### Chest Trauma

Ala Qayet Consultant Thoracic Surgery 12<sup>th</sup> April 2025



# Introduction to Chest Trauma

- Chest trauma accounts for ~25% of trauma-related deaths.
- Can be blunt or penetrating.
  - Blunt more common
- Quick diagnosis and management are crucial.
- Often associated with polytrauma.

### Types of Chest Trauma

• Blunt trauma (e.g., MVCs, falls, crush injuries)

 Penetrating trauma (e.g., stab wounds, gunshots)





Juliquin

### Relevant Thoracic Anatomy

• Thoracic cage: ribs, sternum, clavicle

• Lungs, pleura, heart, great vessels

• Diaphragm



# Primary Survey – ABCDE



### Immediate Life-Threatening Injuries

- Airway obstruction
- Tension pneumothorax
- Open pneumothorax
- Massive hemothorax
- Flail chest with pulmonary contusion
- Cardiac tamponade

# Diagnostic Approach

- Chest X-ray
- FAST/EFAST ultrasound
- CT Chest (when stable)
- ABG, pulse oximetry

• ECG, cardiac enzymes (in cardiac injury suspicion)



This Photo by Unknown Author is licensed under CC BY-SA-NC



# X ray

- Fast
- Easy
- Can be done cross table
- Can be very informative





### CT scan

- > Always with IV contrast
- Informative and give anatomy as well
- Reconstruction can be done



### FAST

- Traditional Focused Assessment with Sonography in Trauma (FAST) has 4 views:
  - the cardiac (subxiphoid) window
  - right upper quadrant (Morrison pouch)
  - left upper quadrant
  - suprapubic
    (bladder) window.



### General Management Principles

 Airway management (intubation, cricothyrotomy)

• Chest tube thoracostomy

Needle
 decompression

 Surgical exploration (thoracotomy) • Fluid resuscitation and blood transfusion

## **Rib Fractures**

- Simple Rib Fractures are the most common
  - oral analgesics and chest physiotherapy
  - Poor pain control contributes significantly to complications like atelectasis and pneumonia
- Old age, associated other comorbid disease, general condition and the need for good analgesia control are indications for admission



- The presence of greater than three rib fractures on chest radiograph is a marker for associated solid visceral trauma and mortality.
- Fractures of the first or second rib require a significant force and in about 20-30% of these patients there is a possibility of major thoracic injury



## Flail Chest

Patients with multiple rib fractures of three or more consecutive ribs at two sites.

- Flail chest occurs in 5-13% of patients with chest trauma
- Frequently require mechanical ventilation
- Mortality rate of up to 33%



## Flail Chest

- Internationally, patients with flail chest are in the hospital for an average of 11 days, predominantly in the ICU settings
- More than 30% of patients require additional care in post acute settings
- Indirect social costs result from inability to work or reduced productivity



### Management

- Simple rib fractures treated conservative with rest and analgesia
- multiple rib fractures or bilateral fractures
  - epidural analgesia
  - aggressive pain control with IV analgesics and intercostal nerve blocks with bupivacaine
  - Surgical management and fixation



### Surgical management



#### Surgical management



#### Surgical management



# Sternal Fractures

- Signifies massive trauma to the chest
- Need to exclude cardiac and great vessel injury
- Cause severe pain and SOB





 If unstable, pain or dehiscence then fixation



# AIR where it shouldn't be

- Pneumothorax
- Pneumomediastinum
- Subcutaneous emphysema
  - Systemic venous air embolism
- Pneumopericardium
- Pneumoperitoneum/retroperitone um

### Pneumothorax





#### Pneumothorax: Simple

- Erect AP/PA view best
- Visceral pleural line
- No vessels or markings
- Variable degree of lung collapse
- ► No shift



# Tension Pneumothorax

- Clinical diagnosis
  - Hypotension
  - ► Raised JVP
  - Respiratory distress
  - Silent chest
- Need immediate management

#### MCHUMOR by T. McCracken



"Off hand, I'd say you're suffering from an arrow through your head, but just to play it safe, I'm ordering a bunch of tests."

- If missed and X ray done
- Shift of mediastinum, heart and trachea away from PTX side
- Depressed hemidiaphragm
- Degree of lung collapse is variable





## Management of Pneumpthorax

Relief of tension and preventing it
 Needle decompression
 2nd intercostal space

- midclavicular line
- Chest tube as definitive
- Analgesia
- O2 therapy







Need underwater seal







#### Underwater seal drain









- As general rule never clamp a chest tube with pneumothorax
- Clamping the tube will convert your pneumothorax to a tension one.





#### Open Pneumothorax

- A large hole or defect in the chest caused by a large low velocity missile.
- It cause a sucing wound
- Air enters the hole rather than the trachea causing hypoxia.



### Open chest wounds

 Asherman chest seal or 3 way adhesive dressing till definite Tx.



It seal the wound

Make one way valve







#### Pneumomediastinum

- Usually from ruptured alveoli.
- Can also be from trachea, bronchi, esophagus, bowel and neck injuries.
- Could be spontaneous

#### Pneumomediastinum: Signs

- Linear paratracheal lucencies
- Air along heart border
- "V" sign at aorticdiaphragm junction
- Continuous diaphragm sign





PNEUMOMEDIASTINUM: CT
## Mx

- Observation
- Supportive
- ► O2
- Might need chest tube
- Need investigation for source
- Treat the underling cause

## Trachea/bronchi injuries

Tears occur within 2cm of carina Persistant pneumothorax ► Large pneumomediastin um "Fallen lung"



### Subcutaneous Emphysema

- Causes: Same as pneumomediastinu m
- Mx is same as above





#### Pneumopericardium

#### Causes: penetrating trauma

Rare





#### Pneumoperitoneum

Pneumoperitoneum and sometimes pneumoretroperitoneum are seen on upright chest film



### Hemothorax

- Venous or arterial bleeding
- 60% controlled by chest tube, 40% need operative management
- Can miss hundreds of cc's on supine film
- Can cause tension
- Source
  - 1. Lung
  - 2. Chest wall
  - 3. Other organs





#### CT: HEMOTHORAX

## Mx

- Treat with chest tube.
- if immediate drainage is 1500 cc or if 250 cc/hr for 4 consecutive hours, then immediate thoracotomy to control source
- If residual collection on CT scan



#### Pulmonary contusions and lacerations

- Contusion: Blood in intact lung parenchyma
- Laceration: Blood in torn lung parenchyma
- Can't tell difference on chest film. Contusions peak in 2-3 days, begin to resolve in a week; lacerations take much longer to resolve and may leave scars





# CT: Pulmonary Contusion

## Mx

- Supportive
- 02
- Ventilatory support
- Tx other associated injuries
- Differentiate from aspiration

#### Diaphragmatic Injuries

5% of major blunt trauma, also thoracoabdominal penetrating trauma

Left side > right 60/40

Sensitivity of Chest film 40%. CT better, but still misses some

Need high clinical suspicion

Might need diagnostic VATS

### Diaphragm Injury: Position of NG Tube

Hard signs: NGT through gastro-esophageal junction then up into chest, and hollow viscus above diaphragm





Diaphragm Injury: Gut in Chest



### MX SURGICAL REPAIR





## Penetrating Trauma

GUNSHOT WOUNDS STAB WOUNDS

# Gunshot Wounds

- Match all entrance and exit wounds
- Find the bullet(s) and keep looking until all are accounted for
- Estimate path of bullet, which may not be straight
- Estimate organs injured



## Injuries depend upon:

- Caliber, weight, construction of bullet
- Velocity
- Tissue impacted



Gunshot Wounds: some terms

- Rounds: the bullet and its casing, propellant and primer
- Bullet: the part of the round that is propelled from the weapon
- Firearms: pistol, rifle, shotgun
- "Blast": a property of high explosives, not firearms. Don't use with GSW.



## Rounds: Pistol and Rifle

## Bullet

- Size: diameter in millimeters or caliber (fractions of an inch)
- Weight: in grams
- Construction: round nose, hollow point, full metal jacket, semi-jacket, no jacket



# Injuries: Bullet

The larger the diameter of the bullet and the more it weighs, the bigger the wound.

Hollow point and semi-jacket bullets mushrooms or fragment on impact and cause bigger wounds than full metal jackets(FML).



# Injuries: Velocity

- Handgun are low velocity (1000 fps) and cause a permanent wound channel (crush) only.
- High-powered and assault rifles are high velocity (3000 fps) and cause a permanent wound channel and also temporary cavitation (blunt or stretch trauma) and so a bigger wound.



### Injuries: Tissue

- Lung is elastic and more resistant to injury than solid organs.
  Bone is least resistant.
- Obviously, the more vital the organ the more serious the injury.







#### Gunshot

# Shotgun











# Shotgun

## Gunshot Wounds

GSWs of the chest cause: pulmonary lacerations, contusions, hemothorax, pneumothorax, mediastinal and heart injuries.

pneumomediastinum and fractures also seen.



#### GSW: Hemo-Pneumothorx

GSW: Lacerations, abnormal Mediastinum, Pneumothorax



#### GSW: Transmediastinum

- Bilateral chest tubes
- Angiography
- Pericardial window
- Triple endoscopy
- Esophagram
- Thoracic spine films



### Gunshot Wounds: CT

May be able to establish bullet tract and avoid surgery, especially thoracoabdominal wounds



Stab wounds All low energy, small diameter wounds. Frequently, superficial stab or slash.

Look for lung laceration, pneumothorax, hemothorax, pneumomediastinum, abnormal contour of mediastinum or heart.

Path of wound is straight.

## Stab wounds

Need to be removed in theatre and under control to visiualise tract and control bleeding



# Lung Injury

- About 30% lung parenchymal injury requires operative intervention
- Location and the extent of the injury largely determine specific intervention
- Time and resources are game changer
- Damage control principles should be applied
- Iung parenchyma sparing operations should be utilized whenever possible and can be accomplished by performing a stapled or sutured tractotomy




- central injuries will often be associated with an unstable physiology requiring emergent intervention
- Hilar clamping or a hilar twist maneuver with temporary closure may be needed to stabilize these patients
- Total pneumonectomy should be considered when patients are too unstable



# EXPLOSION Related Chest Injuries

ACCIDENTAL/TERRORIST EVENT CONVENTIONAL EXPLOSIVE DEVICE IMPROVISED EXPLOSIVE DEVICE



#### High Explosives:

#### • TNT, dynamite, C-4, ANFO, RDX, PETN

Low Explosives:  Gun powder, smokeless propellant, fireworks

#### Explosions

- Blast wave: sudden increase in atmospheric pressure. High explosives only.
- Blast wind: sudden expansion of hot gases.
   High and low explosives.



## EXPLOSION Related Injuries

- Blast Wave: Lung laceration, contusion, edema, barotrauma
- Penetrating Trauma
- Blast Wind: Displacement
- Crush, burns, inhalation injuries







EXPLOSION: Blast Wave causes blast lung



EXPLOSION: Blast Wave causes barotrauma and/or laceration

#### EXPLOSION: Blast wave causes abdominal injuries

Pressure wave injures bowel wall, causing hematoma and perforation, and so pneumoperitoneum



#### EXPLOSION: Penetrating trauma

- Metal fragments from conventional bomb housing
- Scraps of metal, nails attached to Improvised Explosive Device





#### EXPLOSION: Flying glass

#### Managment

Early intervention directed toward diagnosing and treating:

- ► Tension pneumothorax
- ► Massive hemothorax
- Open pneumothorax
- ► Cardiac tamponade
- ► Flail chest

#### Initial management

> Airway, Breathing, Circulation> PRIMARY SURVEY

- Identify & treat immediately life-threatening conditions
- Don't forget the BACK







## ER THORACOTOMY SURVIVAL RATES < 8%

#### ER Thoracotomy

- BLUNT injury with arrest
- Arriving without
  pulse/BP
- Penetrating injury with
  arrest
- High likelihood of isolated / correctable intra-thoracic injury

and the second discount of	Sector Street and a		and the second s	
Indications	tor Emai	dent I	horacotom	1
Indications		Belli		11

#### **Penetrating Trauma**

Traumatic arrest with previously witnessed cardiac activity

Unresponsive hypotension (systolic <70)

Traumatic arrest without previously witnessed cardiac activity (thoracic trauma)\*

Traumatic arrest with previously witnessed cardiac activity (nonthoracic trauma)\*

\*Relative indication

#### **Blunt Trauma**

Rapid chest tube exsanguination (>1500 mL)

Unresponsive hypotension (systolic <70)

Traumatic arrest with previously witnessed cardiac activity (thoracic trauma)\*





#### Esophageal Injury

- Esophageal injuries are rare and are difficult to treat
- Morbidity and mortality associated is high because of injury to several other intrathoracic organs along with it
- Most injuries are secondary to penetrating trauma and may occur at any level
- Pain, fever, subcutaneous emphysema, abdominal tenderness, and mediastinal crunching sounds (Hamman sign) are common physical findings
- Diagnosis is confirmed by esophagography and esophagoscopy

# Key Takeaways

Early recognition saves lives.

Stick to ABCDE.

Know the signs of life-threatening injury.

Timely intervention and reassessment are vital.

Call for help

# Thank You



Its all about teamwork