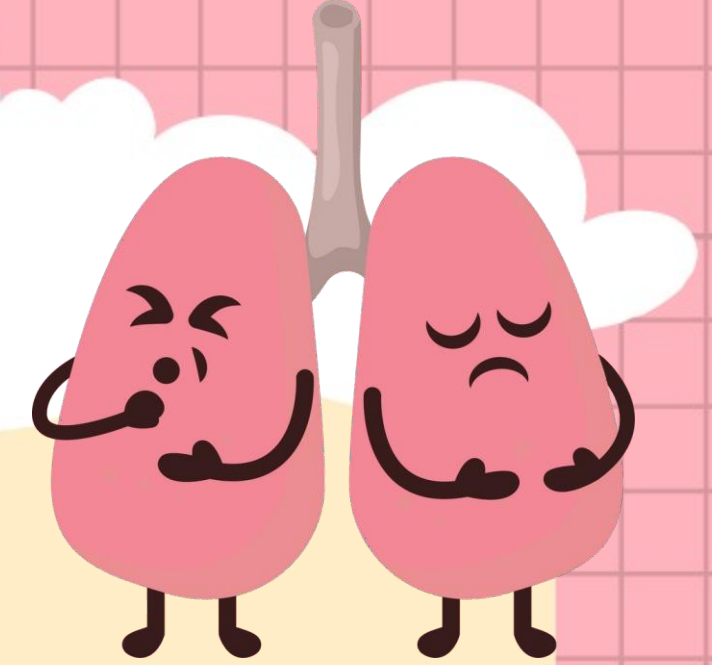


THORACIC TRAUMA

Presented by:
Sahar Alnaimy
Salma al sha'bani
Abd alrahman
alanzi



THORACIC TRUMA

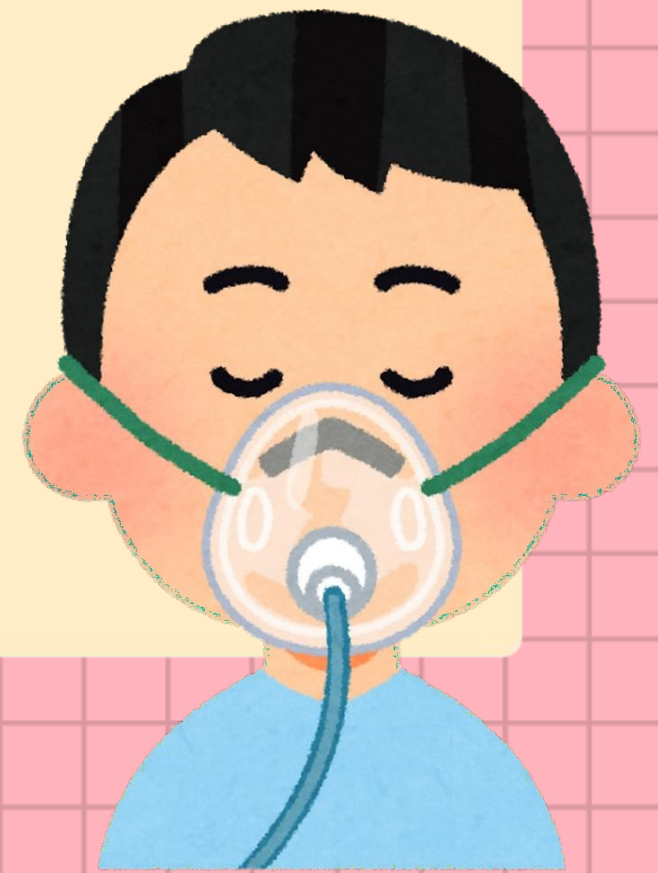
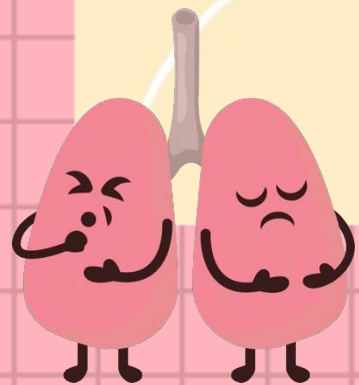
Definition

Chest trauma or (thoracic trauma) is a serious injury of the chest and it is consider a significant cause of mortality.

Epidemiology

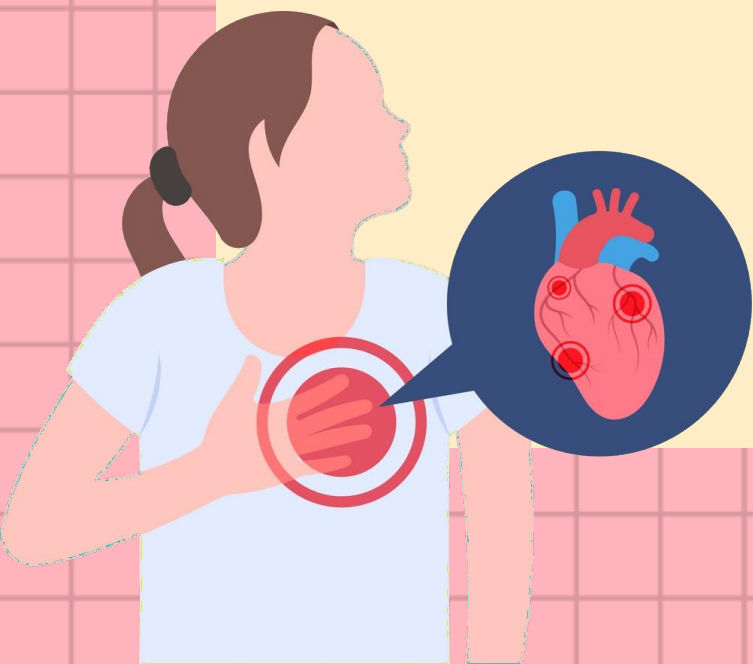
-25% of traumatic deaths are secondary to injuries to the thorax & 25% of all motor vehicle driver deaths are known to have a thoracic injury

-In patients presenting with penetrating trauma, 40% have a thoracic injury, whereas with blunt trauma, 33% have a thoracic injury

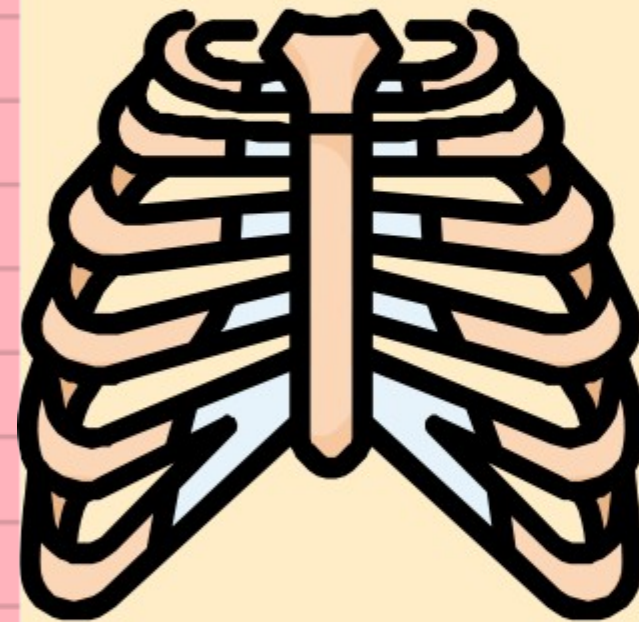


Cardiac Box

Trauma in this region is associated with an increased risk of penetrating cardiac injury and the development of cardiac tamponade and rapid clinical decompensation.

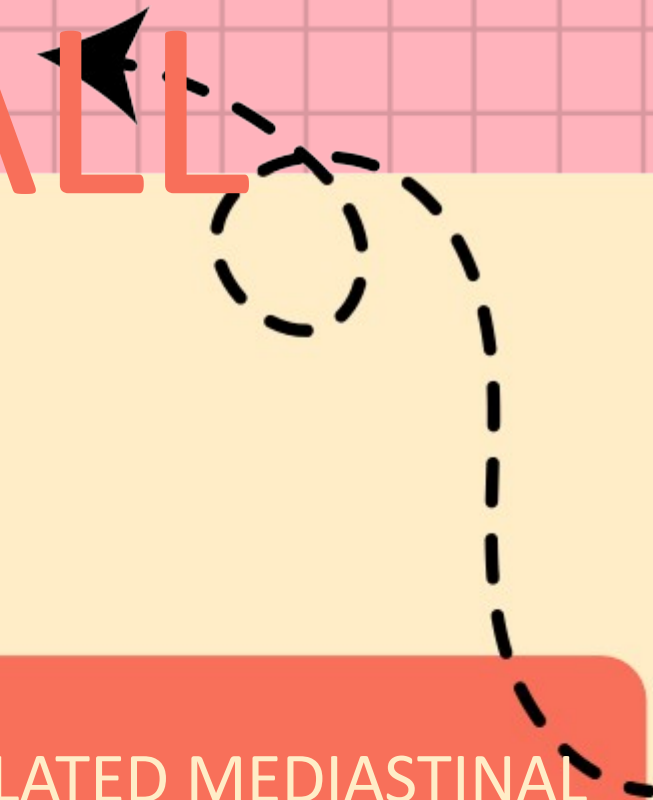


THORACIC WALL



THE MOST COMMON ISOLATED MEDIASTINAL INJURY IN BLUNT TRAUMA IS AN INJURY TO THE AORTA

In penetrating trauma all the mediastinal structures are equally susceptible



TYPE OF CHEST

1 INJURY:

Blunt chest

injury(closed chest injury)

Fall ,crush injury

**associated with multiple injury
such as head limb and**

abdomen

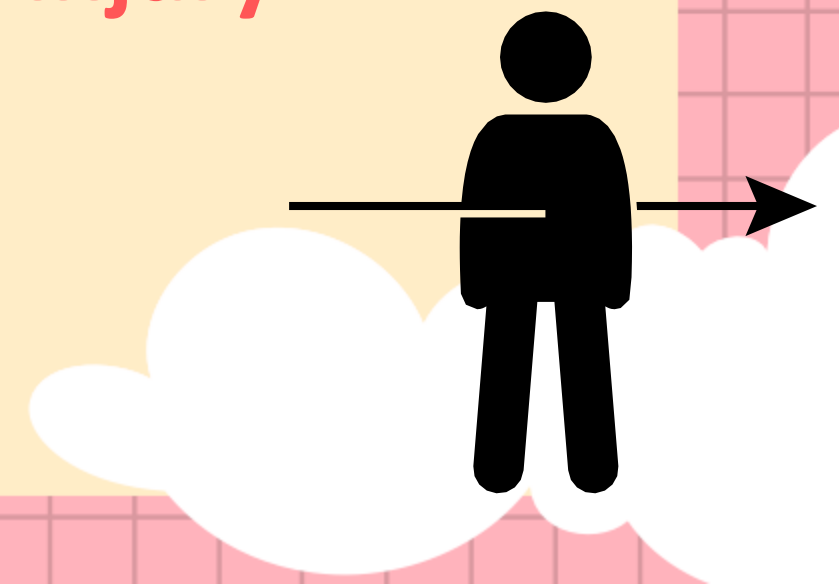


2

penetrating chest
injury(open chest
injury)

Mostly by assault

**associated with chest wall
damage open, pneumothorax,
and organ injury**



PRIMARY SURVEY

Is a systemic, rapid evaluation of the injured patient following the ABCDE system.

The goal : identify immediate, lifethreatening injuries that could account for ventilation or hemodynamic instabilities such as :

Tension pneumothorax, Massive Hemothorax, Flail chest

Airway with c-spine protection

Breathing and ventilation

circulation and haemorrhage control

disability, neuro status

border and environmental control

Secondary survey

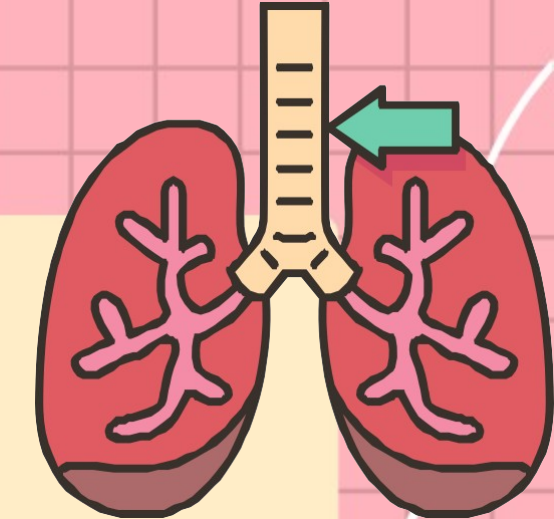
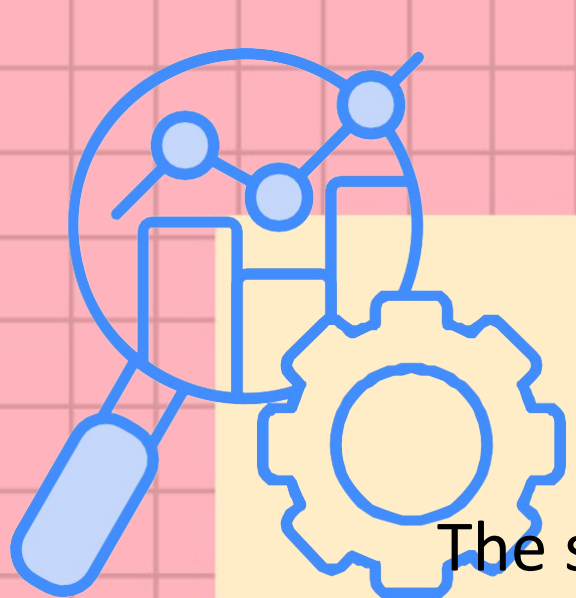
The complete H&P

- Head to toe exam including rectal
- ABCDE reassessed
- Vital functions returning to normal
- Diagnostic studies simultaneously

Patient History Physical examination

Exposure / Environmental control

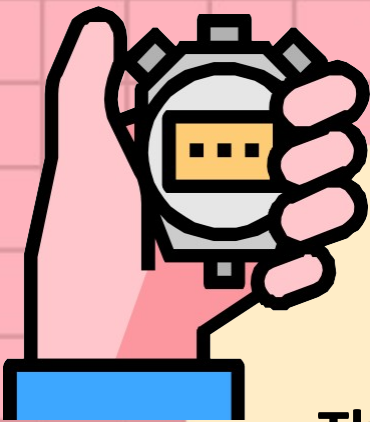




Classical physical examination findings :

The size of the injury, and position of the patient will affect the clinical findings. For example, a small haemothorax may have no clinical signs at all. A moderate haemothorax will be dull to percussion with absent breath sounds at the bases in the erect patient, whereas signs will be posterior in the supine patient. This is also reflected in chest X-ray findings

	Trachea	Expansion	Breath Sounds	Percussion
Tension Pneumothorax	Away	Decreased. Chest may be fixed in hyper-expansion	Diminished or absent	Hyper-resonant
Simple Pneumothorax	Midline	Decreased	May be diminished	May be hyper-resonant. Usually normal
Haemothorax	Midline	Decreased	Diminished if large. Normal if small	Dull, especially posteriorly
Pulmonary Contusion	Midline	Normal	Normal. May have crackles	Normal
Lung collapse	Towards	Decreased	May be reduced	Normal



Timing

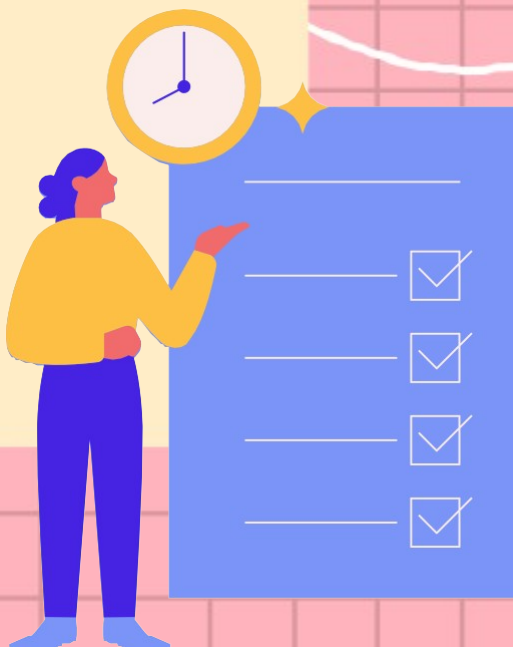
The timing of intervention is oft debated but essentially takes place in one of three time periods mainly dictated by the patient's physiologic status upon arrival to the emergency room: immediate (emergency room thoracotomy), urgent (in the operating room, within 1–4 hours of arrival), and delayed (24 hours after admission) .

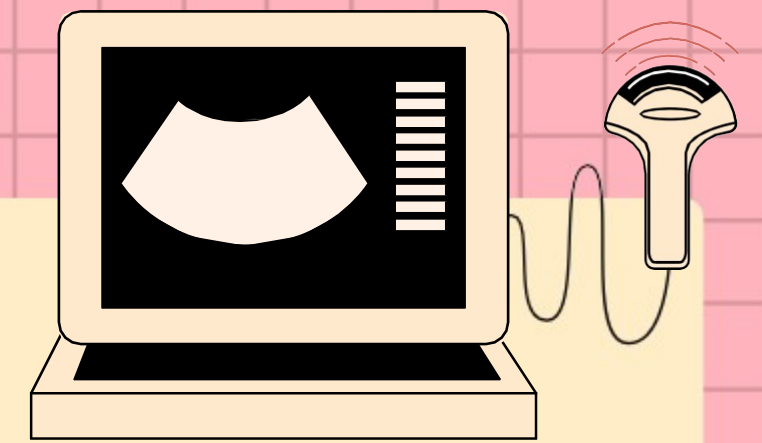
Once the need for intervention is apparent, the critical decision for an appropriate surgical approach is based on the location

Table 2

Thoracotomy in thoracic trauma

Thoracotomy	Immediate	Urgent	Delayed
Setting	Emergency room: upon arrival and assessment	Operating room: within 1–4 h	Operating room: > 24 h
Injury	Patients in extremis after penetrating chest injury	Cardiac, lung esophagus, tracheobrochial, great vessel injuries, aortic rupture	Retained hemothorax, posttraumatic empyema, delayed tracheobronchial injuries, intracardiac injuries





Investigations

Chest Radiography : A systematic review of the film should reveal

suspected and unsuspected injuries, and the presence of any foreign bodies. Fractures of the bony thorax, the mediastinum :widening, or shifting tracheobronchial or esophageal injuries

Computerized tomography (CT) it may reveal injuries not seen clearly

on plain radiographs, It may be useful to screen all patients with blunt trauma CT of the chest has been shown to be more sensitive than plain radiography in detecting thoracic injuries such as pulmonary contusions, hemothorax, and pneumothorax.

Ultrasonography

The focused assessment for the sonographic evaluation of the trauma patient, or FAST examination, four standard viewing ports are used to quickly access for abnormal fluid collection: right upper quadrant, left upper quadrant, pelvis, and subxiphoid.

Of the four views, the subxiphoid view is the most accurate in the hands of surgeons for detecting abnormalities in the trauma setting.

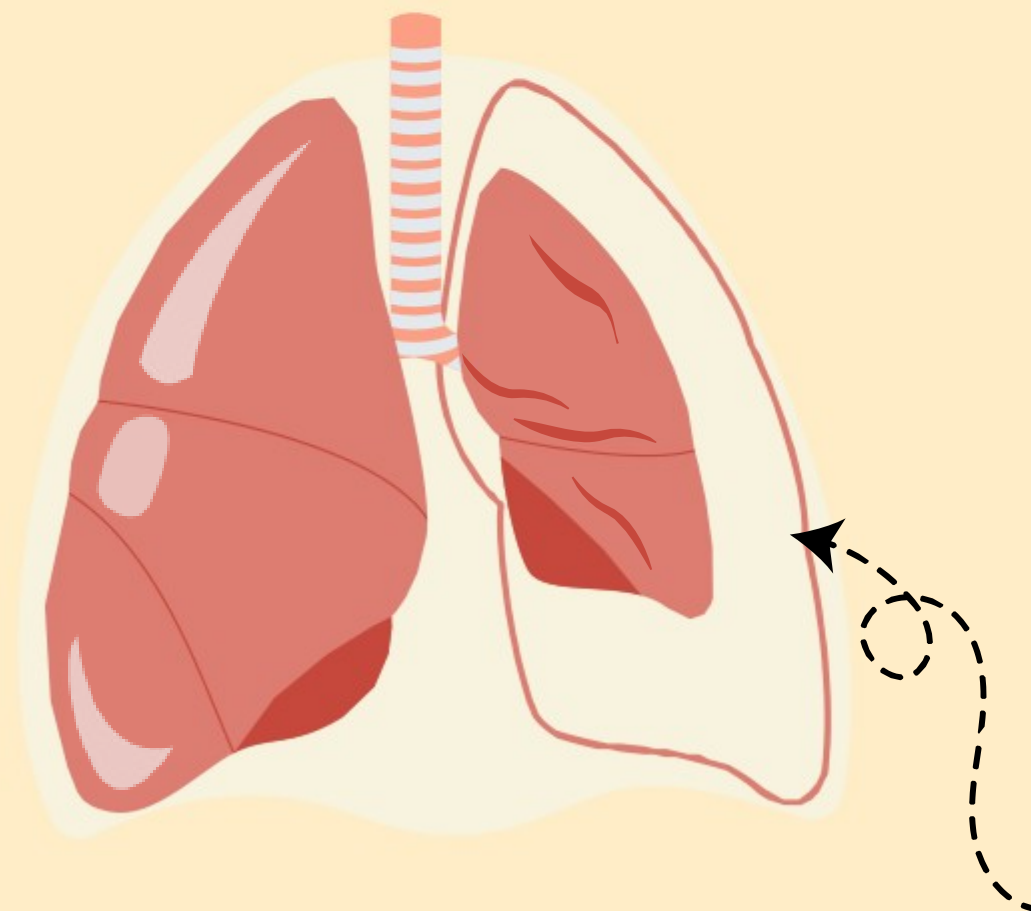
Echocardiography

Angiography Conventional angiography was once the gold standard in the diagnosis of aortic transection or injuries to the great vessels.



Pneumothorax

an abnormal collection of air in the pleural space between the lung and the chest wall



1

pneumothorax (closed)

Simple

is a non-expanding collection of air around the lung. The lung is collapsed, to a variable extent

Diagnosis on physical examination may be very difficult.

The classical signs of reduced air entry and resonance to percussion are often difficult or impossible to appreciate.

Careful palpation of the chest wall and apices may reveal subcutaneous emphysema and rib fractures as the only sign of an underlying pneumothorax

Air in the pleural space

2

Open Pneumothorax

Sucking chest wounds in communication with a defect in the chest wall



Pathophysiology

lung collapse and atelectasis (collapse of alveoli) which decreases gas exchange and Ventilation/Perfusion Mismatch ? hypoxia

Symptoms include dyspnea, tachypnea and chest pain Signs hyperresonance to percussion and decreased breath sounds

Management Chest tube is inserted away from the wound site + Dressing over the wound

3

Tension Pneumothorax

an Immediately fatal condition in which an accumulation of air under pressure in the pleural space in which the defect in the visceral pleura acts like a one-way valve, allowing air to enter the pleural space but not to exit from it, causing collapse of the ipsilateral lung, mediastinal and tracheal shift and compression of the contralateral lung and great vessels, resulting in decreased cardiac filling(preload), decreased cardiac output, fatal hypotension and severe respiratory compromise (totally collapse ,, severe dysfunction of CVS)

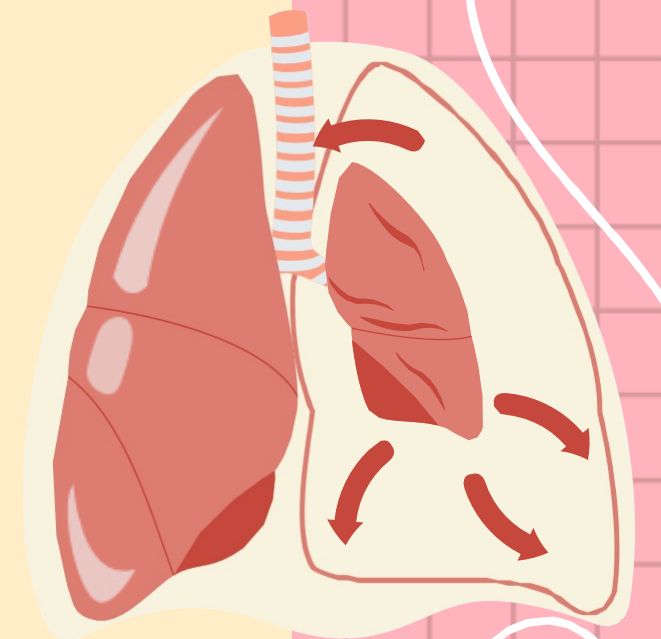
Findings may include:

dyspnea, agitation, cyanosis, tachypnea, subcutaneous emphysema, hypotension(and Hypovolemia) tachycardia,

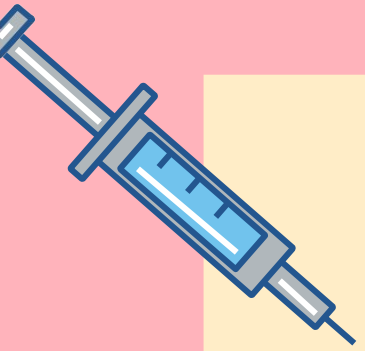
Increased jugular venous pressure

absent breath sounds hyperresonance tracheal shift to the uninvolved side and increased resistance to ventilation

a clinical diagnosis and treatment should never be delayed by waiting for radiological confirmation



Management



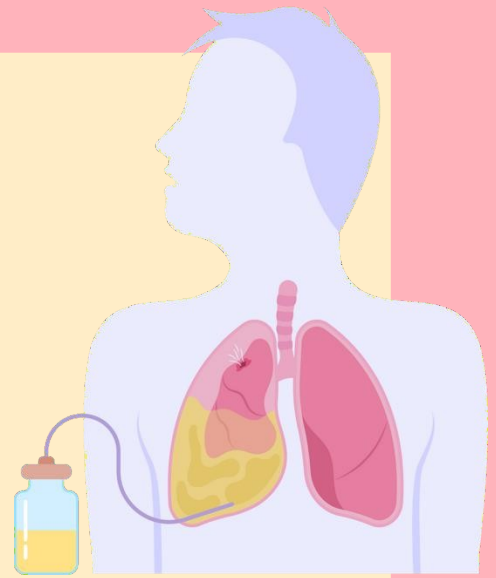
needle decompression

5cm angiocatheter 2nd intercostal space at the mid clavicular line

Insertion of a chest tube

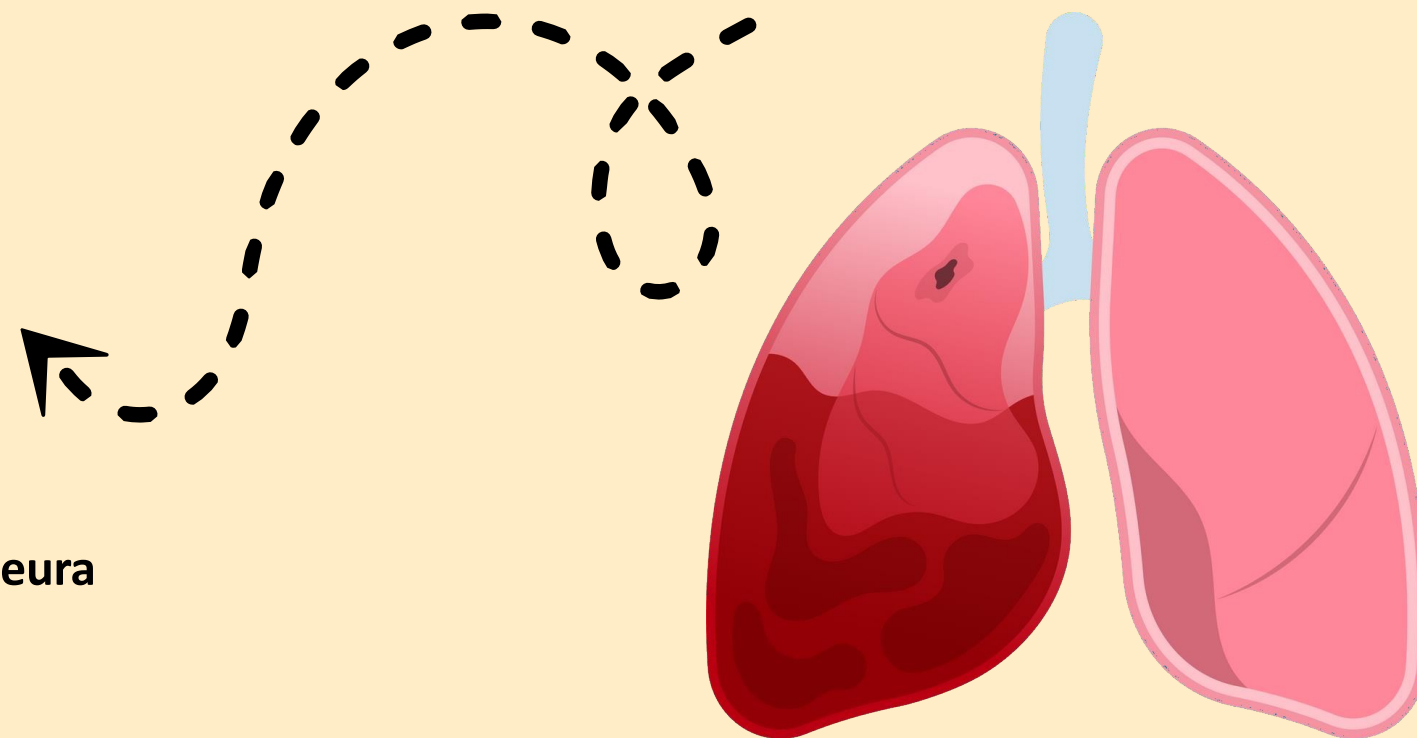
through the fifth intercostal space in the anterior axillary line.

24–28 French chest tube is placed for pneumothoraces,



Hemothorax

- Accumulation of blood in the pleural space caused by injury to:
- 1- Pulmonary parenchyma or hilar vessels
- 2- intercostal vessels or internal thoracic vessels
- 3- great vessels with an opening in the pleura
- 4- heart with a communicating defect in the pericardium and pleura
- Typically accompanies pneumothorax – Hemopneumothorax



Each thorax may hold up to 3,000 mL

Considered Massive Hemothorax when blood loss is greater than 1500 ML into the chest cavity or persistent

>200 cc of blood via chest tube per hour *4 hours * is a serious condition with mortality rate of 75%

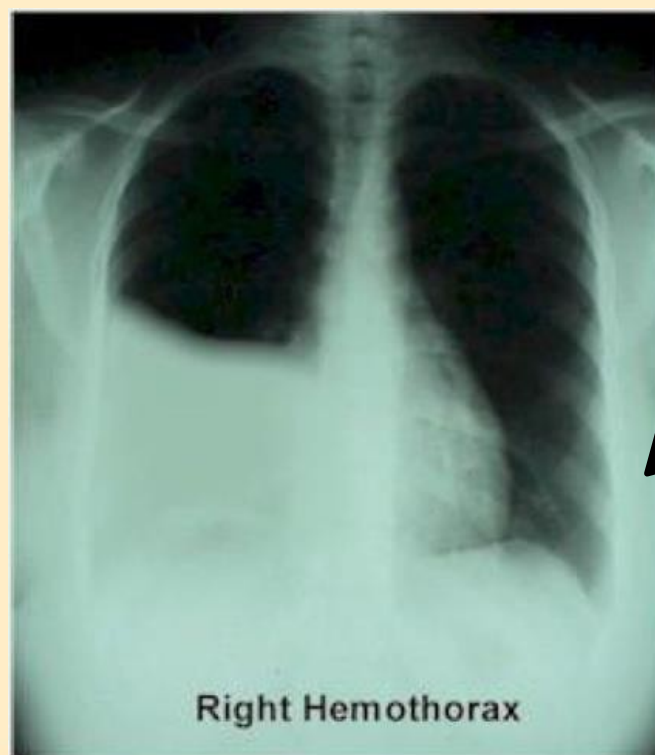
-Accumulation of blood in a hemothorax can significantly compromise respiratory efforts, compressing the lung and preventing adequate ventilation in addition to hemorrhagic shock.

-Lung parenchymal bleeding usually ceases spontaneously as a result of the low pressure in the pulmonary vessels, the compressive effect of the shed blood in a closed space, and a high concentration of thromboplastin in the lung

-Bleeding from any of the major vessels or an intercostal artery or from the internal thoracic arteries, however, may require prompt operative intervention



**Blunting of the
costophrenic angles on an
upright chest radiograph
when more than 250 mL of
blood is lost**



Presentation :

**haemorrhagic shock Hypotension /
Tachycardia / Dyspnea / Tachypnea
flat neck veins / unilateral absence
of breath sounds dullness to
percussion**



Treatment

consists of:

- ❑ correcting the hypovolemic shock
- ❑ insertion of an intercostal drain, chest tube is placed for hemothoraces in some cases, ❑ intubation;
- urgent thoracotomy if Initial blood loss through the chest tube of 1500 mL Or Ongoing blood loss of approximately 250 mL per hour for 3 consecutive hours after its placement



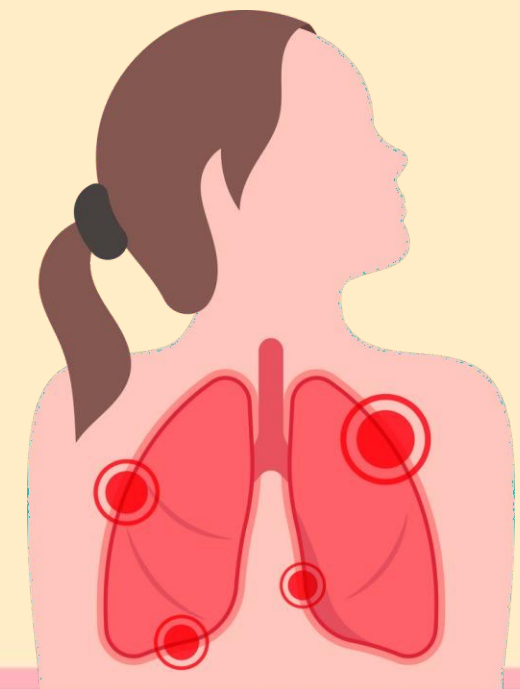
Pulmonary Contusion

Pulmonary contusions are bruises of the lung tissue that result from blunt chest trauma. This condition can occur from a variety of causes, including motor vehicle accidents, falls, sports injuries, or physical assaults. The severity of a pulmonary contusion can range from mild to life-threatening, depending on the extent of the injury.

Pathophysiology

When the chest wall experiences trauma, the force can cause blood vessels in the lung tissue to rupture, leading to localized bleeding and edema (swelling) in the affected areas. This can impair gas exchange and lead to respiratory complications.

- Any chest trauma can lead to pulmonary contusions
- pulmonary contusion and ribs fracture are the most common injury in blunt chest trauma



Pulmonary Contusion

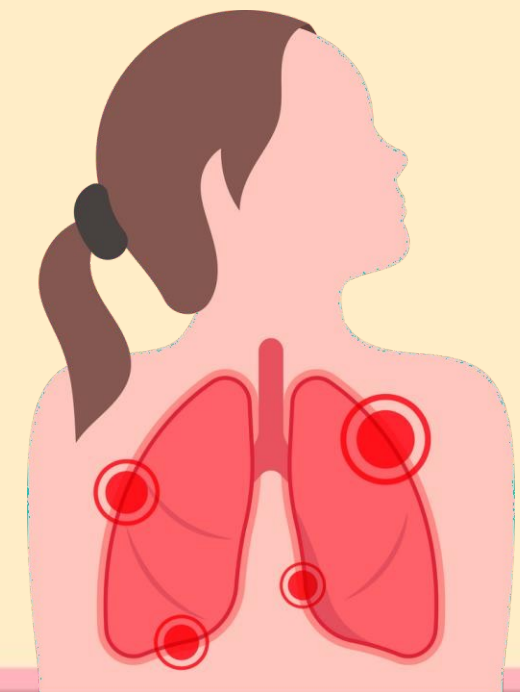
Patients may present with :

Chest Pain, Dyspnea, Hemoptysis , Tachypnea

**Sign : Hypoxemia , Decreased Breath Sound, Crackles or Rales,
Respiratory Distress ,bruising , echymosis**

**The natural progression of pulmonary contusion is worsening hypoxemia
for the first 24–48 hour**

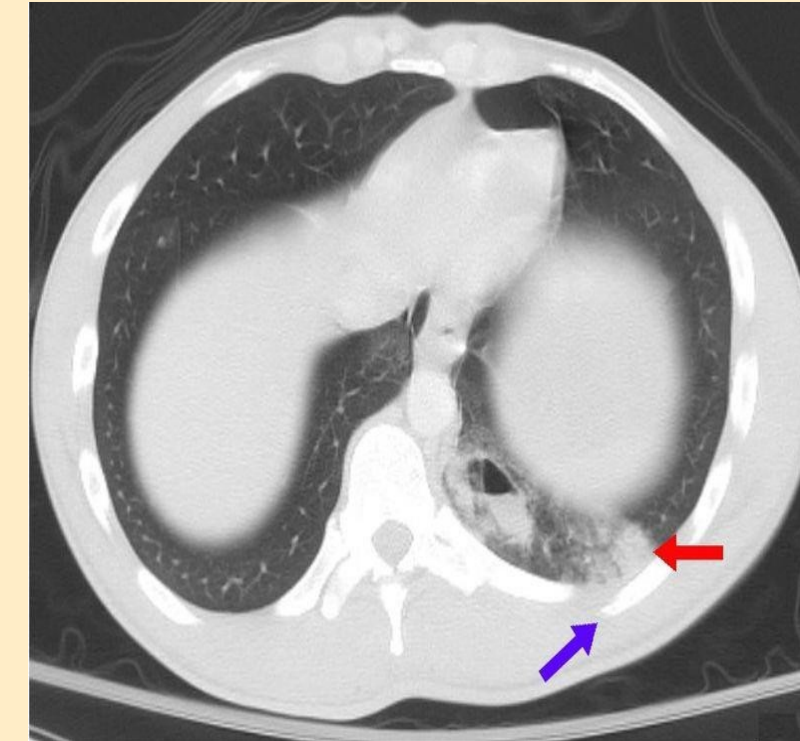
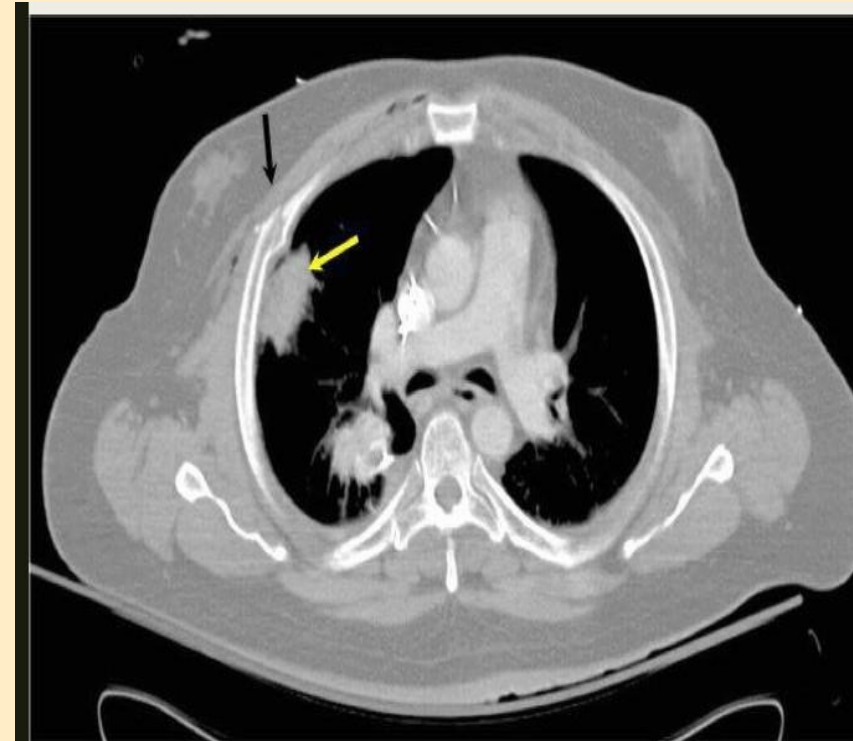
**Hemoptysis or blood in the endotracheal tube is a sign of pulmonary
contusion.**





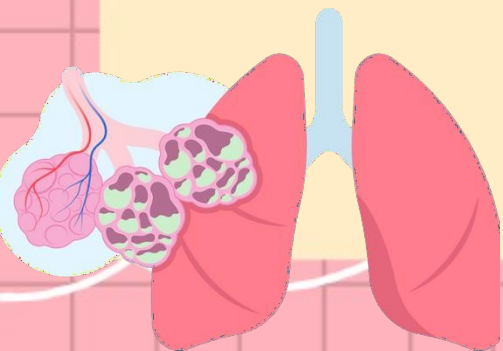
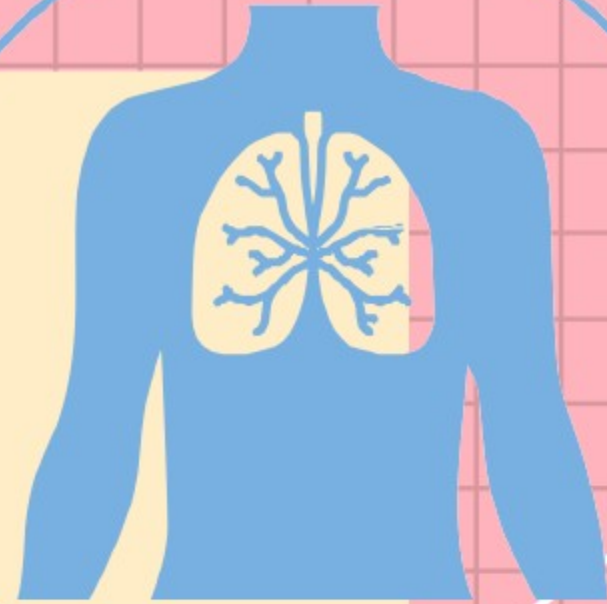
Chest X-Ray Findings:

"On a chest X-ray, pulmonary contusions often appear as areas of hazy opacification, usually close to the site of impact. These findings may be subtle initially but can progress over time."



CT Scan Findings (Gold Standard):

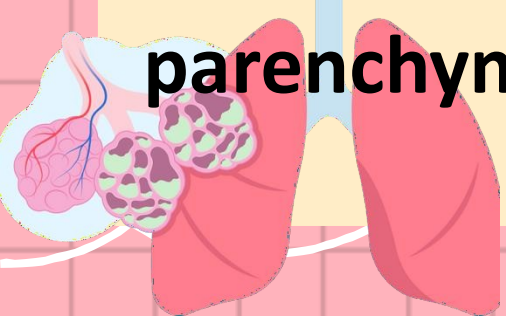
"CT scans provide a more detailed image and are the gold standard in diagnosing pulmonary contusion. We can see areas of ground-glass opacities and consolidation, which indicate bleeding and fluid accumulation in the lung tissue. Unlike X-rays, CT scans can reveal smaller and more diffuse injuries."



Patients with pulmonary contusions are at high risk for complications, including respiratory insufficiency, adult respiratory distress syndrome (ARDS), and secondary pneumonia, due to parenchymal damage and a strong systemic inflammatory response.

Although mortality from an isolated pulmonary contusion is generally low, it can increase to as much as 50% when combined with other serious injuries.

Factors that increase the risk of mortality in pulmonary contusion cases include patient age, the volume of resuscitation required, and the severity of the pulmonary parenchymal injury



Treatment:

"Treatment begins with oxygen administration to improve oxygen saturation levels. Maintaining good oxygenation is critical, especially in patients with hypoxemia."

Pulmonary Hygiene and Analgesia:

"Aggressive pulmonary hygiene—such as chest physiotherapy and coughing exercises—along with adequate pain relief helps to prevent atelectasis and secondary infection."

Mechanical Ventilation in Severe Cases:

"For patients with significant hypoxia, mechanical ventilation may be necessary. According to ATLS guidelines, if a patient has a PaO₂ below 65 mm Hg or SaO₂ below 90%, intubation should be performed within one hour of injury."

Fluid Management:

"Fluid management is crucial but challenging. Excess fluids can worsen pulmonary edema, so it's essential to maintain normovolemia carefully. In cases where large fluid volumes are needed due to other injuries, a pulmonary artery catheter can help monitor fluid status."



Rib fractures

Rib Fracture: A rib fracture is a disruption or break in the continuity of the rib bone

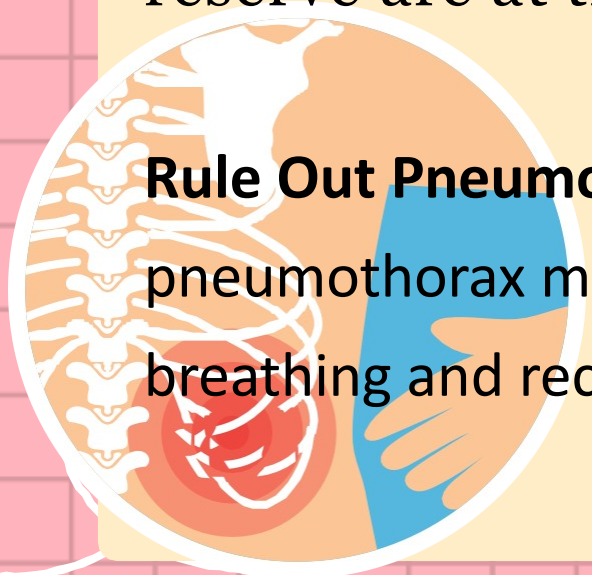
Rib fractures rank as the most prevalent injuries observed after thoracic trauma (TT) and are crucial indicators of the severity of the injury, reflecting the substantial energy that the chest wall has absorbed

Causes of Rib Fracture: Rib fractures are primarily caused by blunt trauma, including:

Motor Vehicle Accidents ,Falls, Sports Injuries , Severe Coughing: Intense coughing can lead to stress fractures in the ribs ,**Osteoporosis:** Weak bones increase the risk of rib fractures from minor trauma

Elderly patients and those with poor pulmonary reserve are at the highest risk.

Rule Out Pneumothorax: In all rib fracture cases, pneumothorax must be ruled out, as it can complicate breathing and recovery



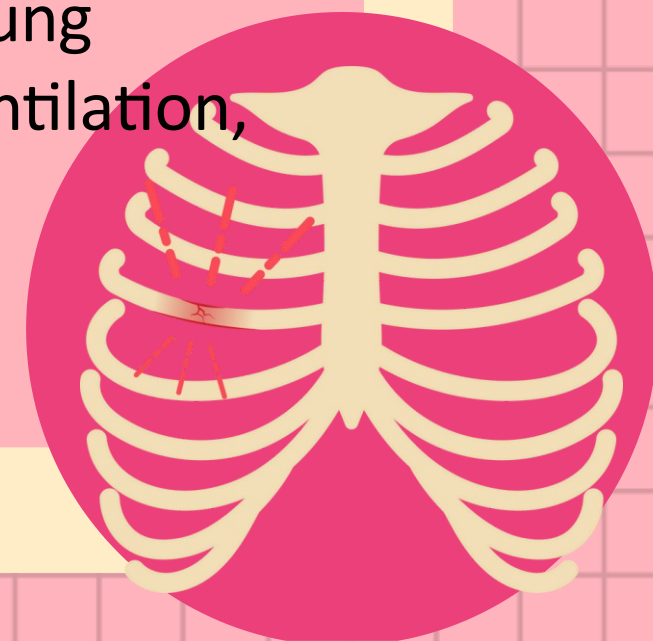
Key Factors Influencing Rib Fracture Outcomes

Age: Older adults have higher risk of complications, including increased mortality and pneumonia rates with multiple fractures.

Number of Ribs Fractured: ≥ 3 fractures significantly raises risk of complications, indicating need for hospitalization.

Elderly individuals with three or more rib fractures experience a fivefold increase in mortality rate and a fourfold increase in the incidence of pneumonia.

Underlying Lung Health: Pre-existing pulmonary conditions worsen outcomes due to reduced lung function, increasing risk of atelectasis, hypoventilation, and pneumonia.



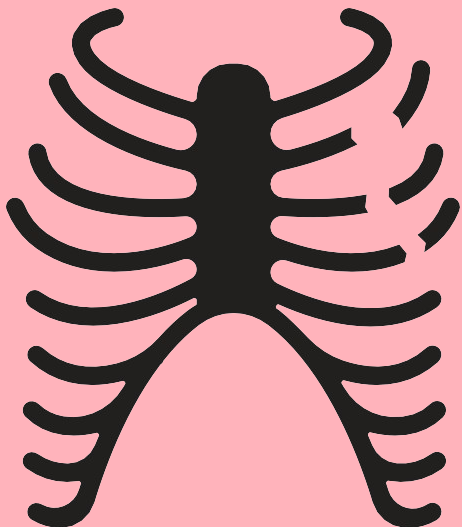
Associated Complications of Rib Fractures:

Rupture of the Aorta: A life-threatening condition where the aorta tears, leading to severe internal bleeding.

Tracheobronchial Tree Injury: Damage to the trachea or bronchi, potentially causing respiratory distress and requiring urgent medical attention.

Vascular Injury

**Pneumothorax, Hemothorax
Lung Contusion, Atelectasis**



Assessment Findings

Localized Pain: Concentrated pain at the fracture site.

Pain Aggravation: Increased pain with palpation, coughing, movement, or deep breathing.

Splinted Breathing: Shallow, guarded respirations to minimize discomfort.

Point Tenderness: Patients can often localize the fracture site by pointing to it, confirmed by palpation.

Crepitus: A crackling sensation or audible crunch may be noted during examination.

Clinical Assessment Techniques

Inspection:

Look for asymmetry, deformities, bruising, and signs of respiratory distress.

Palpation:

Assess localized tenderness, crepitus, and deformities in the chest wall.

Percussion:

Evaluate for dullness or hyperresonance indicating possible complications.

Auscultation:

Listen for decreased breath sounds, adventitious sounds, or pleural friction rub.

Imaging in Rib Fractures

Radiologic Diagnosis:

Isolated rib fractures are primarily diagnosed using a **simple chest radiograph**.

Chest X-ray:

Purpose:

Confirms the presence of rib fractures.

Detects associated conditions, such as:

Pneumothorax: The presence of air in the pleural space.

Hemothorax: The accumulation of blood in the pleural cavity.

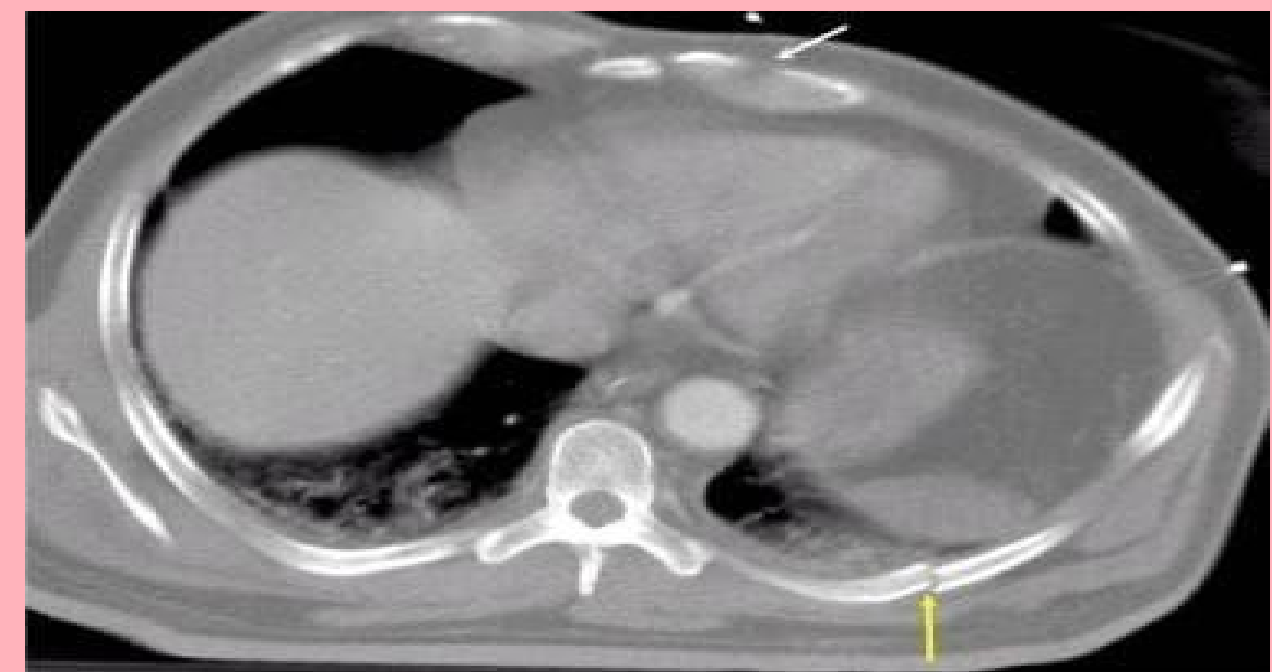
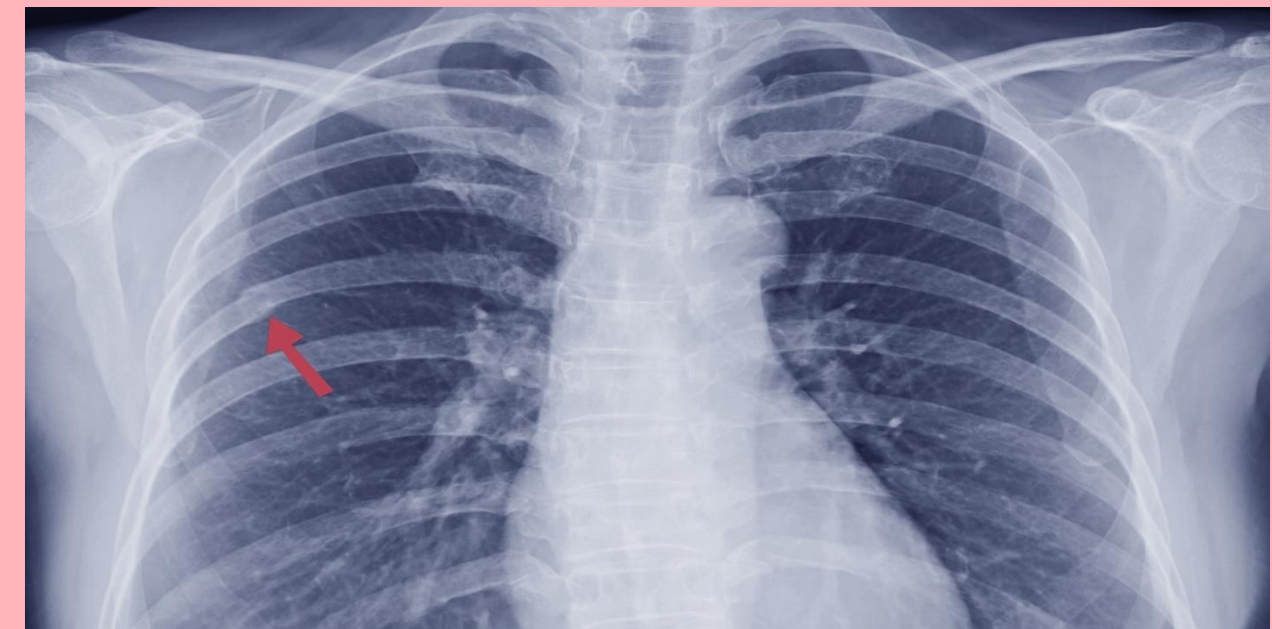
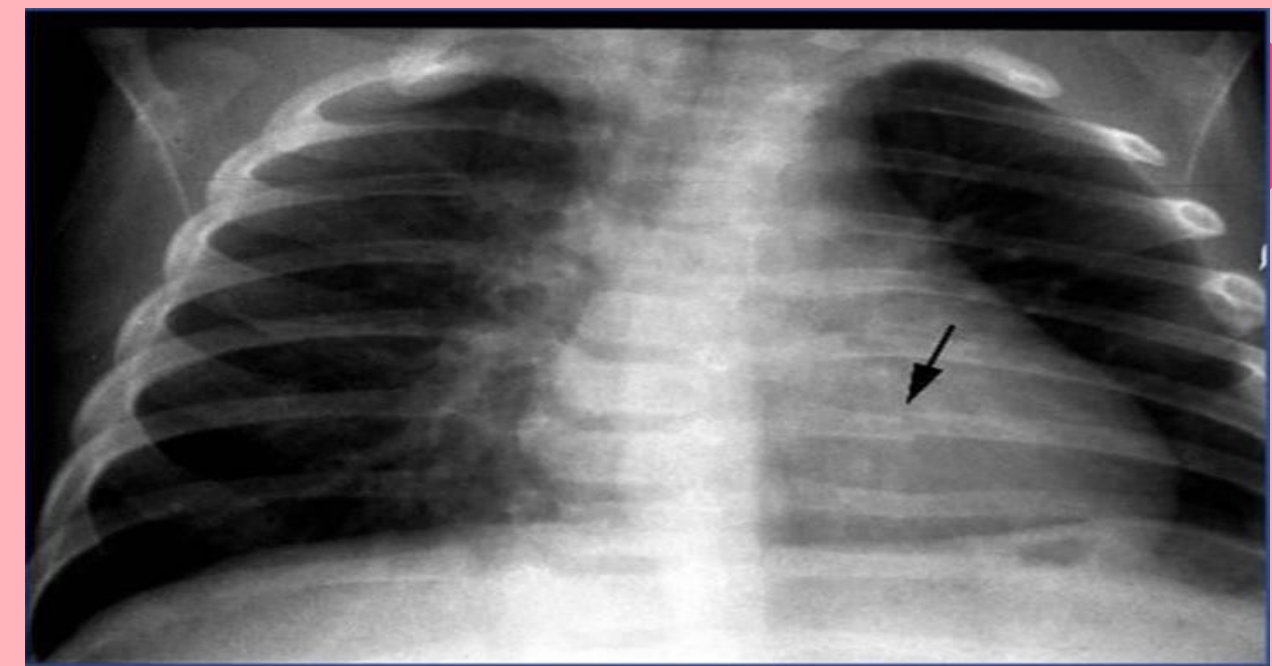
Computed Tomography (CT):

Advantage: The availability of CT has led to its routine use in patients with **severe thoracic trauma (TT)**.

Benefits:

Superior in diagnosing associated lesions.

Provides a better assessment of the rib fractures' extent and evolution.



Management

Oxygen Therapy:

Administer high-concentration oxygen to enhance oxygen saturation.

Ventilation Support:

Use positive pressure ventilation for patients in respiratory distress.

Respiratory Exercises:

Encourage deep breathing and coughing to prevent atelectasis and promote lung expansion.

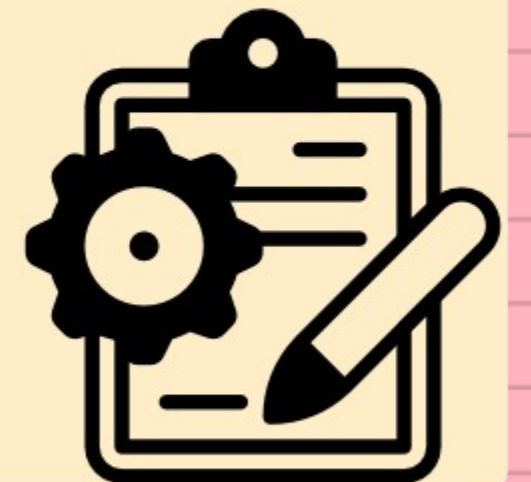
Pain Management:

Pharmacological: Provide analgesics (NSAIDs, opioids) for effective pain control.

Non-Pharmacological: Use non-circumferential splinting to support the chest and reduce pain during movement.

Monitoring:

Continuously assess respiratory status and oxygen levels.



Flail chest

In flail chest, there are segmental fractures involving three or more adjacent ribs.

Separation of Rib Segment: A segment of the rib cage becomes detached from the chest wall due to these fractures, creating an unstable section.

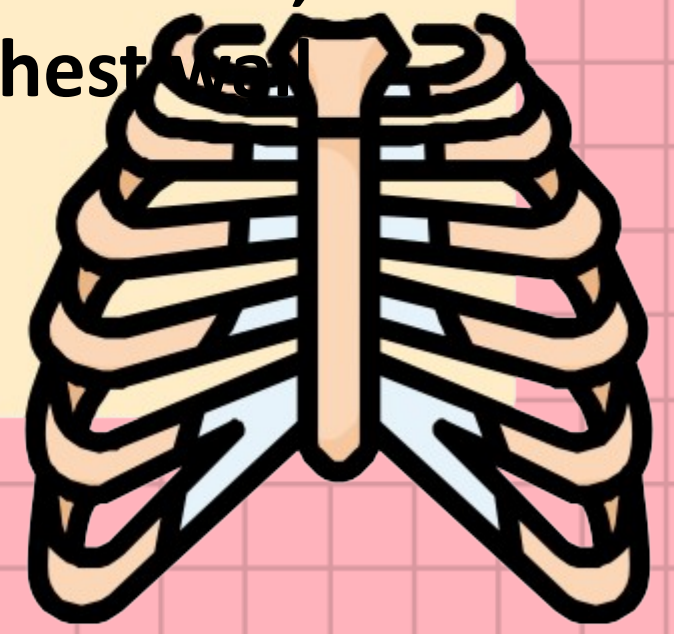
Abnormal Chest Movement (Paradoxical Breathing):

During inspiration , the fractured rib segment is pulled inward, sinking into the chest.

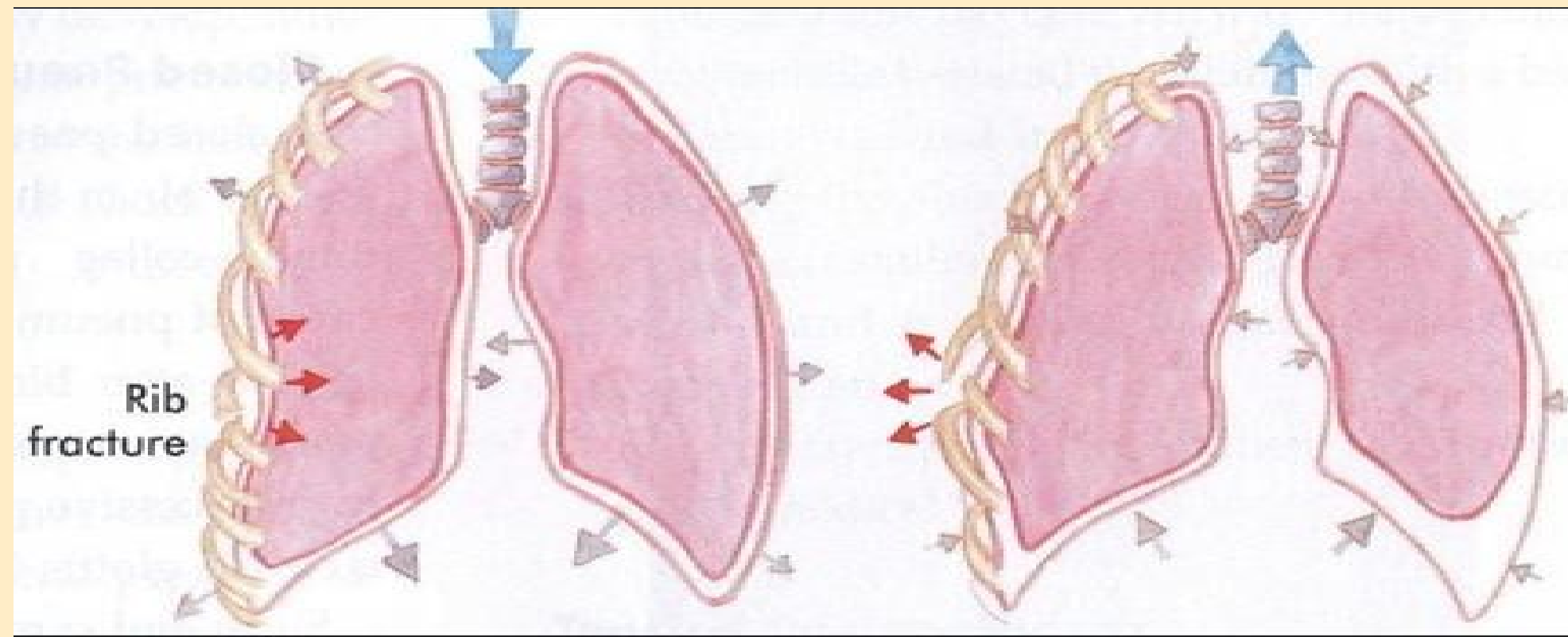
During expiration the fractured segment is pushed outward, moving opposite to the

normal motion of the chest wall.

Paradoxical Movement: This movement is known as *paradoxical breathing* because, while the fractured segment moves inward with inhalation, the rest of the chest wall expands outward.



Flail chest usually occurs due to blunt trauma that leads to multiple rib fractures, typically three or more ribs fractured in two or more places. Thoracic Impact and Pulmonary Contusion: The blunt force required to break the ribs and compromise the thoracic cage often causes a pulmonary contusion (bruising of the lung tissue) underneath. This contusion can sometimes be more severe than the flail chest segment itself



signs and Symptoms of Flail Chest

Paradoxical Breathing: Chest moves inward during inhalation instead of expanding.

Pain at Fracture Sites: Intensifies with chest movement, breathing, coughing, or sneezing.

Respiratory Splinting: Shallow breathing to reduce pain.

Examination Findings:

Diminished breath sounds on chest auscultation.
Crepitus (grinding sounds) upon palpation of the chest.

Severe Cases:

Shortness of breath and cyanosis

Refractory hypoxemia

Hemodynamic instability (e.g., arrhythmias, hypotension, tachycardia)

Voluntary splinting as a result of pain, mechanically impaired chest wall movement and the associated lung contusion are all causes of the hypoxia.



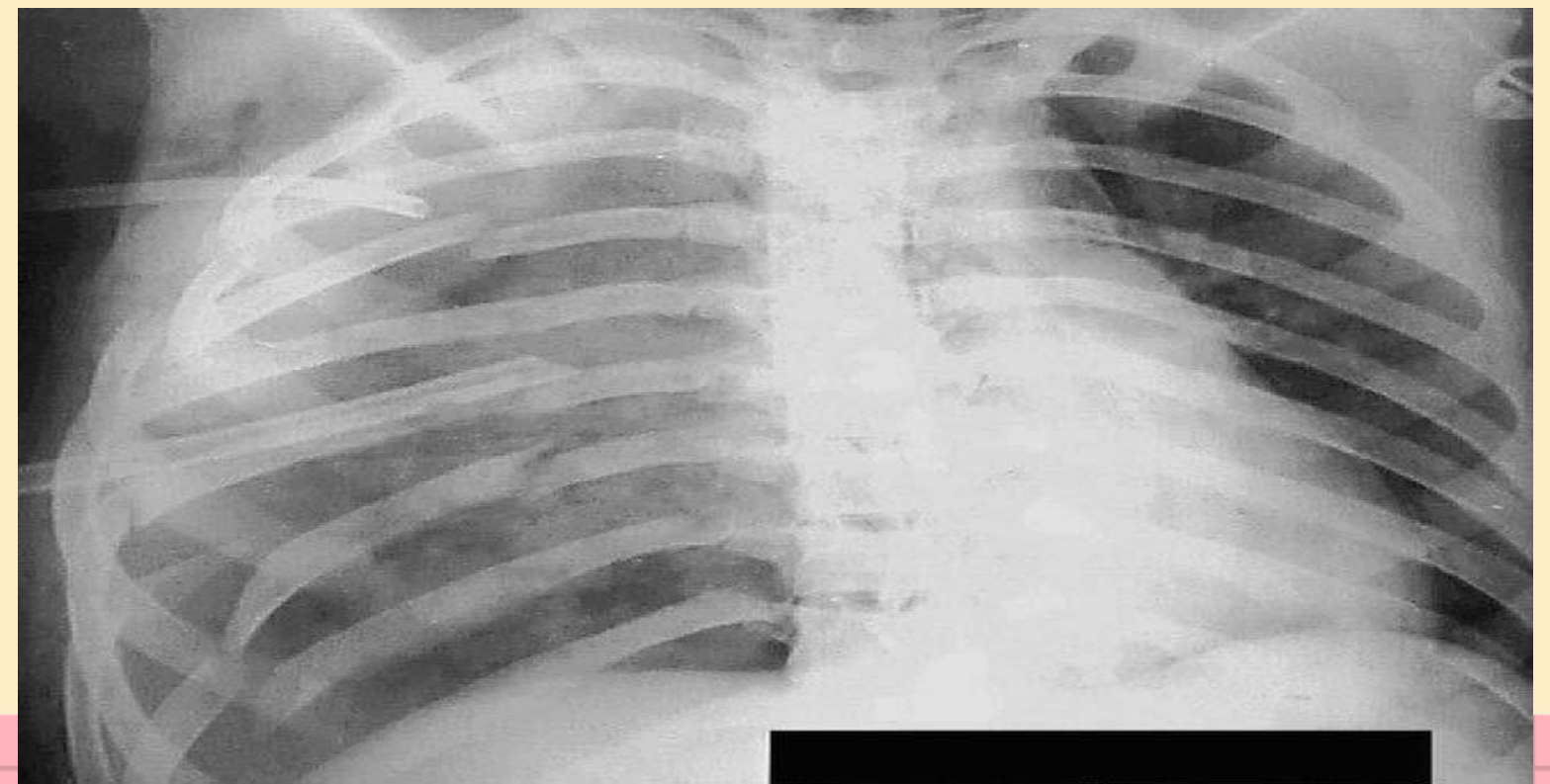
Images

Imaging for Confirmation:

While diagnosis is clinical, imaging like chest X-rays or CT scans may be used to confirm rib fractures and assess any additional injuries, such as lung contusions or pneumothorax (air leakage in the chest cavity).

It is difficult to see if the fractures are displaced or nondisplaced

CT scan is probably better for visualizing these fractures



Treatment of Flail Chest

1.Initial Management:

- 1.Splinting: Direct pressure applied to the affected area.
- 2.IV Fluids: To support hemodynamic stability.
- 3.Supplemental Oxygen: Helps improve oxygen levels.
- 4.Pain Management: NSAIDs, acetaminophen, nerve blocks, or opioids.

2.Additional Interventions:

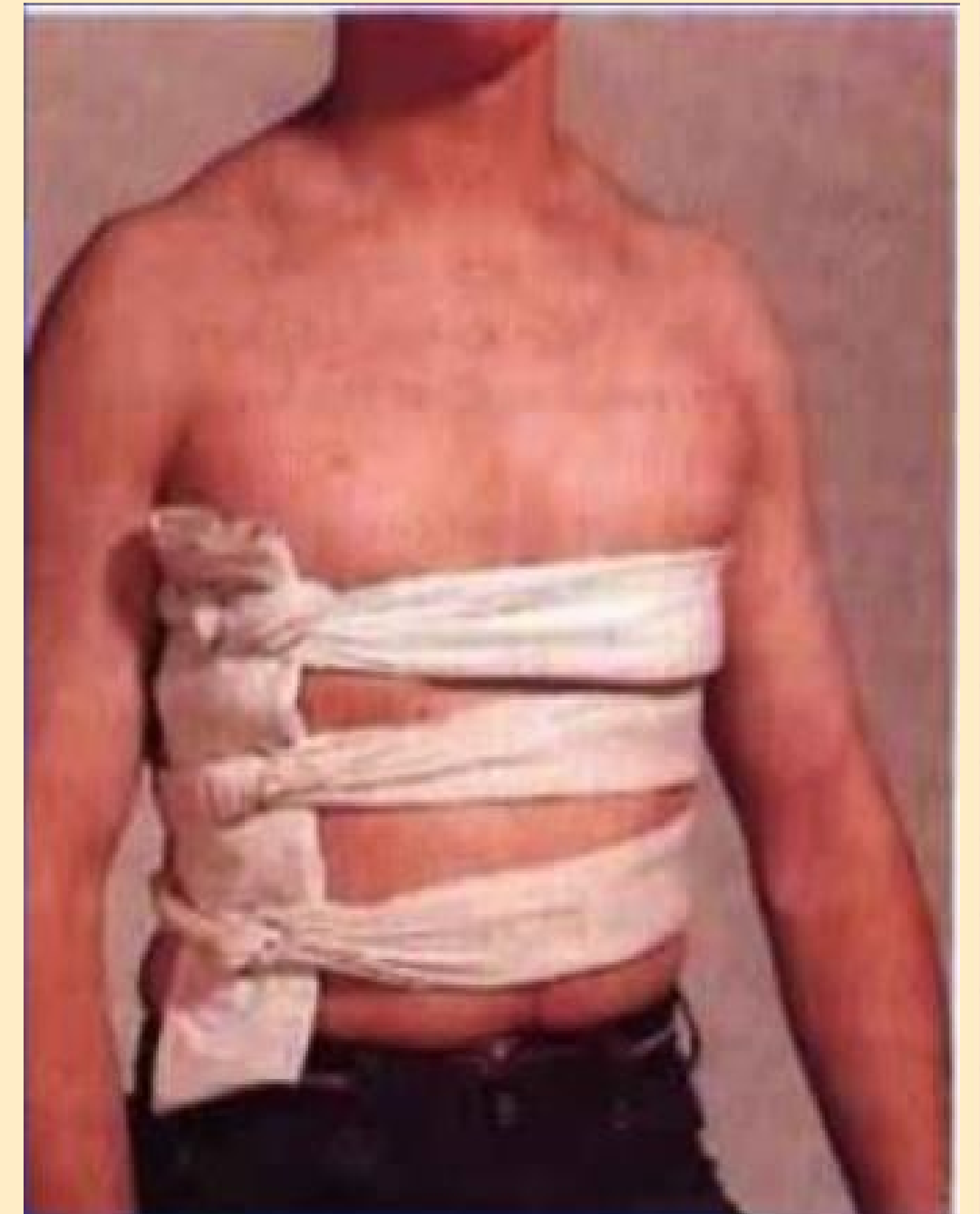
- 1.Chest Physiotherapy: To maintain lung function and clear secretions.

Pulmonary Hygiene: Ensures proper mucus and secretion clearance.

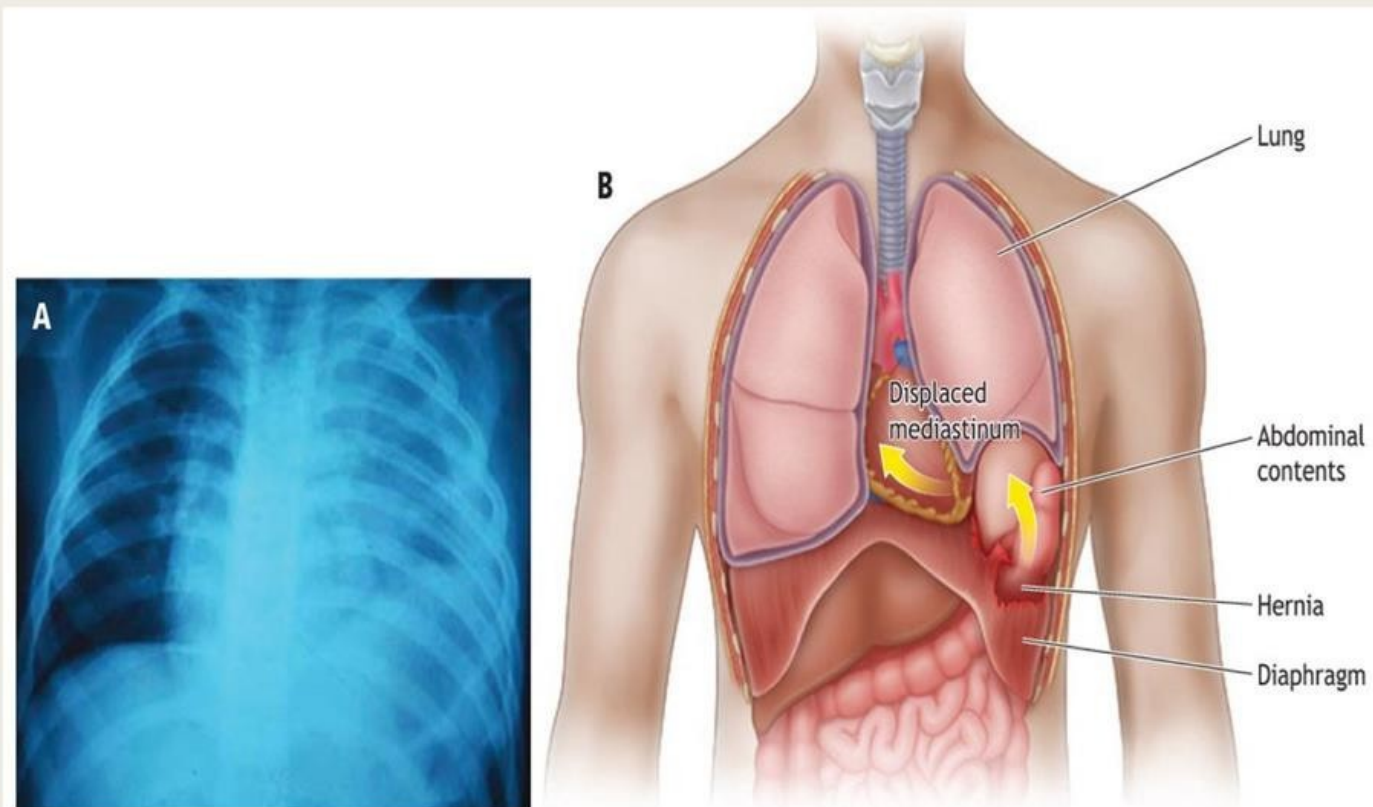
3.Advanced Care:

Mechanical Ventilation: If conservative treatment fails, intubation and ventilation with positive end-expiratory pressure (PEEP) may be used.

Surgical Intervention: To stabilize displaced ribs if needed.



Diaphragmatic Rupture



■ **FIGURE 4-10** Diaphragmatic Rupture. (A) Radiograph view. (B) Blunt trauma produces large radial tears that lead to herniation, whereas penetrating trauma produces small perforations that can take time, sometimes even years, to develop into diaphragmatic hernias.

Definition

A tear in the Diaphragm that allows the abdominal organs enter the chest cavity

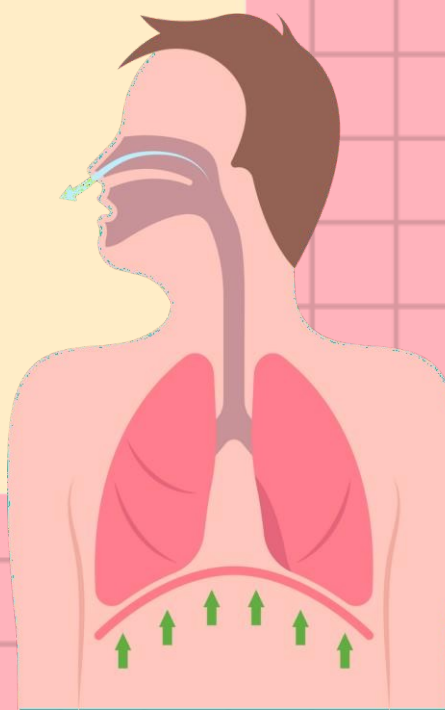
*More common on Left side due to liver helps protect the right side of diaphragm *Associated with multiple injury patients *Blunt > Penetrating *These injuries do not heal spontaneously and can produce herniation ,so need operative repair when diagnosed

Signs & Symptoms

Decreased breath sounds on side of rupture Bowel sounds heard in the chest cavity

Breathlessness (dyspnea)

Abdominal pain



Diagnosis can be difficult; therefore, have a high index of suspicion based on mechanism :

Rapid deceleration or direct crush to the upper abdomen Severe chest trauma, lower rib fractures Penetrating injuries to the chest and upper abdomen

***CXR is diagnostic in only 25% to 50% of cases of blunt trauma. Possible findings include:**

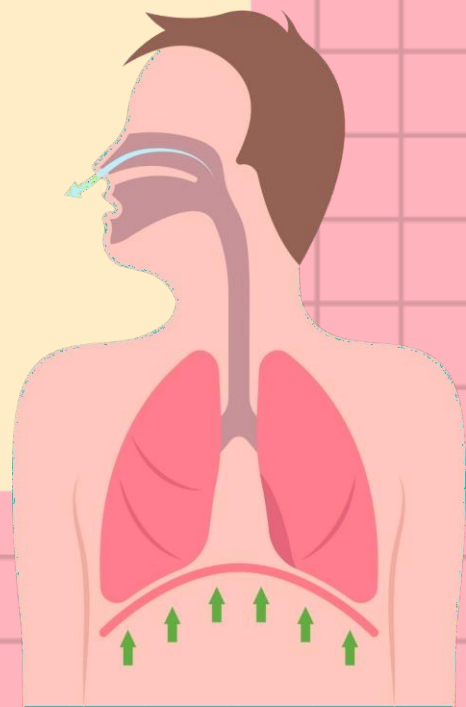
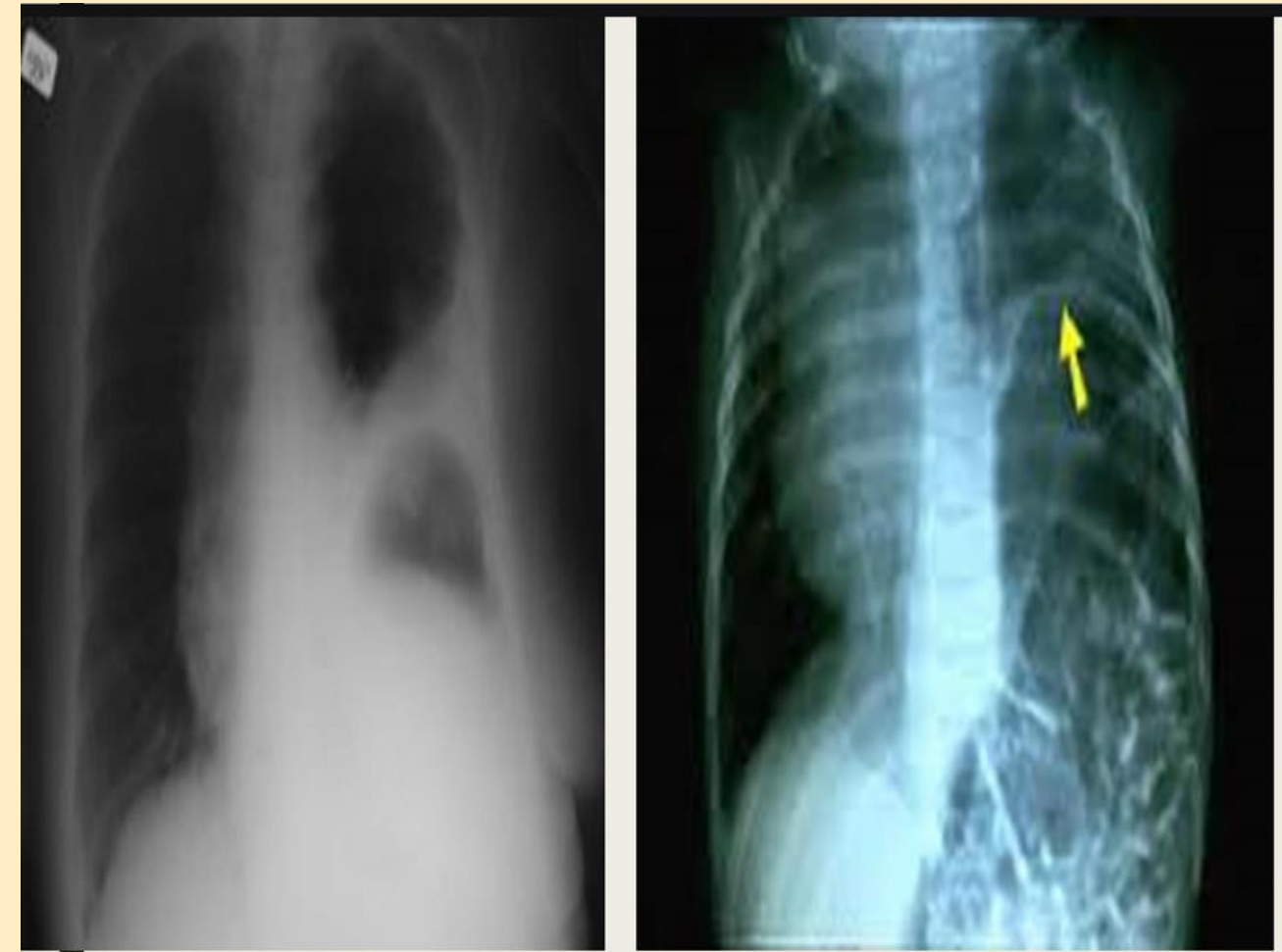
Hemi diaphragmatic elevation.

Stomach, colon, or small bowel in

chest.

***CT scan may miss diaphragmatic injury in the absence of gross hollow visceral herniation.**

***Direct visualization of the injury by laparotomy, laparoscopy, or thoracoscopy remains the gold standard for diagnosis.**



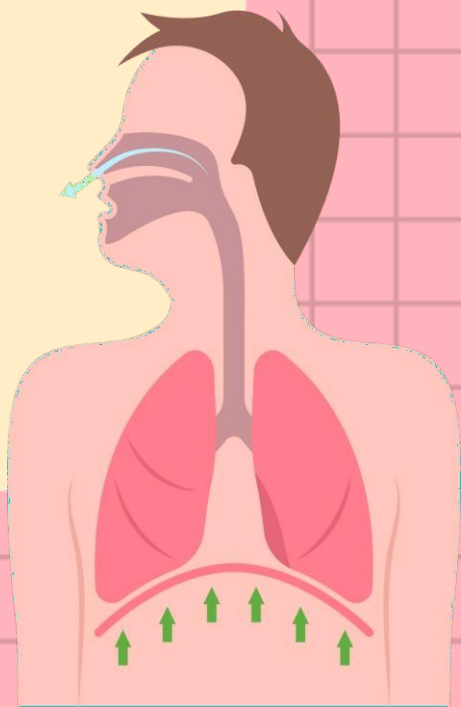
The diaphragm

A small injury to the diaphragm may go undiagnosed initially and present years later as a diaphragmatic hernia.

Diaphragmatic hernias classically present in one of three phases: 1. Acute phase: Occurs shortly after injury with signs and symptoms related to the intra-thoracic and intra-abdominal structures

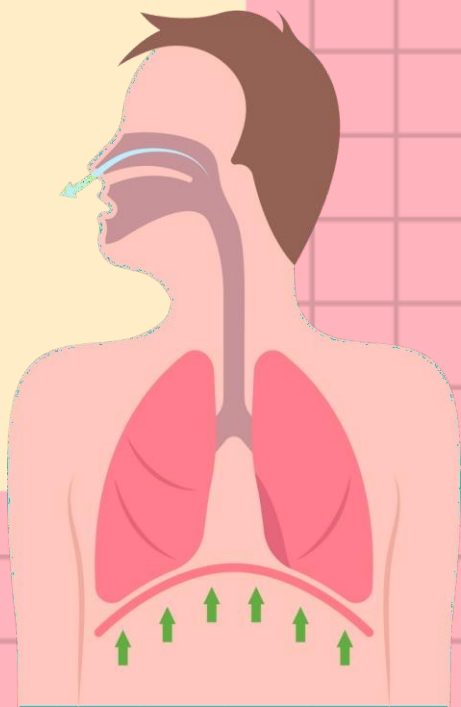
2.Interval phase: Symptomatically silent for days to years, during which time there is progressive herniation from the abdomen to the chest because of the differential pressure during the respiratory cycle

3.Late phase: Symptoms occur as a result of complications of herniated viscera, namely intestinal obstruction or gangrene in addition to respiratory or cardiac compression



Management

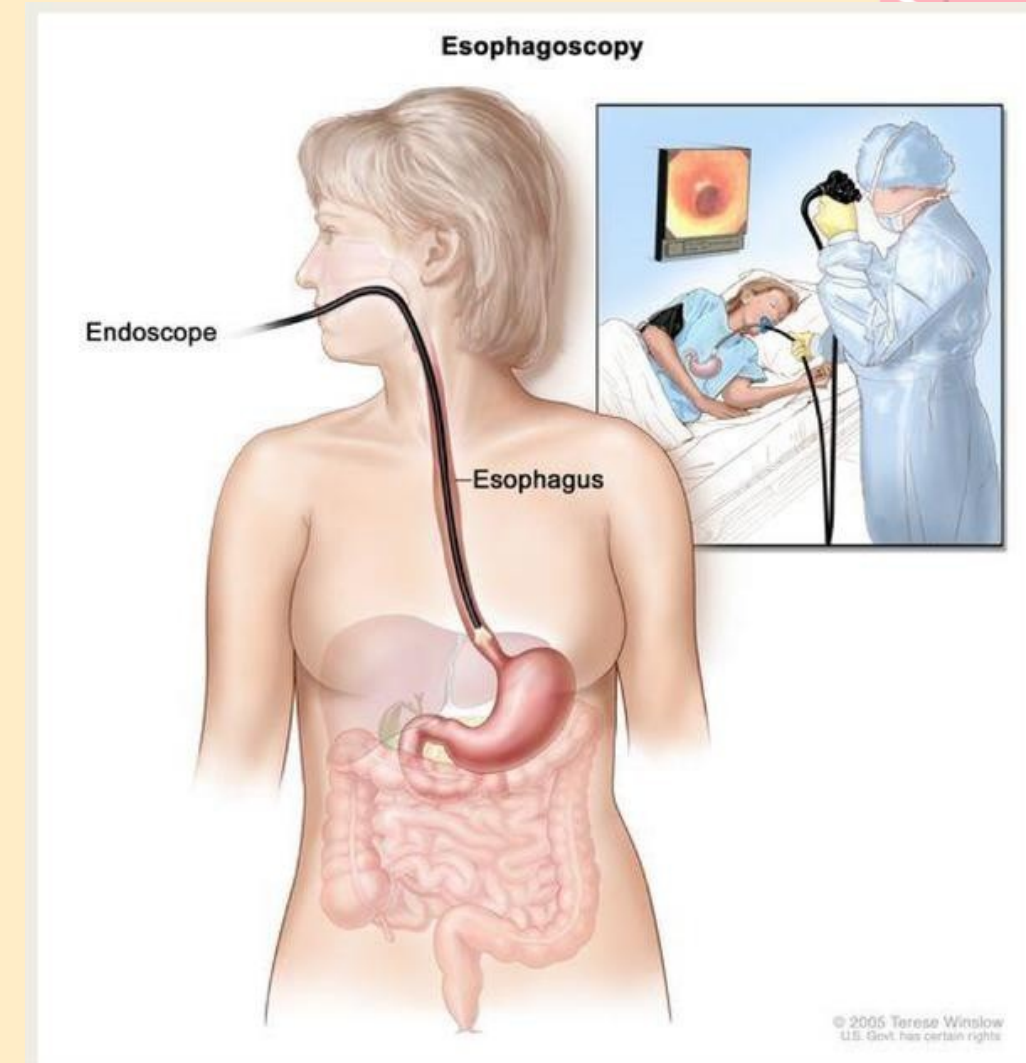
- *ABC's with c-spine control as indicated**
- *High Flow oxygen**
- *Treat Associated Injuries**
- *Definitive treatment is surgery**



Esophageal Injury

***Most injuries to the esophagus as a result of penetrating trauma occur in the neck. thoracic and abdominal esophageal penetrating ! injuries to adjacent vital structures**

***Blunt injury to the esophagus is relatively rare, but can result in a rupture of the esophagus from anteroposterior compression against closed upper and lower esophageal sphincters, usually occurs at the level of the carina where the esophagus may be tethered by subcarinal lymph nodes**

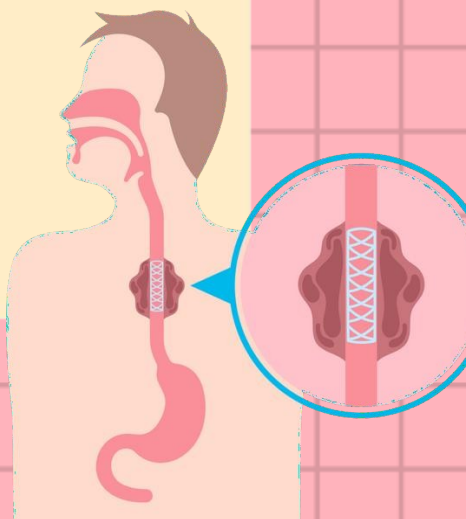


Esophageal Injury

***An injury to the esophagus can lead to mediastinitis if left untreated *An injury to the cervical esophagus typically drains into the deep cervical fascia, which is in continuity with the mediastinum**

***An injury to the proximal two thirds of the esophagus often drains into the right pleural space and results in a right-sided effusion. Conversely , injury to the distal third of the esophagus typically drains into the left pleural space.**

***Injury to the very distal esophagus may present as free intra-abdominal air, peritonitis, or as a sub phrenic abscess if diagnosis is delayed.**



Esophageal Injury

On physical examination

***Subcutaneous air and pleural effusions are the hallmarks of esophageal injury. As opposed to tracheobronchial injuries, which create a large amount of air in abnormal locations, the resultant air from an esophageal injury can be very subtle and a challenge to diagnose**

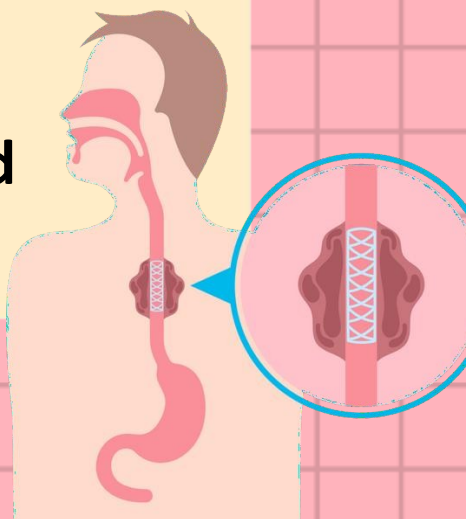
***Mediastinal emphysema may be appreciated on physical examination as a “crunch” with each heartbeat, known as Hamman’s sign**

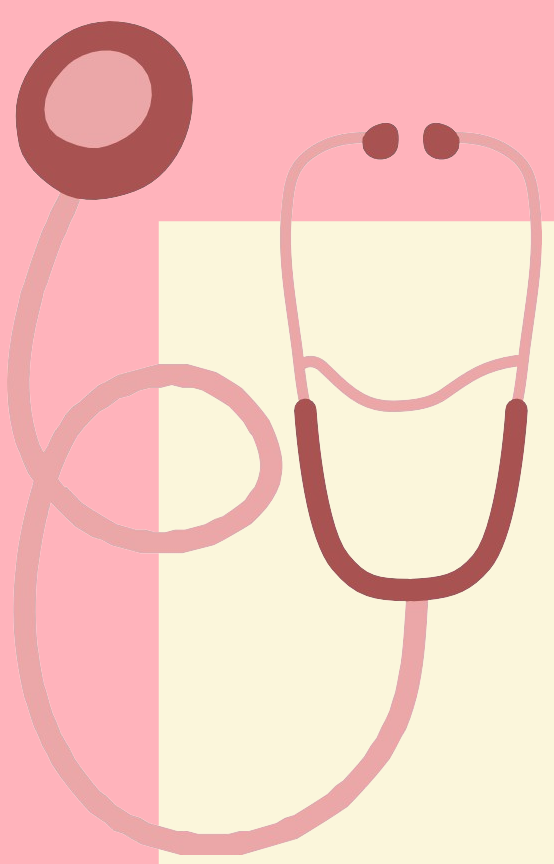
Other diagnostic methods

Esophagoscopy

barium swallow

Management of these injuries can be difficult but primary repair is preferred when possible, although resection and diversion may be required





THANK YOU

