



432 Surgery Team

10

INTRODUCTION TO MECHANISMS OF TRAUMA AND
TREATMENT PRIORITIES



Done By:
Alhanouf Aljaser

Reviewed By:
Omar Alzuman
Manar Aleid

جامعة
الملك سعود
King Saud University



COLOR GUIDE: • Females' Notes • Males' Notes • Important • Additional

Objectives

Not given! 😞

Mechanisms and Patterns of Injury

BLUNT	PENETRATING
<p>Classified into:</p> <ol style="list-style-type: none">1. High energy transfer e.g. Car Accident2. Low energy transfer e.g. Fall from a bicycle <p>● Associated with multiple widely distributed injuries because the energy is transferred over a wider area during blunt trauma.</p>	<p>Classified into:</p> <ol style="list-style-type: none">1. Stab wound2. Gunshot wound3. Shotgun <p>● Damage is localized to the path of the bullet or knife.</p>

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**.

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.
- 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**).

Note(s):

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

- Although the concepts within primary survey are presented in a sequential fashion in reality they often proceed simultaneously.

a) Airway Management with cervical spine protection

- I. Conscious patient who do not show tachypnea and have normal voice do not require early attention to the airway.
- II. 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.
- III. Establishment of a definitive airway (i.e. endotracheal intubation) is indicated in:
 - patients with apnea
 - inability to protect the airway due to altered mental status
 - impending airway compromise due to inhalation injury
 - hematoma
 - facial bleeding
 - soft tissue swelling or aspiration
 - inability to maintain oxygenation

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

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 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:

- Direct laryngoscopy, **you see the tube heading the vocal cords.**

- Capnography, (**Capnography** is the monitoring of the concentration or partial pressure of carbon_dioxide)

- Audibility of bilateral breath sounds, **by auscultation**.
- 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).

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 must take care of are):

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

Note(s):

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-Tensional pneumothorax: body pressure is greater than atmospheric pressure(air trapped in the plura)
-Open pneumothorax:(there is an opening here)body pressure is equal to the atmospheric pressure.
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1) Tension Pneumothorax

Accumulation of air in the pleural cavity, causing respiratory distress
→distended neck veins → hypotension → cardiovascular collapse.

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. **Accumulation of air in the right lung will deviate the trachea to the left side.**
- **Lack or decreased breath sounds on the affected side.**
- Subcutaneous emphysema on the affected side.

- Distended neck veins due to impendence of superior vena cava, but **the neck veins may be flat due to systemic hypovolemia (bleeding)**.

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 intra-pleural pressure becomes positive which depresses the ipsilateral hemi-diaphragm 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 cardiac output which results in **cardiovascular collapse**.

****Why the patient develops hypotension??**

Because the lung will push the heart contralaterally → heart will be twisted → as well as the SVC and aorta → decrease pre-load.

Note(s):

If there is a tension pneumothorax on the right side, this will push the mediastinum to the left and knik the SVC which lead to congestion of the face and upper limbs and distention of the neck veins b/c 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 distended.

Treatment:

- **Immediate needle thoracostomy** decompression with a 14 gauge angiocatheter in the second intercostal space in the mid-clavicular line.
- **Tube thoracostomy** 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 comprises ventilation due to equilibration of atmospheric and pleural pressures which prevents lung inflation and alveolar ventilation and result in hypoxia and hypercarbia.

Treatment: Closure of the chest wall defect → if it is small and tube thoracostomy → if it is a large deficit.

3) Flail Chest. (here, we don't do ribs fixations)

- 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** may be evident in patient with spontaneous ventilation due to the negative intra-pleural pressure of inspiration.
- 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.**
- 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 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, 16 gauge or larger in adults.
- 3) Fluid resuscitation.

-We start with **crystalloid** like ringer's lactate → *1-↓systemic inflammatory response, 2-it is similar to plasma, 3-no metabolic hyperchloremic acidosis here*.

-If it is not available, use normal saline → *it contains large amount of Cl⁻ which can lead to hyperchloremic metabolic acidosis and the patient 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 .

Note(s):

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

- 1) Takes time
 - 2) Causes hemithorax Pneumothorax
-

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 it may damage the vessels.**

- 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 myocardium***
- c) Massive hemoperitoneum *** bleeding in the abdomen***
- d) Mechanically unstable pelvic fracture *** bleeding in the pelvis***

Note(s):

Triad of Cardiac tamponade:

- 1) hypotension
- 2) muffled heart sounds.
- 3) high JVP

***those are the causes of massive hypotension in traumatic patients**

****if the patient is hypotensive and you couldn't find a source of bleeding when looking in the abdomen or chest. Think of cardiac tamponade, very commonly missed.**

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

- a) Chest radiograph
- b) Pelvis radiograph
- c) Focused Abdominal Sonography for Trauma (FAST), it is performed as part of 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***
 - (3) suprapubic region ***perivascular***
 - (4) subxyphoid region ***pericardium***

Immediate treatment

A. 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 **(if the tube drain >1500 ml. blood) 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 patients.

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 reliable early sign of hypovolemia, **because blood volume must decrease by >30% before hypotension occurs.**

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)			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
CN/Mental Status	Slightly anxious	Mildly anxious	Anxious and confused	Confused and Lethargic

- Fluid resuscitation begins with a 2 L (Adult) or 20 ml/kg (child) IV bolus of **isotonic crystalloid**, typically Ringers' Lactate.
- For persistent hypotension, this is repeated once in an adult and twice in a child before re+6d 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**.
- Based on the initial response to fluid resuscitation, hypovolemic injured patients can be separated into three broad categories:
 1. Responders ***BP will stabilize***
 2. Transient responders ***BP will improve and then it will fall down again which means there is an active bleeding.**
 3. Non-responders ***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.
- **Vaginal examination** with speculum should be performed in women with pelvic fractures to exclude an open fracture.

In addition to physical examination the following should be done:

1. Vital Signs Monitoring
2. CVP Monitoring
3. ECG Monitoring
4. **Nasogastric Tube Placement**, which is contraindicated in complex maxillofacial injury or fractures at the base of the skull and should be passed orally.
 - It evaluates 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 *(CBC-LFT-amylase)*
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 trunkal 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 :
 1. Type and Cross- Matching.
 2. Complete Blood Count
 3. Blood Chemistry
 4. Coagulation Studies
 5. **Lactate Level** *most sensitive test in patients with hypovolemia*
 6. Arterial Blood Gas Analysis “ABG”

SUMMARY

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

❖ **primary survey** : ABC air, Breath, circulation.

A. Airway Management

B. Breathing and Ventilation

- I. Tension pneumothorax. Accumulation of air in the pleural cavity.
- II. Open pneumothorax. full-thickness loss of the chest wall.
- III. 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. Adequate urine output is 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 top to toe

*In addition to physical examination the following should be done:

1. Vital Signs Monitoring.
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4. Nasogastric Tube Placement.
5. Foley Catheter Placement.
6. Repeat FAST as needed.
7. Laboratory Measurement. *(CBC-LFT-amylase)*
8. Radiographs.

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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"

Questions

1) What is the trauma resuscitation of choice?

- 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:?

- A. Control of hemorrhage with anterior and posterior nasal packing.
- B. Tube thoracostomy in the right hemithorax.
- 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) Which of the following steps is NOT part of the primary survey in a trauma patient?

- a. Insuring adequate ventilatory support
- b. Measurement of blood pressure and pulse
- c. Neurologic evaluation with the Glasgow Coma Scale
- d. Examination of the cervical spine



Answers:

- 1st Questions:C
- 2nd Questions:C
- 3rd Questions:D