

L9-Introduction To Mechanisms Of Trauma



Surgery Team
MED 433

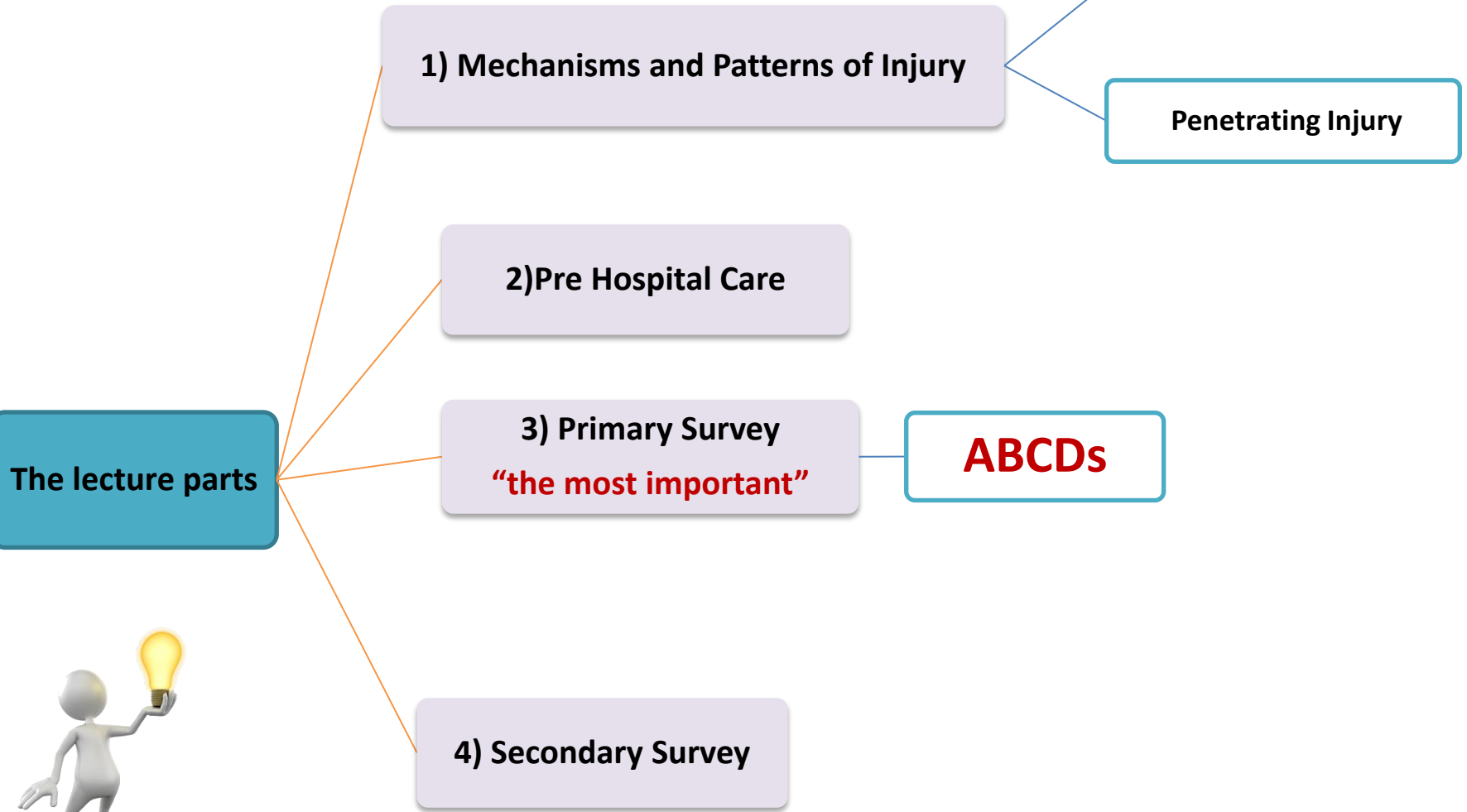


Objective was not given 😞 !!

[Color Index:](#) Slides & Raslan's () | [Doctor's Notes](#) | Extra Explanation | [Additional](#)

This work is based on doctor's Slides +Notes and Raslan's only (Does not include the book)

Mind Map



1) Mechanisms and Patterns of Injury

Mechanisms and Patterns of Injury

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.

2)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:

- **Ground Ambulance**
- **Helicopter**

Initial Evaluation and Resuscitation of the Injured Patient in the ER is done by using **primary survey and secondary survey**.

3) Primary Survey “the most important”

- The goal of primary survey is to **identify and treat conditions that constitute an immediate threat to life.**
- Advanced trauma life support (ATLS) provides a structured approach to the trauma patient with standard Algorithms of care, as assessment of the “**ABCDs**” (Airway with cervical spine protection, Breathing, Circulation, Disability and Exposure)
- It emphasizes the “**golden hour**” concept that timely prioritized interventions are necessary to prevent death.
- Although the concepts within primary survey are presented in a sequential fashion (ABCs), in reality they often proceed simultaneously (As a trauma team every member check one, one are checking the airways and the other is checking the circulation in the same time.. and like this)

NOTE:- Golden hour: it's the first hour of the patients arrival to the ER.

ABCDs

1) Airway Management with cervical spine protection

- Conscious patient who do not show tachypnea and have **normal voice** do not require early attention to the airway. (So you proceed to the next step! Which is the **Breathing**)

Patients with penetrating neck injuries and:

- an expanding hematoma
- evidence of chemical or thermal injuries to the mouth, nares or hypopharynx
- extensive subcutaneous air in the neck
- complex maxillofacial trauma
- 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.

Establishment of a definitive airway (e.g. endotracheal intubation) **is indicated in:**

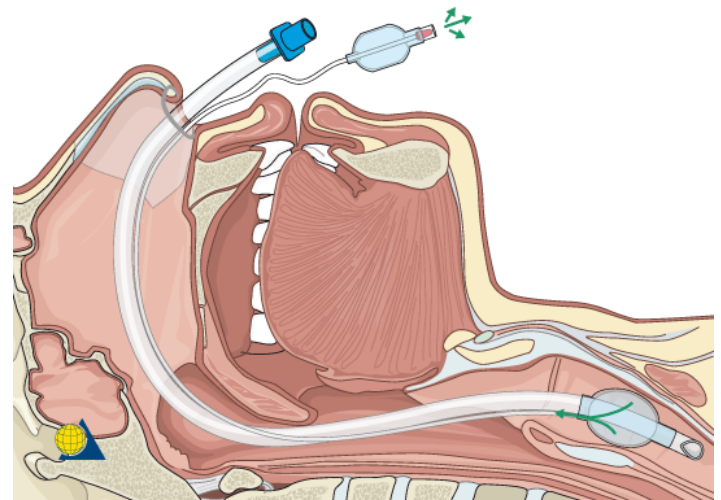
1. patients with apnea
2. inability to protect the airway due to altered mental status
3. impending airway compromise due to inhalation injury
4. hematoma
5. facial bleeding
6. soft tissue swelling or aspiration
7. inability to maintain oxygenation

Altered mental status is the most common indication for intubation in the ER.

Options for Endotracheal Intubation Include:

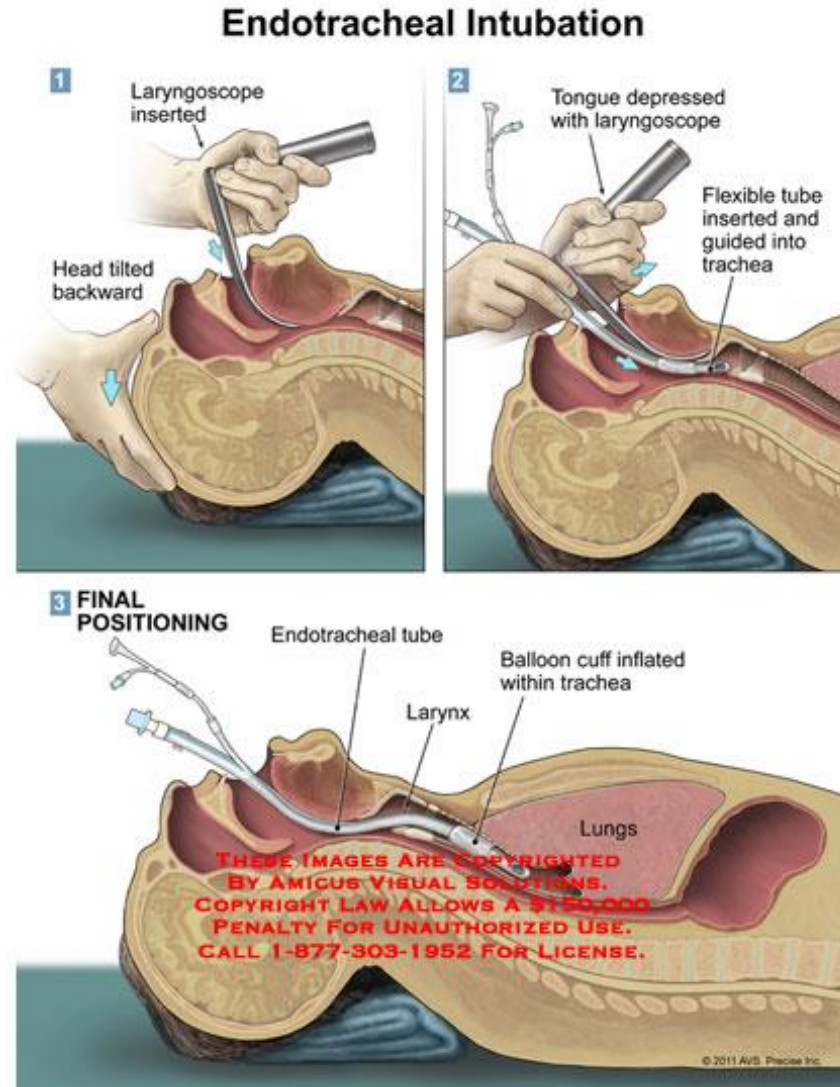
- 1. Nasotracheal intubation:** (here we have to make sure that tube is on trachea)

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 (because in orotracheal intubation we have to use muscle relaxant to control breathing). It is contraindicated in maxillofacial injuries, **why?** It may cause further injuries.



2. Orotracheal intubation:-

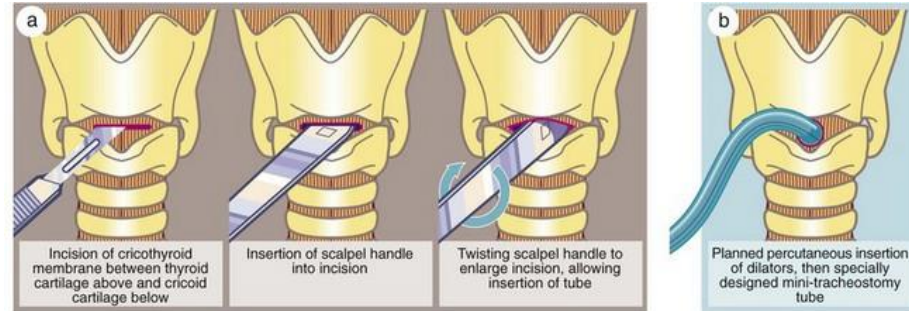
- It is the most common technique used to establish a definitive airway. Because all patients are presumed to have cervical spine injuries, manual in-line cervical immobilization is essential, Especially in unconscious patients in which we must protect the cervical spine
- **Correct endotracheal placement is verified with:**
(to make sure that the tube is in the trachea not in the esophagus, otherwise patient will die because no oxygen is going to the lung 😊)
 1. Direct laryngoscopy, you see the tube heading the vocal cords.
 2. Capnography (is the monitoring of the concentration or partial pressure of carbon dioxide)
 3. Audibility of bilateral breath sounds, by auscultation.
 4. And finally Chest X-Ray, only in stable patients



3. Surgical routes

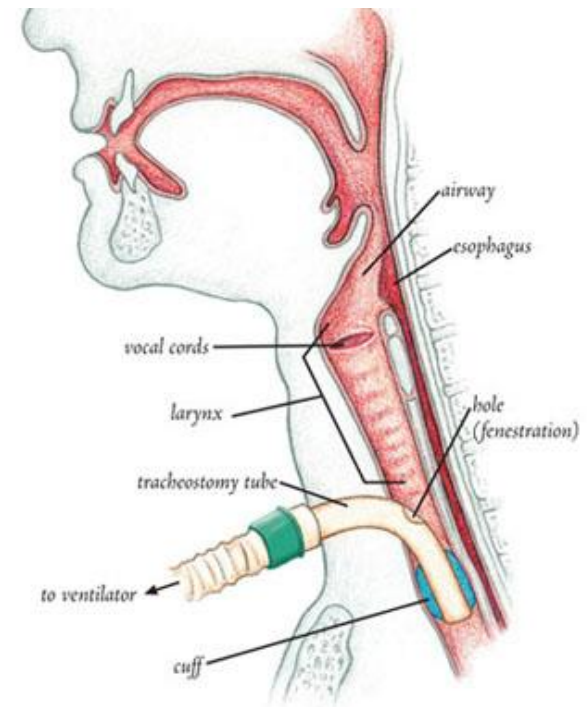
a) Cricothyroidotomy:

- (a small incision is made through the skin and cricothyroid membrane)
- **Patients in whom attempts at intubation have failed or who are precluded from intubation due to extensive facial injuries.** It has no complications that affect the vessels because you go to the laryngeal membrane directly (no stenosis).



b) Emergent Tracheostomy:

- Is indicated in a patient **with extensive laryngeal injury.** it may cause complications that might damage the vessels (stenosis).



2) 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 must take care of are)
 - a. **Tension pneumothorax.**
 - b. **Open pneumothorax.**
 - c. **Flail chest with underlying pulmonary contusion.**

a) Tension Pneumothorax

Accumulation of air in the pleural cavity with lung making a one way valve, allowing the air to enter but not going out.

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

1. Tracheal deviation away from the affected side. (e.g. Accumulation of air in the right lung will deviate the trachea to the left side).
2. Lack or decreased breath sounds on the affected side.
3. Subcutaneous emphysema on the affected side.
4. Distended neck veins due to impendence of superior vena cava, **but the neck veins may be flat due to systemic hypovolemia (bleeding).**



- 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.
- The normally negative intra-pleural pressure **becomes positive** which depresses the ipsilateral hemidiaphragm and shift the mediastinal structures into the contralateral chest.
- Subsequently the contralateral lung and the heart rotates about the superior and inferior vena are compressed, this decreases venous return and ultimately cardiac output which results in **cardiovascular collapse**.

If there is a tension pneumothorax on the right side, this will push the mediastinum to the left and compress the SVC which lead to congestion of the face and upper limbs and distention of the neck veins because there is obstruction of venous return. This condition is known as **“Superior vena cava syndrome”**. but if the patient is hypovolemic, the veins will not be distended.

Treatment:

- 1) **Immediate needle thoracostomy:** decompression with a 14 gauge needle in the **second intercostal space in the mid-clavicular line**.
- 2) **Tube thoracostomy :** in the **fifth intercostal space in the midaxillary line**, immediately in the emergency department before the chest radiograph.

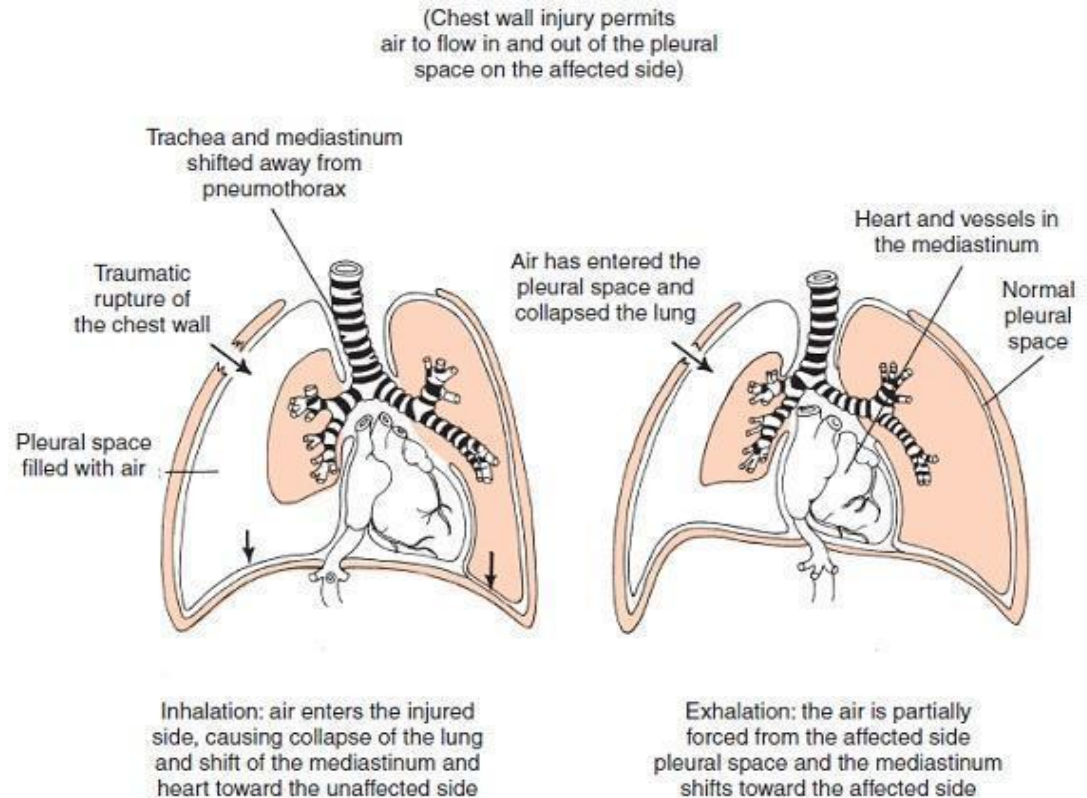
b) Open Pneumothorax :

This occurs with full-thickness loss of the chest wall, permitting free communication between the pleural space and the atmosphere (two-way valve)

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

Pleural pressures = atmospheric pressures

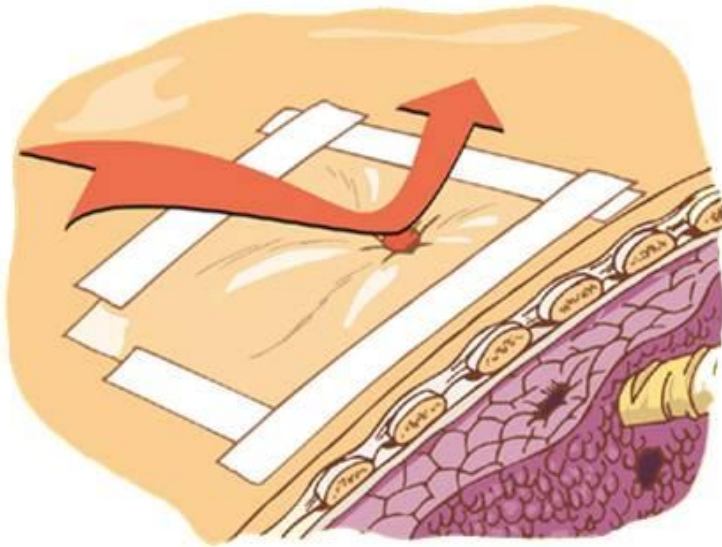
The open pneumothorax also called **sucking chest wound** .



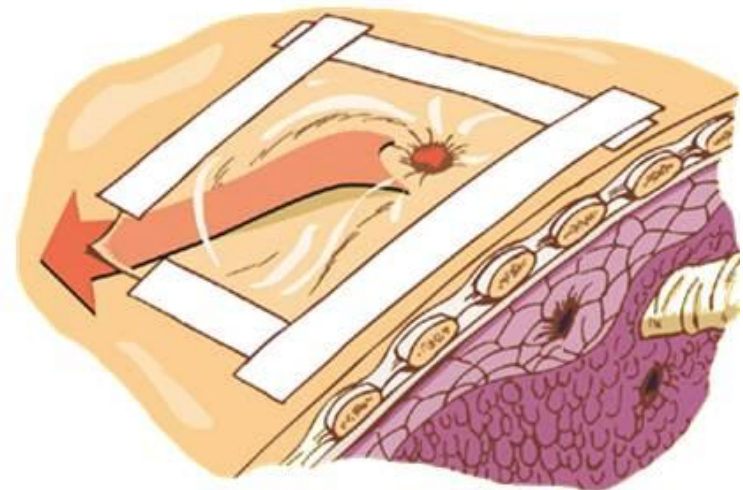
Treatment of open pneumothorax:

Complete occlusion of the injury may result in converting an open pneumothorax into a tension pneumothorax.

Initial treatment : occlusive dressing, which is taped on three sides over the wound. Dressing permits effective ventilation, while the untapped side allows accumulated air to escape from the pleura.



Inspiration



Expiration

Definitive treatment : wound closure and tube thoracotomy.

C) 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 (so the flail segment will move inside with inspiration and out expiration)
- 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.
- **Most of the time flail chest is associated with contusion of the lung parenchyma.**

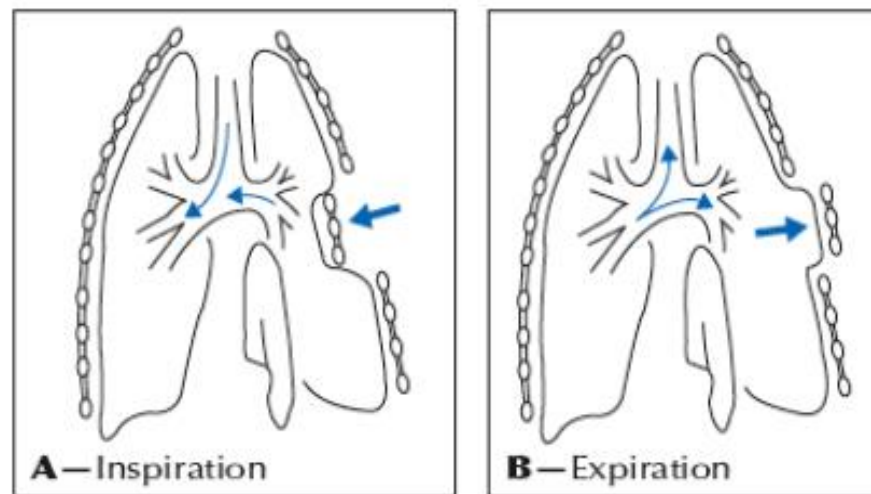


Figure 1. In patients with flail chest, the negative pressure within the pleural cavity causes the flail segment to collapse inward during inspiration. This illustration also shows the movement of air associated with flail chest as air is shunted from the lung under the flail segment to the opposite hemithorax (A). Conversely, the flail segment moves outward during expiration, and air from the unaffected hemithorax is shunted to the lungs under the flail segment (B).

Video of patient with flail chest (notice the paradoxical movement) :

https://www.youtube.com/watch?v=mJ_FYwUqzsM

3) 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 16 gauge or larger in adults. (remember: talking about needles, 16 gauge is smaller in diameter than 14 gauge and so on.. 😊)
- 3- Fluid resuscitation :
 - We start with crystalloids like **normal saline or ringer's lactate but ringer's is better. Normal saline contains large amount of Cl- which can lead to hyperchloremic metabolic acidosis and the patient is already has metabolic acidosis.**
 - (So give normal saline if ringer's is not available)
- 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 cut down 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 unfeathered extremity for fluid resuscitation in patient under 6 years of age. (so the fluid will go directly to the bone marrow)
- 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 (so that you don't injure other vessels).

NOTE:- It is best to avoid central vein in primary survey, why?

- 1) Takes time
- 2) Causes hemi-thorax Pneumothorax

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

- a) Massive hemothorax. *bleeding in the thorax*
- b) Cardiac tamponade. * bleeding in the pericardium, compressing the heart*
- c) Massive hemoperitoneum. * bleeding in the abdomen*
- d) Mechanically unstable pelvic fracture. *could rupture main vessels in pelvic causing severe bleeding*

Immediate treatment
in the next slide

- Those are the main causes of massive hypotension in traumatic patient.
- If the patient has hypotension and you couldn't find a source of bleeding when looking in the abdomen and chest, **think of cardiac tamponade, as it is very commonly missed.**

Triad of Cardiac tamponade: 1) Hypotension 2) muffled heart sounds 3) high JVP

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

- a) Chest radiograph.
- b) Pelvis radiograph.
- c) Focused **A**bdominal **S**onography for **T**rauma (**FAST**).

The **FAST** is performed as part of the initial evaluation of the trauma patient in the emergency center. It consists of four separate views of four anatomical areas:

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

Massive Hemothorax :-

Clinically, If you listen to the chest there will be no breathing sounds on the affected side.

- Tube thoracostomy to facilitate lung re-expansion
- Massive hemothorax (>1500 ml. blood in pleural cavity) is an indication for operative intervention.

Cardiac Tamponade :-

- Pericardial drain under ultrasound guidance.
- Followed by operative intervention to repair the cause.

Mechanically Unstable Pelvis Fracture :-

- Pelvis fracture.
- Immediate external fixation.

Massive Hemoperitoneum with Hemodynamic Instability :-

- Fluid resuscitation.
- Immediate surgical intervention.

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.

1) Tachycardia is often the earliest sign of ongoing bleeding. **And it is not reliable in old patients or patients on beta-blockers.**

2) Hypotension is not a reliable early sign of Hypovolemia, **because blood volume must decrease by >30% before hypotension occurs.**

- 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.

Shock Classification:

	Class I	Class II	Class III	Class IV
Blood Loss	< 750	750-1500	1500-2000	> 2000
% Blood Vol.	< 15%	15 – 30%	30 – 40%	> 40%
Pulse	< 100	> 100	> 120	> 140
Blood Pressure	Normal	Normal	Decreased	Decreased
Pulse Pressure	Normal	Decreased	Decreased	Decreased
Resp. Rate	14 – 20	20 – 30	30 – 40	> 40
UOP	> 30	20 – 30	5 – 15	negligible
Mental Status	sl. Anxious	mildly anx	confused	lethargic
Fluid	crystalloid	crystalloid	blood	blood

Based on the initial response to fluid resuscitation, hypovolemic injured patients can be separated into three broad categories:

1. **Responders.** *BP was stabilized after fluid resuscitation*
2. **Transient responders.** *BP was initially improved then it fell down again which means there is an active bleeding.
3. **Non-responders.** *there is a major bleeding that you can't control by resuscitation*

3) Disability and Exposure

In Disability and Exposure, **The Glasgow coma scale (GCS)** score should be determined for all injured patients

For more information about GCS , go to Lecture 8 - Increased ICP (slide 13)

And finally, before you go to the secondary survey you have to make sure that there is no life threatening condition is missed.

4) Secondary Survey

- Once the immediate threats to life have been addressed, a thorough history is obtained and the patient is examined from head 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.
- **Vaginal examination** with speculum should be performed in women with pelvic fractures to exclude an open fracture.

Secondary Survey

In addition to physical examination the following should be done:

1. Vital Signs Monitoring
2. CVP Monitoring
3. ECG Monitoring
4. Nasogastric Tube Placement
 - 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.
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*).
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-Ray
 - 2) Chest X-Ray
 - 3) Pelvis X-Ray

Secondary Survey

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

In critically injured patient blood sample for :

- Type and Cross- Matching **in case we needed blood transfusion**
- Complete Blood Count
- Blood Chemistry
- Coagulation Studies
- Lactate Level **most sensitive test in patients with hypovolemia**
- Arterial Blood Gas Analysis

Summary

- **Initial Evaluation and Resuscitation of the Injured Patient in the ER is done by using primary survey and secondary survey. primary survey : ABC (airways and spine protection, Breathing, circulation)**
- **A. Airway Management**
- **B. Breathing and Ventilation**
 - Tension pneumothorax. Accumulation of air in the pleural cavity.
 - Open pneumothorax. full-thickness loss of the chest wall.
 - Flail chest. ribs are fractured in at least two locations with negative intrapleural pressure of inspiration
- **C. Circulation: FOUR life-threatening injuries:**
 1. Massive hemothorax
 2. Cardiac tamponade.
 3. Massive hemoperitoneum.
 4. Mechanically unstable pelvic fracture.
- **THREE critical tools used to differentiate these in multisystem trauma patient are:**
 - 1)Chest radiograph
 - 2)Pelvis radiograph
 - 3)Focused Abdominal Sonography for Trauma(FAST)
- **For Fluid resuscitation.** We start with crystalloid like ringer's lactate
- **Urine output is a quantitative reliable indicator of organ perfusion.** (0.5 ml/kg per hour in an adult, and 1 ml/kg per hour in child)
- **Secondary Survey once the immediate threats to life have been addressed, a thorough history is obtained and the patient is examined from head to toe**
- **In addition to physical examination the following should be done:**
 1. Vital Signs Monitoring.
 2. CVP Monitoring.
 3. ECG Monitoring.
 4. Nasogastric Tube Placement.
 5. Foley Catheter Placement.
 6. Repeat FAST as needed.
 7. Laboratory Measurement (CBC-LFT-amylase)
 8. Radiographs.
- **In critically injured patient blood sample for :**
 - Type and Cross- Matching.
 - Complete Blood Count Blood Chemistry
 - Coagulation Studies
 - Lactate Level *most sensitive test in patients with hypovolemia*
 - Arterial Blood Gas Analysis "ABG"



MCQs

1) What is the trauma fluid resuscitation of choice? (432)

- a. Normal saline
- b. 1/2 Normal
- c. ringer's lactate
- d. 0.9% NaCl

2) A 28-year-old male was injured in a motorcycle accident in which he was not wearing a helmet. On admission to the emergency room he was in severe respiratory distress and hypotensive (blood pressure 80/40 mm. Hg), and appeared cyanotic. He was bleeding profusely from the nose and had an obviously open femur fracture with exposed bone. Breath sounds were decreased on the right side of the chest. The initial management priority should be? (432)

- a. Control of hemorrhage with anterior and posterior nasal packing.
- b. Tube thoracotomy in the right hemi-thorax.
- c. Endotracheal intubation with in-line cervical traction.
- d. Obtain intravenous access and begin emergency type O blood transfusions.
- e. Obtain cross-table cervical spine film and chest film.

3) The best method to stop continuous bleeding from pelvic fracture is by:

- a. Applying mass trouser
- b. Insertion of external fixators
- c. Internal fixation
- d. Internal pelvis packing

4) Immediate life saving attention is required for a trauma victim who suffers any of the following conditions except:

- a. Airway obstruction
- b. Fracture of the femoral shaft
- c. Massive flail chest
- d. Open pneumothorax
- e. Tension pneumothorax

5) In hemodynamically stable trauma patient, intra-abdominal injury is best assessed by:

- a. Clinical abdominal examination
- b. CT scan
- c. Diagnostic peritoneal lavage (DPL)
- d. Four quadrants peritoneal tapping

Answers: 1) C , 2) C , 3) b , 4) b, 5) b

Thank You..

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