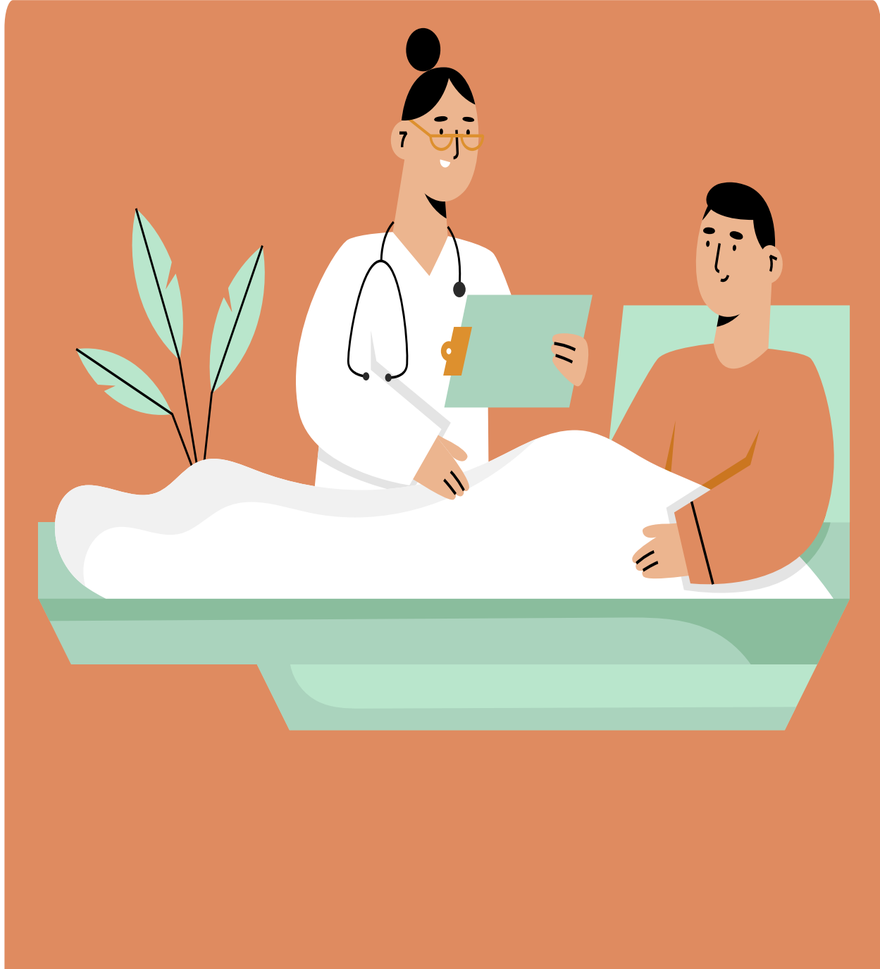
MED437
KING SAUD UNIVERSITY

SURGERY TEAM 437



Mechanism of trauma and trauma care

Objectives:

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Color Index:

- Important
- Doctor's Notes
- Extra
- Davidson's

Editing File / Feedback

Introduction

- Trauma is the primary cause of death and disability between ages 1 to 44 years.
- Analyzing a trauma scene is a vital skill.
- Determining the events that lead to trauma, often predict the injuries encountered.

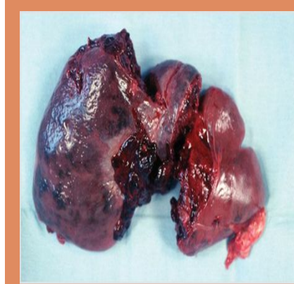
Trauma

- Injury occurs when an external source of energy affects the body beyond its ability to sustain and dissipate energy.

Different forms of energy produce **different kinds of trauma:**

1-Mechanical energy
2-Chemical energy
3-Electrical energy
4-Barometric energy

The most common



Spleen is the most commonly injured solid organ.

Factors Affecting Types of Injury

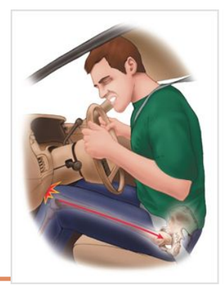
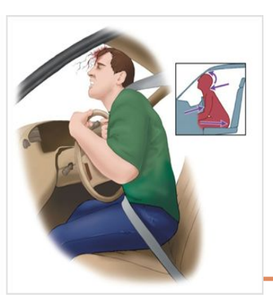
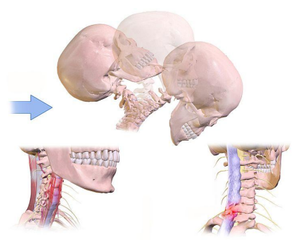
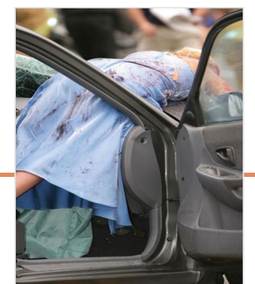
- **Ability of body to disperse energy delivered**
- **Force and energy**
  - Size of object
  - Velocity
  - Acceleration or deceleration
  - Affected body area
- **Duration and direction**
  - The larger the area, the more energy will be dissipated.
- **Position of victim**
- **The impact resistance of body parts has a bearing on types of tissue disruption.**
  - Organs that have gas inside are easily compressed.
  - Liquid-containing organs are less compressible.

1-Blunt Trauma

•Injuries in which tissues are not penetrated by external object

a)Motor Vehicle Crashes:

•Five phases of trauma:
•Phase 1: Vehicle Deceleration
•Phase 2: Occupant deceleration
•Phase 3: Deceleration of internal organs
•Phase 4: Secondary collisions hitting the windshield for example
•Phase 5: Additional impacts received by the vehicle

Impact Patterns: IMPORTANT	
Frontal or head-on impacts	•Front end of the car distorts. •Passengers decelerate at same rate as vehicle. •Abrupt deceleration injuries are produced by a sudden stop of a body's forward motion
Unrestrained occupants	• usually follow one of two trajectories: •Down-and-under pathway. •Up-and-over pathway  Knee injury, or more commonly the energy gets transmitted from the femur to the pelvis leading to pelvic fracture.  Head hits the windshield leading to brain trauma.
Lateral or side impacts	•Impart energy to the near-side occupant •Seat belts offer little protection. •The body is pushed in one direction, while the head moves toward the impacting object. 
Rear impacts	•Have the most survivors •Whiplash injury is common. •Energy is imparted to the front vehicle. Can lead to hyperextension injury of the neck.   Extra picture: Whiplash injury
Rotational or quarter-panel impacts	•Occurs when a lateral crash is off center •The vehicle's forward motion stops, but the side continues in rotational motion. There could be injury anywhere, and this is considered as a 'severe mechanism'. Some things we do them just based on 'severe mechanism' like if someone comes in and he was thrown out of the car السيارة تقلبت و even if he is stable based on the impact pattern we try to do imaging for the whole body looking for injury.
Rollovers	•Patients may be ejected. •Patients may be struck hard against the interior of the vehicle. 

Restrained Versus Unrestrained Occupants

Seat belts	Air bags
•Seat belts stop the motion of an occupant traveling at the same speed as the vehicle. •Associated injuries include cervical fractures and neck sprains + hollow viscus injury. Always if there's seat belt sign we care about the duodenum and spine.	•Air bags have reportedly reduced deaths in direct frontal crashes by about 30%. •Can also result in secondary injuries: •Direct contact •Chemicals The main injury caused by airbags is burns as airbags are very hot.

1-Blunt Trauma (continue)

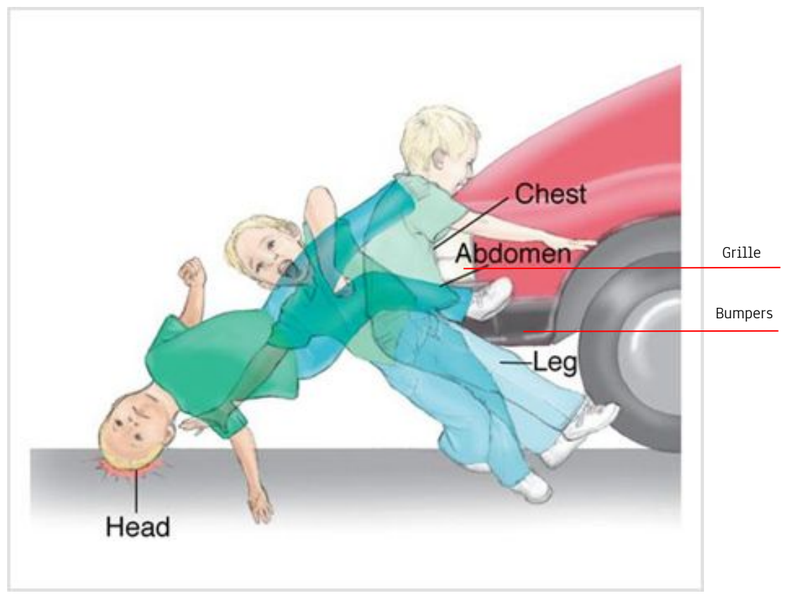
B)Pedestrian Injuries: Pedestrian vs. car is considered severe mechanism

Even if the patient is stable و شكله ما فيه شي

•Three predominant MOIs:
•First impact:
- Car strikes body with its bumpers.

•Second impact:
- Adult is thrown on hood and/or grille of vehicle.

•Third impact:
- Body strikes the ground or some other object.



•**Waddell triad**: Pattern of injuries in children and people of short stature
•Bumper hits pelvis and femur.
•Chest and abdomen hit grille.
•Head strikes vehicle and ground.

C) Falls from Heights:

•Severity of injuries impacted by:
•Height
•Position unconscious will fall on their head, whereas conscious fall on the legs or hand.
•Surface
•Physical condition

In falls from heights , if the patient falls on their legs the force is transmitted and usually stops at the pelvis. So pelvic fractures are common in these cases.

Penetrating Trauma

Involves disruption of skin and tissues in a focused area.

- **Low velocity:** Caused by sharp edges
- **Medium and high velocity:** Object might flatten out, tumble, or ricochet.

Stab Wounds

Severity depends on:

1. Anatomic area involved
2. Depth of penetration
3. Blade length
4. Angle of penetration

Gunshot Wounds

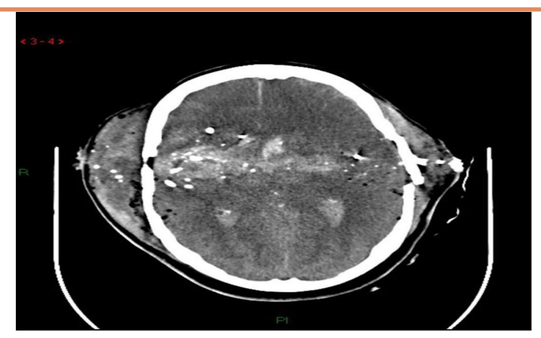
Severity depends on:

1. Type of firearm
2. Velocity of projectile
3. Physical design/size of projectile
4. Distance of victim from muzzle
5. Type of tissue struck

Handgun:	• Revolver holds 6 to 10 rounds of ammunition • Pistol holds up to 17 rounds of ammunition • Accuracy is limited.
Shotguns:	• Fire round pellets
Rifles:	• Fire single projectile at a very high velocity • Impart a spin for accuracy

- Exit wounds occur when projectile's energy is not entirely dissipated.
- Size depends on energy dissipated and degree of cavitation.

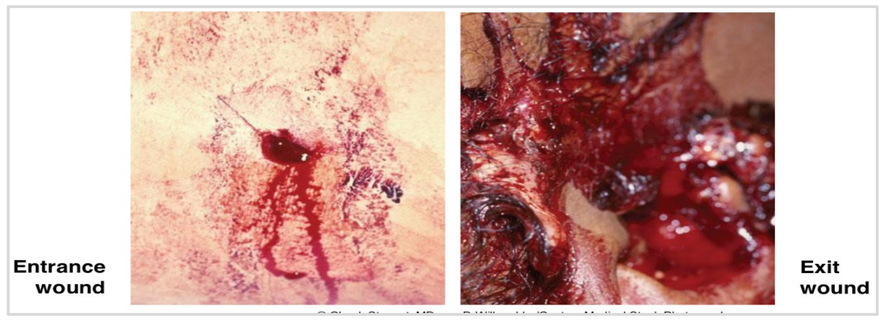
- Projectile creates a permanent cavity.
- May be straight line or irregular pathway
- Pathway expansion: Tissue displacement that results from low-displacement sonic pressure
- Missile fragmentation: Projectile sends off fragments that create paths through tissues.



Exit wounds occur when projectile's energy is not entirely dissipated.

- Size depends on energy dissipated and degree of Cavitation.

Exit wounds are Usually bigger and distorted لأن الرصاصة تكون بطيئه



The doctor said all what you need to know from gunshot wounds is that there's an entrance wound and an exit wound. The patient has to have an even number of holes. If there isn't an even number then the bullet in there somewhere you have to look for it. Why? To know the trajectory (the path the bullet took inside the body) in order to know which parts could be injured.

Gunshot Wounds

Wounding potential depends on:

1. Powder charge
2. Size and number of pellets
3. Dispersion of the pellets
4. Range at which the weapon was fired
5. Barrel length
6. Type of choke at the end of the barrel

Try to obtain the following: Weapon used, range fired, and bullet used

Look for: Powder residue around the wound, entrance and exit wounds.

Trauma Care

Goals/ Principles of Trauma Care

- Rapid, accurate, and physiologic assessment
- Resuscitate, stabilize, and monitor by priority
- Prepare for transfer to definitive care
- Teamwork for optimal, safe patient care

Principles

- Treat greatest threat to life first prioritize by the ABC
- Definitive diagnosis less important
- Physiologic approach
- Time is of the essence
- Do no further harm
- Teamwork required to succeed

Approach primary survey

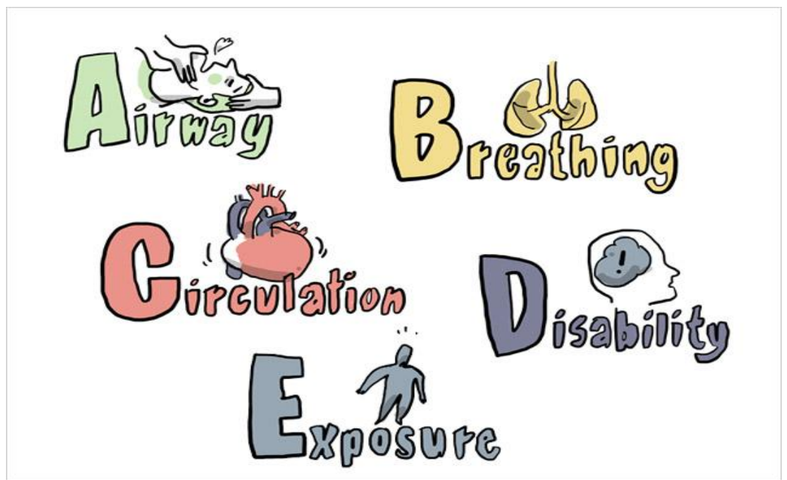
A: Airway with c-spine protection

B: Breathing/ ventilation/ oxygenation

C: Circulation: Stop the bleeding!

D: Disability (neuro status)

E: Expose/ Environment/ body temp Expose the whole patient but also prevent hypothermia



Sequence and Teamwork

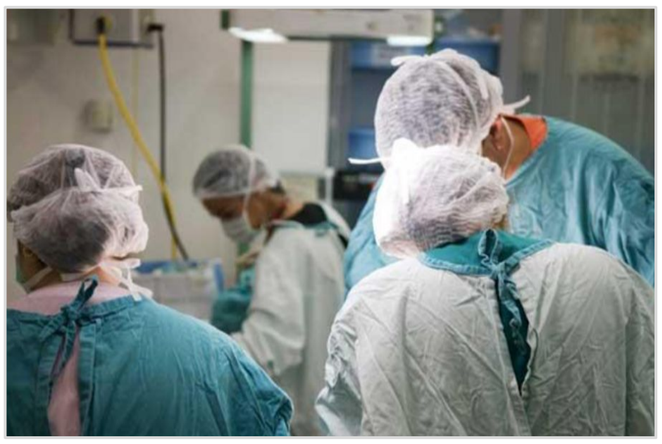
- Simultaneous primary survey and resuscitation of vital functions
- Simultaneous secondary survey and reevaluation of vital functions

In-hospital Preparation

- Pre Planning essential
- Team approach
- Trained personnel
- Proper equipment
- Lab / x-ray capabilities
- Standard precautions
- Transfer agreements
- QI Program

Standard Precautions

1. Cap
2. Gown
3. Gloves
4. Mask
5. Shoe covers
6. Goggles/ face shield



Triage

Sorting of patients according to:

- ABCDE's
- Available resources
- Other factors, e.g., salvageability

Primary Survey

A Airway / C-spine protection

B Breathing / Life-threatening chest injury

C Circulation / Stop the bleeding

D Disability / Intracranial mass lesion

E Exposure / Environment/ Body temp

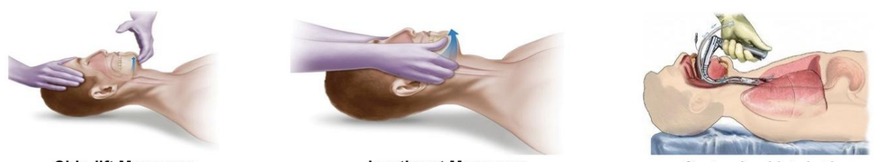
Priorities are the same for all!

Primary Survey: Airway

Caution	C-Spine Injury (Never do head tilt in tauma bc if he has c-spine injury and you did a head tilt he'll be quadriplegic for life

- **Assess for airway patency**
- Snoring
- Gurgling
- Stridor
- Rocking chest wall motions
- Maxillofacial trauma/ laryngeal injury
- Chin lift/ Modified jaw thrust(These are techniques to open the airway and we prefer Jaw thrust in trauma why?Bc chin lift technique moves the c spine and as we said we assume that every trauma pt has c spine injury
- There are some **Advanced Airway Techniques like : Oral tracheal intubation(**It is the most **common technique used to establish a definitive airway.** + it prevents vomiting and secretions from going to lungs
- Because all patients are presumed to have cervical spine injuries, manual in-line cervical immobilization is essential by using cervical collar. is the most secure way, provides you a way to ventilate the patient but it requires extra training not everybody can do this, if we couldn't go through the mouth we do it surgically but most of the time you don't want to go through these things it's better to do jaw thrust bc it's easier for both the patient and the doctor.
- Look, listen, feel
- Remove particulate matter if there's blood, teeth.
- Definitive airway as necessary intubation (**Altered mental status** is the **most common** indication for intubation**!!!!**
- Reassess frequently

The first thing you check is if the patient is able to speak or not



Chin-lift Maneuver | Jaw-thrust Maneuver | Orotracheal intubation

Video: Airway Manoeuvres (1:19)

Primary Survey: Breathing (Assess and ensure adequate oxygenation and ventilation)

Caution	Tension/open pneumothorax

- Chest rise and symmetry (By physical examination)
- Air entry
- Respiratory Rate/ Effort
- Color/ Sensorium
- **Oxygen saturation.(** The most important method in breathing assessment, if O2 sat is good move on) and you have to Administer supplemental oxygen **for EVERY patient**
- Ventilate as needed
- Tension pneumothorax: Needle decompression in the 2nd intercostal space
- Open pneumothorax: Occlusive dressing
- Reassess frequently

In tension pneumothorax you have a one way valve. When there's negative pressure in the chest wall, air leaves the lungs to the pleural cavity. When there's positive pressure the valve is closed and the air is trapped, slowly building up.
Once the pressure in the chest is increased , there's no venous return, then no cardiac output. So you can never treat the C circulation without dealing with the pneumothorax!

EXTRA: Tension pneumothorax

جا ستيشن بسنة من السنوات، اعطوهم اكس راي وطلبوا الدياقنوززز وسألوا عن الاكس راي فايندتقز والمانجمنت

Pathophysiology

There's a parenchymal tear in the lung which acts as a one-way valve, with each inhalation allowing additional air to accumulate in the pleural space. The normally negative intrapleural pressure becomes positive:

- Depresses the ipsilateral hemidiaphragm.
- Shift the mediastinal structures into the contralateral chest.
- Subsequently the contralateral lung is compressed.
- The heart rotates about the superior and inferior vena cava, this decreases venous return and ultimately cardiac output which results in cardiovascular collapse.

When there is lung injury the air escape from the lung into pleural cavity then doesn't go back again from pleural cavity into the lung→ the air will start to accumulate with every breath in a closed space so the pressure will go up and Subsequently it can lead to tension pneumothorax when 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 and finally the patient will become hypotensive.

#So the patient will be **hemodynamically compromised** in tension pneumothorax due to the pneumothorax it self

Diagnosis

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

- General and Inspection: signs of tachycardia, hypotension, hypoxia, **distended neck** veins due to impedance of superior-vena cava, but the neck veins may be flat due to systemic hypovolemia.

- Palpation: **Tracheal deviation** away from the affected side (contralateral side). (e.g. accumulation of air in the right lung will deviate the trachea to the left side), Subcutaneous **emphysema** on the affected side.

- Percussion: hyperresonance (ipsilateral).

- Auscultation: **Lack or decreased breath sounds** on the affected side.

You should NOT diagnose it from chest x ray! It's very clear clinically عليه الحقوا، وقت مافيه يموت قاعد المريض! it is a clinical diagnosis and requires immediate treatment the patient will die if you wait for a CXR :ثانية مره بكتبها Anyways CXR findings: Mediastinal deviation to the opposite side, tracheal deviation to the opposite side,hyperexpanded lower diaphragm, collapsed lung, hyperlucent lung field.

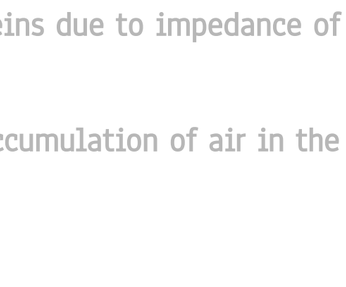
Treatment

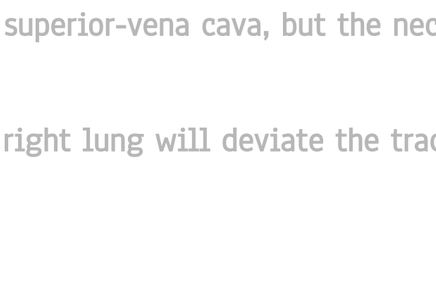
★ First: Immediate needle thoracostomy:

- Decompression with a 14 gauge angiocatheter
- In the second intercostal space in the midclavicular line [so you convert tension pneumothorax into simple pneumothorax, the blood pressure will go up and now you have more time to insert chest tube]

★ Then: Insert Tube thoracostomy:

- In the **fifth** intercostal space in the **midaxillary line** immediately in the emergency department before the chest radiograph.





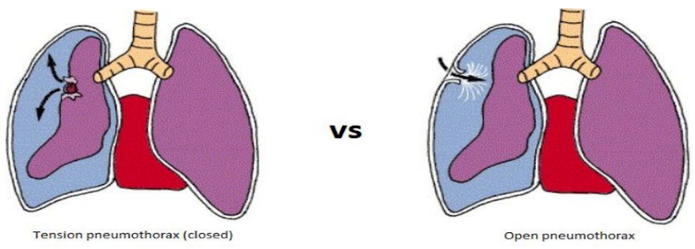
EXTRA: Open pneumothorax (or sucking chest wound).

Pathophysiology

Is the opposite of Tension pneumothorax when you have an opening in the chest wall and the air is going into pleural space from outside through the open chest , unlike tension pneumothorax where the air is coming from inside due to lung injury

- 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

[in other words: Normally In inspiration the chest expands so you create negative pressure and the air goes into the nose→ trachea→ bronchi→ lung, but if you have an opening in the chest wall the resistance in this opening will be less than the resistance in the trachea so the air will go in and out faster through this opening so it's ineffective breathing]

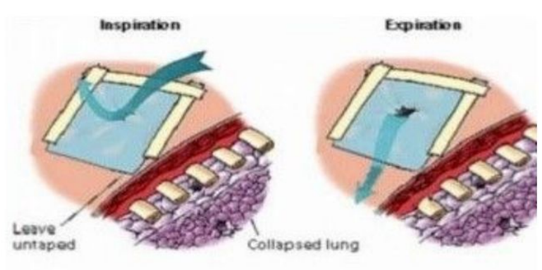


Treatment

★ First: Close the chest wall defect create one-way valve(flutter valve dressing) that allows the air to go out through the opening in the expiration because the dress is pushed by the +ve pressure, but not to go inside through the inspiration because the dress will be sucked by the -ve pressure So the patient can now breathe normally through the nose.

- Placement of dressing secured on 3 sides to create (flutter-valve) because securing on 4 sides will cause tension pneumothorax, a chest tube distant from injury must then be placed.
- this done when you're not in the hospital , in hospital we do dressing and chest tube-

★ Then: tube thoracostomy in the 5th intercostal space midaxillary line



Primary Survey: Circulation (1-Control hemorrhage: THE MOST IMPORTANT THING IS TO STOP THE BLEEDING! 2-Restore the the volume by giving isotonic solutions)

Non hemorrhagic shock every patient treat him as if he is bleeding with 2 large bore IVs and 1 L of fluid. If still hypotensive we give blood.

- Cardiac tamponade picked up by ultrasound (FAST)
- Tension pneumothorax
- Neurogenic
- Septic (late)

Lethal triad (triad of death) when you leave the patient bleeding for a long time the Pt will end up with having this triad which is :

1-Hypothermia 2-Coagulopathy 3- acidosis once they develop this triad it's very difficult to treat them

Assess organ perfusion

- Level of consciousness
- Skin color
- Pulse rate and character
- Tachycardia
- Vasoconstriction
- ↓ Cardiac output
- Narrow pulse pressure
- ↓ MAP
- ↓ Blood flow

Resuscitation

Bleeding?

You have 4 cavities where the patient could be bleeding: chest- abdomen- pelvis- bone

Find it!

- Direct pressure
- Operation
- Avoid blind clamping
- Obtain venous access
- Restore circulating volume
- Ringer's lactate, 1-2 L
- PRBCs if transient response or no response
- Reassess frequently

Consider

- **Tension pneumothorax:** Needle decompression and tube thoracostomy same picture as bleeding (hypotension and tachycardia)
- **Massive hemothorax:** Volume resuscitation and tube thoracostomy
- **Cardiac tamponade:** Pericardiocentesis and direct operative repair In a young patient fluid around the heart is always due to injury.

Massive hemothorax

- (> 1.5 L) Massive bleeding in the chest
- Kind of similar to tension pneumothorax but instead of having air pushing on the lung you have blood
- Treat it by inserting chest tube in the 5th intercostal space midaxillary line, Use a big size tube (32) because you don't want it to be blocked by blood.

Cardiac tamponade

- Blood collected in the pericardium because of heart injury so with every single beat of the heart, the heart will bleed into the pericardium space, pressure will accumulate and compress the heart causing tamponade
- In medical cardiac tamponade the management is Pericardiocentesis to relieve the pressure , in trauma we are more concerned with the heart injury that led to tamponade so treatment IS NOT Pericardiocentesis. You need to take the pt to OR to fix the heart
- If you don't have a cardiac surgeon you treat it as a medical cardiac tamponade (where there is fluid accumulating around the heart not blood) with Pericardiocentesis
- The triad of signs in cardiac tamponade **(Beck's triad)**: Hypotension, Distended neck veins, and muffled heart sounds. Other signs include tachypnea, tachycardia, pulsus paradoxus, and a reduced level of consciousness.

Primary Survey: Disability

Caution	Observe for neurologic deterioration

- **Baseline neurologic evaluation**
- Pupillary response
- Neurosurgical consultas indicated
- You need to check three things only:
- 1- glasgow coma scale (see fig)
- 2- pupil response
- 3- unilateral signs like weakness on one side
- If you find one of the above the patient immediately goes to neurosurgery for evacuation of bleeding.
- You have to know how to calculate Glasgow coma scale its commonly asked in OSCE

Table 7.1 Glasgow Coma Scale

Eyes open	
• Spontaneously	4
• To verbal command	3
• To pain	2
• No response	1
Best motor response	
To verbal command	
• Obeys verbal command	6
To painful stimulus	
• Localizes pain	5
• Flexion withdrawal	4
• Abnormal flexion (decorticate rigidity)	3
• Extension (decerebrate rigidity)	2
• No responses	1
Best verbal response	
• Orientated and converses	5
• Disorientated and converses	4
• Inappropriate words	3
• Incomprehensible sounds	2
• No response	1
Total number of points (minimum 3, maximum 15)	

Recall Extra

Describe the GCS scoring system:

Eye opening (E) (Think: Eyes = "four eyes")	Motor response (M) (Think: Motor = "6-cylinder motor")	Verbal response (V) (Think: Verbal = "Jackson 5")
4—Opens spontaneously	6—Obeys commands	5—Appropriate and oriented
3—Opens to voice (command)	5—Localizes painful stimulus	4—Confused
2—Opens to painful stimulus	4—Withdraws from pain	3—Inappropriate words
1—Does not open eyes	3—Decorticate posture	2—Incomprehensible sounds
	2—Decerebrate posture	1—No sounds
	1—No movement	

What is a normal human GCS? 15
What is the GCS score for a dead man? 3
What is the GCS score for a patient in a "coma"? ≤ 8
GCS indication for intubation? ≤ 8
How does scoring differ if the patient is intubated?
Verbal evaluation is omitted and replaced with a "T"; thus, the highest score for an intubated patient is 11 T

Primary Survey: Exposure

Caution	Prevent hypothermia

- Completely undress the patient
- Remove helmet if present.
- Look for visible / palpable injuries
- Log roll, protect spine

Resuscitation: Overview

If in doubt, establish definitive airway

- Oxygen for all trauma patients
- Chest tube may be definitive for chest injury
- Stop the bleeding!
- 2 large-caliber IVs
- Prevent hypothermia

Primary Survey: Adjuncts

Monitoring

- Vital signs
- ABGs
- ECG
- Pulse oximetry
- End-tidal CO2

Diagnostic Tools

- Chest / pelvis x-ray
- C-spine x-rays when appropriate
- FAST to look for bleeding in the chest and abdomen
- DPL

Consider need for transfer

Secondary Survey

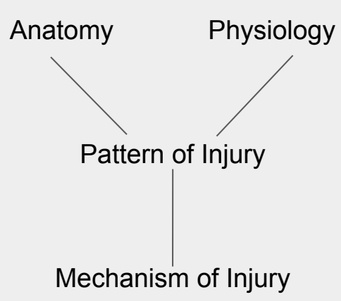
Start After	Key Parts
• Primary survey completed • Resuscitation in process • ABCDEs reassessed • Vital functions returning to normal	• AMPLE History • Complete physical exam: Head-to-toe • Complete neurologic exam • Special diagnostic tests • Reevaluation

The doctor said this is extremely important and could come as an OSCE station (take AMPLE history)

A:allergy. M:medication. P: Pastillnesses/Pregnancy. L: Last meal. E: Events/Environment

Secondary Survey

Mechanism of Injury



Summary

Primary Survey Adjuncts
Resuscitation
Secondary Survey Adjuncts
Continuous Reevaluation
Safe transfer
Definitive care

Summary

- **One, safe way**
- **Do no further harm**
- **Treat greatest threat to life first**
- **Teamwork**

Summary

Trauma

Factors Affecting Types of Injury:

- Ability of body to disperse energy delivered
- Force and energy
- Duration and direction
- Position of victim
- The impact resistance of body parts has a bearing on types of tissue disruption

Blunt Trauma

a) Motor Vehicle Crashes:

Five phases of trauma:

1. Phase 1: Vehicle Deceleration
2. Phase 2: Occupant deceleration
3. Phase 3: Deceleration of internal organs
4. Phase 4: Secondary collisions
5. Phase 5: Additional impacts received by the vehicle

1-Impact Patterns

- Frontal or head-on impacts
- Unrestrained occupants
- Lateral or side impacts
- Rear impacts
- Rotational or quarter-panel impacts
- Rollovers

2-Restrained Versus Unrestrained Occupants

- Seat belts

Associated injuries include cervical fractures and neck sprains

- Air bags

Can Result in secondary injuries:
Direct contact
Chemicals

B) Pedestrian Injuries

C) Falls from Heights

Penetrating Trauma

A) Stab Wounds

Severity depends on:

1. Anatomic area involved
2. Depth of penetration
3. Blade length
4. Angle of penetration

B) Gunshot Wounds

Severity depends on:

1. Type of firearm
2. Velocity of projectile
3. Physical design/size of projectile
4. Distance of victim from muzzle
5. Type of tissue struck

Trauma care

Primary Survey

- A Airway / C-spine protection
- B Breathing / Life-threatening chest injury
- C Circulation / Stop the bleeding
- D Disability / Intracranial mass lesion
- E Exposure / Environment/ Body temp

Secondary Survey

- AMPLE History
- Complete physical exam: Head-to-toe
- Complete neurologic exam
- Special diagnostic tests
- Reevaluation

Quiz

1) The most common type of trauma caused by which type of energy?

A. Mechanical energy
B. Chemical energy
C. Electrical energy
D. Barometric energy

2) the most commonly injured solid organ is?

A. gallbladder
B. spleen
C. pancreas
D. liver

3) Which type of Impact Pattern can lead to hyperextension injury of the neck?

A. Unrestrained occupants (Down-and-under pathway)
B. Unrestrained occupants (Up-and-over pathway)
C. Rotational or quarter-panel impacts
D. Rear impacts

4) Which type of Impact Pattern can lead to pelvic fracture?

A. Unrestrained occupants (Down-and-under pathway)
B. Unrestrained occupants (Up-and-over pathway)
C. Rotational or quarter-panel impacts
D. Rear impacts

5) Which type of Impact Pattern can lead to brain trauma?

A. Unrestrained occupants (Down-and-under pathway)
B. Unrestrained occupants (Up-and-over pathway)
C. Rotational or quarter-panel impacts
D. Rear impacts

6) Which type of Impact Pattern considered as severe mechanism?

A. Unrestrained occupants (Down-and-under pathway)
B. Unrestrained occupants (Up-and-over pathway)
C. Rotational or quarter-panel impacts
D. Rear impacts

7) in Motor Vehicle Crashes there is Five phases of trauma which are?

A. Vehicle Deceleration > Occupant deceleration > Deceleration of internal organs > Additional impacts received by the vehicle > Secondary collisions
B. Vehicle Deceleration > Occupant deceleration > Deceleration of internal organs > Secondary collisions > Additional impacts received by the vehicle
C. Vehicle Deceleration >Deceleration of internal organ > Occupant deceleration> Secondary collisions > Additional impacts received by the vehicle
D. Vehicle Deceleration > Secondary collisions > Deceleration of internal organs > Occupant deceleration > Additional impacts received by the vehicle

1(A) 2(B) 3(D) 4(A) 5(B) 6(C) 7(B)