separating a segment, so a part of the chest wall moves independently.
- The number of ribs that must be broken varies by differing definitions: some sources say at least two adjacent ribs are broken in at least two places, some require three or more ribs in two or more places.
- The flail segment moves in the opposite direction as the rest of the chest wall: because of the ambient pressure in comparison to the pressure inside the lungs, it goes in while the rest of the chest is moving out, and vice versa.
- This so-called "**paradoxical motion**" can increase the work and pain involved in breathing

(C)

Circulation with Hemorrhage Control.

- 1) Blood pressure and pulse should be measured manually at least every 5 minutes in patient with significant blood loss until normal vital signs values are restored.
- 2) Two peripheral catheters, 15- 16 gauge or larger in adults.
- 3) Fluid resuscitation. **We start with crystalloids like normal saline or ringer's but ringers is better becausec the normal saline contains large amount of Cl- >> can lead to more hyperchloremic metabolic acidosis and the pt. is already has metabolic acidosis..**
- 4) Blood should be drawn simultaneously and send for measurement of hematocrit level, as well as for typing and cross-matching for possible blood transfusion in patient with evidence of hypovolemia.
- 5) If peripheral angiocatheter access is difficult, saphenous vein cutdown at the ankle provide excellent access.

- 6) Additional venous access through femoral or subclavian vein (can be used for CVP* measurement).
- 7) Intraosseous needle can be placed in the proximal tibia (preferred) or distal femur of an unfractured extremity for fluid resuscitation in patient under 6 years of age.
- 8) External control of hemorrhage should be achieved promptly while circulating volume is restored. Manual compression of open wounds with ongoing bleeding should be done with a single 4 x 4 gauze and a gloved hand. Blind clamping of bleeding vessels should be avoided because u may damage the vessels . **MOST IMP**

*Central Venous Pressure.

During the circulation section of the primary survey **FOUR** life-threatening injuries must be identified.

- a) Massive hemothorax “bleeding in the thorax”
- b) Cardiac tamponade “bleeding in the myocardium”
- c) Massive hemoperitoneum “bleeding in the abdomen”
- d) Mechanically unstable pelvic fracture “bleeding in the pelvis”

These are the causes of massive hypotension in traumatic pts.

If the patient has hypotension and you can not find a source of bleeding when looking in the abdomen and chest. Think of cardiac tamponade, as it is very commonly missed.

IMP

THREE critical tools used to differentiate these in multisystem trauma patient :

- a) Chest radiograph
- b) Pelvis radiograph
- c) Focused Abdominal Sonography for Trauma(FAST)

The FAST exam is performed as part of the initial evaluation of the trauma patient in the emergency center. It consists of four separate views of four anatomic areas (see diagrams below):

1. The right upper abdomen (Morison's space between liver and right kidney)
2. The left upper abdomen (perisplenic and left perirenal areas)
3. Suprapubic region (perivesical area)
4. Subxyphoid region (pericardium)

Immediate treatment

“clinically if u listen to the chest there will be no breathing sounds on the affected side”

a) Massive Hemothorax

- Tube thoracostomy to facilitate lung re-expansion
- Massive hemothorax (if the tube drain >1500 ml.

Blood) this is an indication for operative intervention.

b) Cardiac Tamponade

- Pericardial drain under ultrasound guidance
- Followed by operative intervention

c) Mechanically Unstable Pelvis Fracture

- Pelvis fracture
- Immediate external fixation

d) Massive Hemoperitoneum with Hemodynamic Unstability

- Fluid resuscitation
- Immediate surgical intervention with shock pt

Shock Classification and Initial Fluid Resuscitation

Classic signs and symptoms of shock : are tachycardia, hypotension, tachypnea, mental status changes, diaphoresis and pallor. The quantity of acute blood loss correlates with physiologic abnormalities.

MCQ!!!

Signs and Symptoms of Advancing Stages of Hemorrhagic Shock

	Class I	Class II	Class III	Class IV
Blood loss (ml)	Up to 750	750 – 1500	1500 – 2000	> 2000
Blood loss (% BV)	Up to 15%	15 – 30%	30 – 40%	>40 %
Pulse Rate	<100	>100	>120	>140
Blood Pressure (mmHg)	Normal	normal	Decreased	Decreased
Pulse Pressure	Normal or Increased	Decreased	Decreased	Decreased
Respiratory Rate	14 – 20	20 – 30	30 – 40	> 35
Urine Output ((ml/hr	>3	20 – 30	5 – 15	Negligible “Anuria”
CN/Mental Status	Slightly anxious	Mildly anxious 428 surgery team	Anxious and confused	Confused and Lethargic

- 1) Tachycardia is often the earliest sign of ongoing bleeding.
- 2) Hypotension is not reliable early sign of Hypovolemia, because blood volume must decrease by **>30%** before hypotension occurs.

Tachycardia is not reliable in old pts. And pts. On beta blockers

- Fluid resuscitation begins with a 2 L (Adult) or 20 ml/kg (child) IV bolus of isotonic crystalloid, typically Ringers's Lactate.
- For persistent hypotension, this is repeated once in an adult and twice in a child before red blood cells (RBCs) are administered.
- Urine output is a quantitative reliable indicator of organ perfusion. Adequate urine output is 0.5 ml/kg per hour in an adult, and 1 ml/kg per hour in child **v.imp**
- Based on the initial response to fluid resuscitation, hypovolemic injured patients can be separated into three broad categories:
 1. Responders “BP will be stabilize”
 2. Transient responders “BP will improve and then it will fall down again which means there an active bleeding”
 3. Non-responders “which means there is a major bleeding that you can't control by resuscitation”

Before you go to the secondary survey you have to make sure that there is no life threatening condition is missed.

Secondary Survey

- Once the immediate threats to life have been addressed, a thorough history is obtained and the patient is examined from top to toe to ensure that no wound, bruise or swelling is missed.
- The back and spine are examined with the patient “log-rolled”, looking specifically for localized tenderness, swelling, bruising or a “step”.
- The perineum is examined and a rectal examination is performed to evaluate for sphincter tone, presence of blood, rectal perforation, or high riding prostate, this is particularly critical in patients with suspected spinal cord injury, pelvic fracture, or transpelvic gunshot wounds **very IMP**.
- Vaginal examination with speculum should be performed in women with pelvic fractures to exclude an open fracture.

In edition to physical examination the following should be done:

1. Continuous vital Signs Monitoring
2. CVP* Monitoring
3. ECG Monitoring
4. Nasogastric Tube Placement, which is contraindicated in complex maxillofacial injury and should be passed orally
 - It evaluate the stomach content for blood which may suggest gastro- duodenal injury.
 - If it passed to the chest it may suggest diaphragmatic injury.

*Central Venous Pressure.

5 . Foley Catheter Placement

- To monitor the urine output-Foley Catheter placement should be deferred after urological evaluation in patients with signs of urethral injury (*Blood at the meatus, perineal or scrotal hematoma, or a high riding prostate on the PR exam.*).

6. Repeat FAST as needed

7. Laboratory Measurement

8. Radiographs

- Selective radiography and laboratory tests are done early after the primary survey.

- For patients with severe blunt trauma the following radiograph should be done: -
 - 1) Lateral Cervical Spine X-R
 - 2) Chest X-R
 - 3) Pelvis X-R

- For patients with truncal gunshot wound, anteriorposterior and lateral radiographs of the chest and abdomen should be done with marking the entrance and exit sites with metallic clips or stables.

- In critically injured patient blood sample for :
 - Type and Cross- Matching.
 - Complete Blood Count
 - Blood Chemistry
 - Coagulation Studies
 - Lactate Level
 - Arterial Blood Gas Analysis “ABG”