

ASSESSMENT & MANAGEMENT OF CHEST TRAUMA

Dr. Muhammad Shamim

FCPS (Pak), FRCS (Glas), FACS (USA), FICS (USA), MHPE (NI & Eg)

Assistant Professor, Dept. of Surgery

College of Medicine, Prince Sattam bin Abdulaziz University

Email: surgeon.shamim@gmail.com

Web: surgeonshamim.com





CASE SCENARIO

- **27-year-old male was unrestrained driver in high-speed, frontal-impact collision**
- **Blood pressure: 90/70; heart rate: 110; respiratory rate: 36**
- **Initial assessment: GCS score 15, patent airway**

What leads you to suspect thoracic injury in this patient?

How would you evaluate this patient for potential thoracic injuries?

INTRODUCTION

- ❖ Any form of physical insult to the chest
 - ✓ Blunt
 - ✓ Penetrating
- ✓ **Common in the poly-trauma patient and can pose life-threatening problems if not promptly identified during the primary survey.**

EPIDEMIOLOGY

- 25% of all trauma death
- 2nd leading cause of death
- Major thoracic traumas are associated with multi-system injuries in **70%** of cases.

MECHANISM

Blunt Trauma

- Due to blunt force (blast, blow, crush) to chest, as in
 - Road traffic accidents
 - Falls from a height
 - Direct blow (e.g. rib fracture)
 - Deceleration injury
- As a result there can be:-
 - ✓ Pulmonary haemorrhage
 - ✓ Shock &
 - ✓ hypoxia

- Rib fracture is the most common sign of blunt thoracic trauma
- Fracture of scapula, sternum, or first rib suggests massive force of injury

RESTRAINING DEVICES IN MVC

- **Lap seat belt**

- Mesenteric tear or avulsion
- Rupture of small bowel or colon
- Iliac artery or abdominal aorta thrombosis
- Chance fracture of lumbar vertebrae (hyperflexion)

- **Shoulder Harness**

- Rupture of upper abdominal viscera
- Intimal tear or thrombosis in innominate, carotid, subclavian, or vertebral arteries
- Fracture or dislocation of C-spine
- Rib fractures
- Pulmonary contusion

- **Air Bag**

- Corneal abrasions, keratitis
- Abrasions of face, neck, chest
- Cardiac rupture
- C or T-spine fracture



Penetrating Trauma

- Low Energy
 - Arrows, knives, handguns
 - Injury caused by direct contact and cavitations
- High Energy
 - Military, hunting rifles & high powered hand guns
 - Extensive injury due to high pressure cavitations
- Shotgun
 - Injury severity based upon the distance between the victim and shotgun & caliber of shot

TYPES OF CHEST INJURY

❖ Chest wall injuries

- ✓ Simple Rib fracture
- ✓ Flail chest

❖ Injuries within the pleural space

- ✓ Pneumothorax
- ✓ Tension pneumothorax
- ✓ Hemothorax
- ✓ Sucking chest wound

❖ Injury to lung parenchyma & tracheobronchial tree

- ✓ Lung contusion

❖ Injury to the cardiovascular system

- ✓ Rupture of great vessels
- ✓ Cardiac tamponade

❖ Diaphragmatic injuries,

❖ Esophageal injuries

PATHOPHYSIOLOGY

- **Mechanisms;-**
 - Pain
 - Blood loss
 - ↓ed venous return
 - Lung contusion.
- As a result, there is hypoventilation, hypotension & ventilation perfusion mismatch
- Finally, hypoxia, increased CO₂ & acidosis

INJURIES ASSOCIATED WITH PENETRATING INJURY

- Open pneumothorax (including sucking chest wound)
- Tension pneumothorax
- Pneumomediastinum
- Hemothorax
- Hemopneumothorax
- Laceration of vascular structures
- Tracheobronchial tree lacerations
- Esophageal lacerations
- Penetrating cardiac injuries
- Pericardial tamponade
- Spinal cord injuries
- Diaphragm trauma
- Intra-abdominal penetration with associated organ injury

- *Immediately life threatening*

- Laryngeotracheal injury / Airway obstruction
- Tension pneumothorax
- Pericardial tamponade
- Open pneumothorax
- Massive haemothorax
- Flail chest

- *Potentially life threatening*

- Aortic injuries
- Tracheobronchial injuries
- Myocardial contusion
- Rupture of diaphragm
- Oesophageal injuries
- Pulmonary contusion

General approach, initial management and workup of chest trauma patient

GENERAL APPROACH¹⁵

Taking proper history & P/E

- Systematic approach –
 - since signs are easily missed
 - Pt may have more than one injury
 - Obvious injury is not necessarily the most important one
- Aim to identify & treat immediately life threatening condition
- P/E of chest and neurologic examination needs the following assessment;
 - Pattern of breathing, breath sounds and cardiorespiratory distress
 - Level of consciousness, pupillary response, movement of extremities – severity of neurologic injury

INITIAL MANAGEMENT

- Basic principles of resuscitation is to restore **tissue perfusion**, i.e.
 - ❖ **securing airway**
 - ❖ **Restoring circulating volume**
- The ABCDs methods:
 - **Airway**
 - **Breathing**
 - **Circulation**
 - **Disability**
 - **Exposure**



AIRWAY

Look for:

- **Associated injuries** to the head, face, cervical spine and upper and lower airway.
- Low level of **consciousness**, airway obstruction or disruption, and inability to oxygenate the patient by mask indicate the need for tracheal intubation.
- Blood in the airway, recent food intake, and trauma itself with decreased gastric emptying, increases the risk for **aspiration** of gastric contents.
 - Insert NGT.

❖ The following should be done as required:

- Clearing the air way
- Endotracheal intubation
- Tracheostomy or cricothyroidotomy

BREATHING

- **Inspection** for respiratory rate,
 - presence of paradoxical motion of the chest wall, or obvious chest wounds.
- **Palpation**; should seek pain, crepitus or subcutaneous emphysema as clues to underlying pathology.
- **Auscultation** of the lung fields may detect a *pneumothorax* or *hemothorax* before a chest x-ray is performed, as well as assessing the adequacy of air entry.
- **Percussion** can differentiate between pneumo and hemothorax, but difficult to assess in the resuscitation bay.

Management

- *Aspiration of fluids & secretions* from oral cavity, pharynx and trachea, and also from the stomach by NG tube.
- *Oxygen supplementation*
- *Artificial ventilation-*
introduce plastic airway & endotracheal tube.
- **Decompress tension pneumothorax** using wide bore needle thoracocentesis in the safe triangle (historical: 2nd ICS in MCL).
- *Drain haemothorax* by urgent **tube thoracostomy insertion** at the 5th/6th ICS of MAL and should be connected to under water seal.

CIRCULATION

- **Hypotension:** in thoracic trauma is usually associated with hypovolemia.
 - it should be aggressively treated initially with volume expansion with crystalloids while other possible etiologies, i.e. pneumothorax, cardiac tamponade and blunt cardiac injury are assessed.
- **Arrhythmia** should raise suspicion of blunt cardiac injury
- **Hypertension** may worsen bleeding in thoracic trauma and may dislodge thrombus which is containing a major vessel disruption and therefore should be treated.
- **Two large bore peripheral IV's** are a minimum for resuscitation and a central access is usually needed both for therapy and monitoring

Management

- ✓ Control major and life threatening **bleeding** e.g using compressive dressing.
- ✓ Administer controlled IV fluid
- ✓ Blood transfusion

DISABILITY

Neurological assessment.

- ◆ Level of consciousness: **AVPU** (**A**lert, responds to **V**oice, or **P**ain, **U**nresponsive)
- ◆ pupillary response, mov`t of extremities – severity of neurologic injury

EMERGENCY THORACOTOMY

- Use:
 - Evacuation of pericardial blood
 - Control of intrathoracic hemorrhage
 - Open cardiac massage
- ❖ Done before definitive treatment of some thoracic structures

Indications

1. **cardiac arrest (resuscitative thoracotomy)**
2. **massive hemothorax (greater than 1500 mL of blood through the chest tube acutely or greater than 200 to 300 mL/hr after initial drainage)**
3. **penetrating injuries of the anterior chest with cardiac tamponade**
4. **large open wounds of the thoracic cage,**
5. **major thoracic vascular injuries in the presence of hemodynamic instability,**
6. **major tracheobronchial injuries**
7. **evidence of esophageal perforation.**



Complications

- Collapsed lung lead to respiratory failure
- Lung fibrosis
- Empyema
- Pneumothorax
- Shock leading to death

Work-up of patients with chest trauma:

❖ *Laboratory tests:*

- Complete blood count,
- ABG
- Electrolytes, glucose, BUN, creatinine
- ECG,
- Blood type and cross match
- Cardiac enzymes

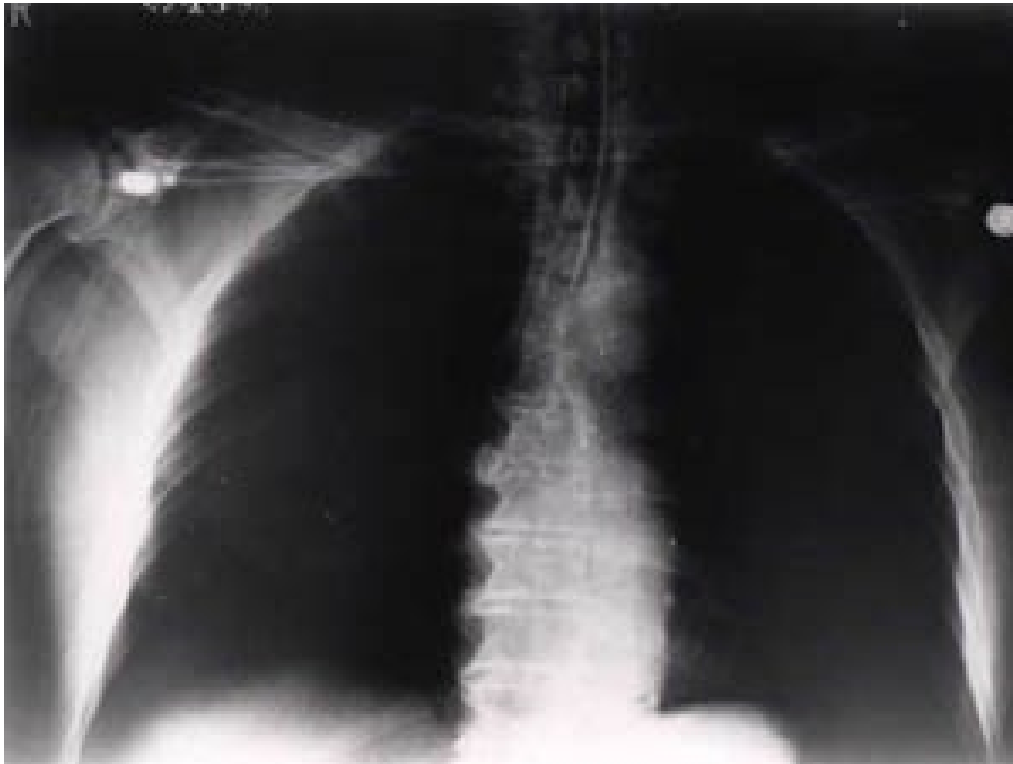
❖ Chest x ray:

Can reveal both suspected and unsuspected pathology.

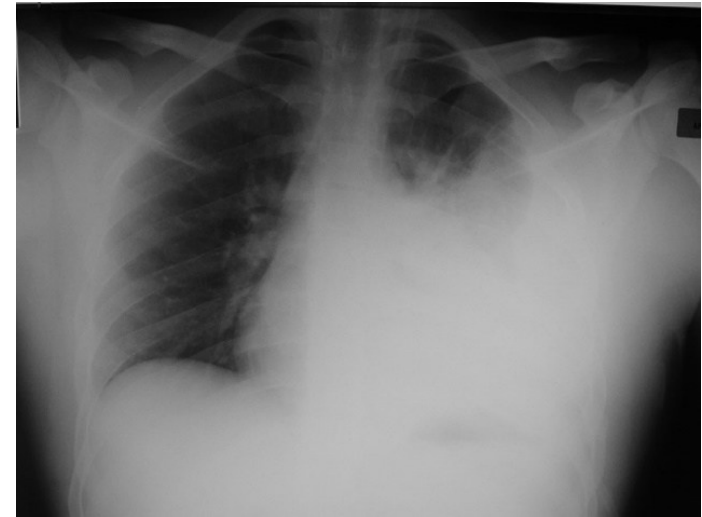
- **Bony thorax** including ribs, clavicles, scapulae, and vertebrae, should be examined for fracture.
- **Soft tissues** ; evaluate for Emphysema or Opacification.
- **The lung fields**; likewise demonstrate Pneumothorax, Hemothorax, consolidation suggestive of **lung contusion**.

- **Radiographic abnormalities** of the mediastinum,
 - Pneumomediastinum - Airway rupture
 - Widening of the mediastinum - Aortic disruption
 - Shift of the mediastinum - tension pneumothorax

- **Assessment of the cardiac silhouette** may aid in the diagnosis

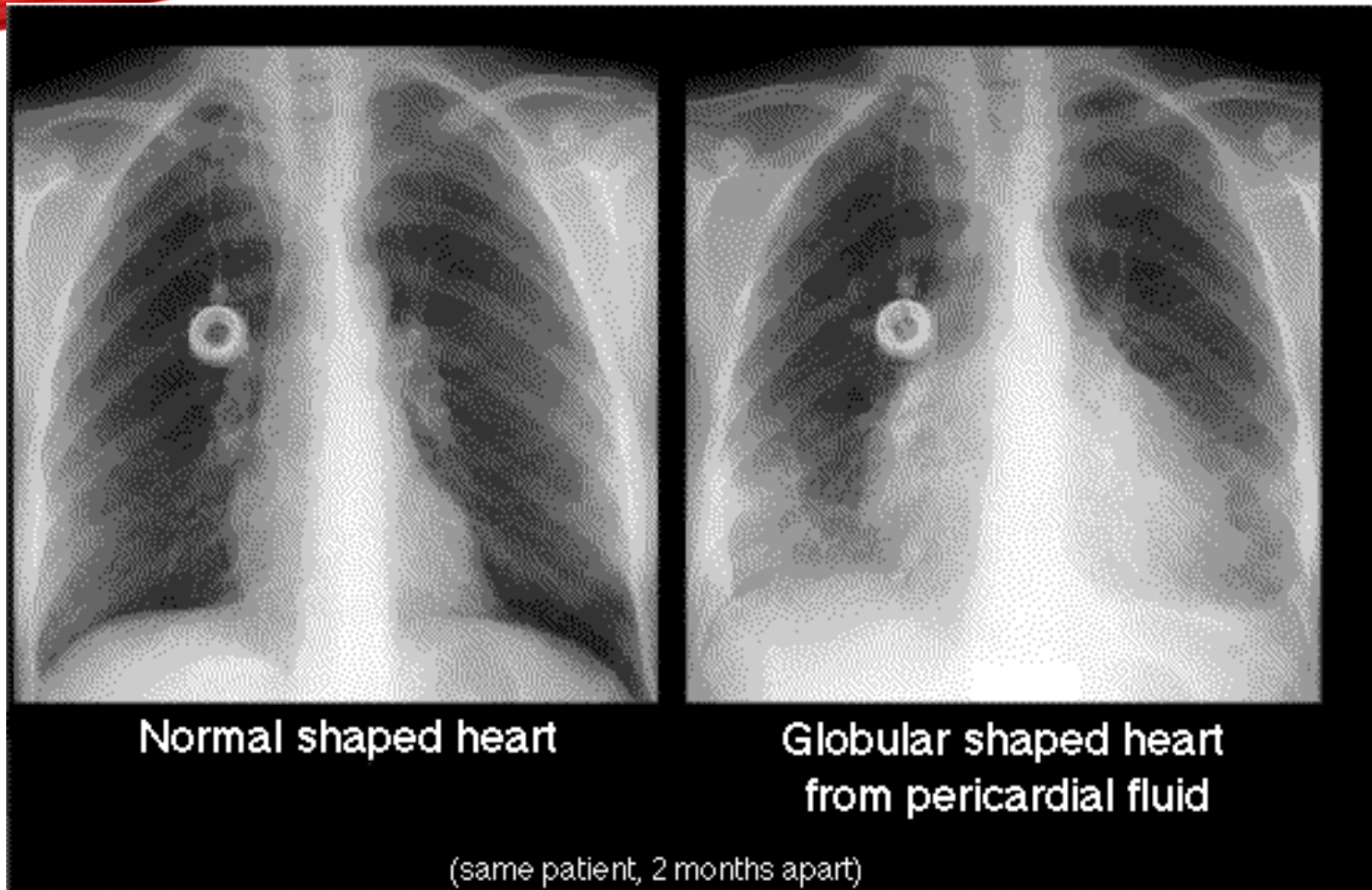


Tension pnemothorax



Massive
Hemothorax





Cardiac tamponade

Other imaging:

- Echocardiogram
 - *Precordial or Transesophageal,*
 - useful in evaluating for pericardial fluid, valve and wall motion, and the presence and extent of aortic disruption.
- FAST
- CT scan
 - may reveal aortic disruption and pneumothorax not readily apparent on plain chest x-ray.
- Arteriography
 - used to precisely locate *vascular injury*

SPECIFIC INJURIES OF CHEST WALL



RIB FRACTURE

❖ Simple Rib Fractures

- >50% of significant chest trauma cases are due to blunt trauma
- Compressional forces flex and fracture ribs at weakest points
- Ribs 1-3 requires great force to fracture
 - Possible underlying lung injury
- Ribs 4-9 are most commonly fractured
- Ribs 10-12 less likely to be fractured
 - If fractured, suspect liver and spleen injury
- Hypoventilation is COMMON due to PAIN

- **Diagnosis:** clinical
 - pain
 - restriction of ventilation
 - point tenderness & palpable deformity
 - crepitus & subcutaneous emphysema
- **Management:**
 - effective analgesia, intercostal nerve block & muscle relaxant

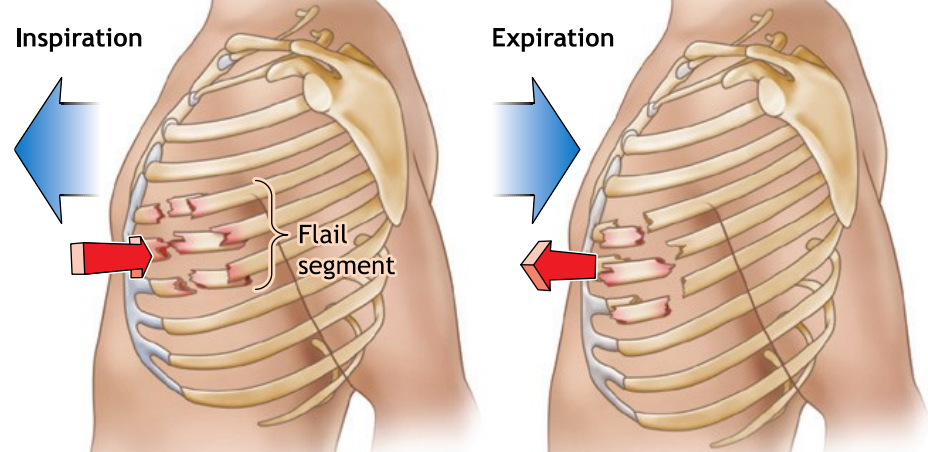
FLAIL CHEST

- ✓ is defined as an unstable chest wall resulting from fractures to **>3 adjacent ribs**, with each rib fractured in **more than one location**.
- ✓ **Paradoxical motion** of the chest wall occurs during respiration.
- ✓ There is frequently an underlying pulmonary contusion that contributes to respiratory insufficiency and increased work of breathing, necessitating mechanical ventilation
- ✓ Interfere also **with venous return**

Signs & Symptoms

- Dyspnea
- Chest pain
- Paradoxical chest wall movement
- Poor air movement
- Crepitus
- Hypoxia
- Cyanosis





- **Diagnosis:**

- Clinical: paradoxical movement of ribs

- **Management:**

emergency

- stabilize the segment with sand bags
- traction with towel clip
- ventilation

- careful fluid management to prevent fluid overload
- vigorous pulmonary toilet to prevent atelectasis and pneumonia,
- adequate analgesia

Bulky dressing for splint of flail chest

- Use Trauma bandage and Triangular Bandages to splint ribs



PLEURAL SPACE INJURIES

Pneumothorax

- It occurs when air from an injured lung or airway is trapped within the pleural cavity and increases the normal negative intrapleural pressure.
- It may be caused by penetrating or blunt mechanisms.
- It is due to rib fractures penetrating the lung parenchyma or by lung injuries without chest wall involvement.

Clinical presentation

- Mild or severe form
 - Asymptomatic
 - Sudden onset of *chest pain*
 - *Shortness of breath*
 - Cough
- Physical examination
 - Amount of collapse
 - Significant
 - *Diminished tactile fremitus*
 - *Hyper resonance on percussion*
 - *Decreased breath sound*
- *Treatment: Chest tube insertion*

Tension pneumothorax

- Develops when a **'one-way valve' air leak** occurs either from the lung or through the chest wall.
- Air is forced into the thoracic cavity without any means of escape, completely collapsing the affected lung.
- The air is under tension or pressure.
- The mediastinum is displaced to the opposite side, and the opposite lung is compressed.
- There is decreased venous return and hypoxia.

TENSION PNEUMOTHORAX

Injury to the lung

Valvular air leak

Lung collapse

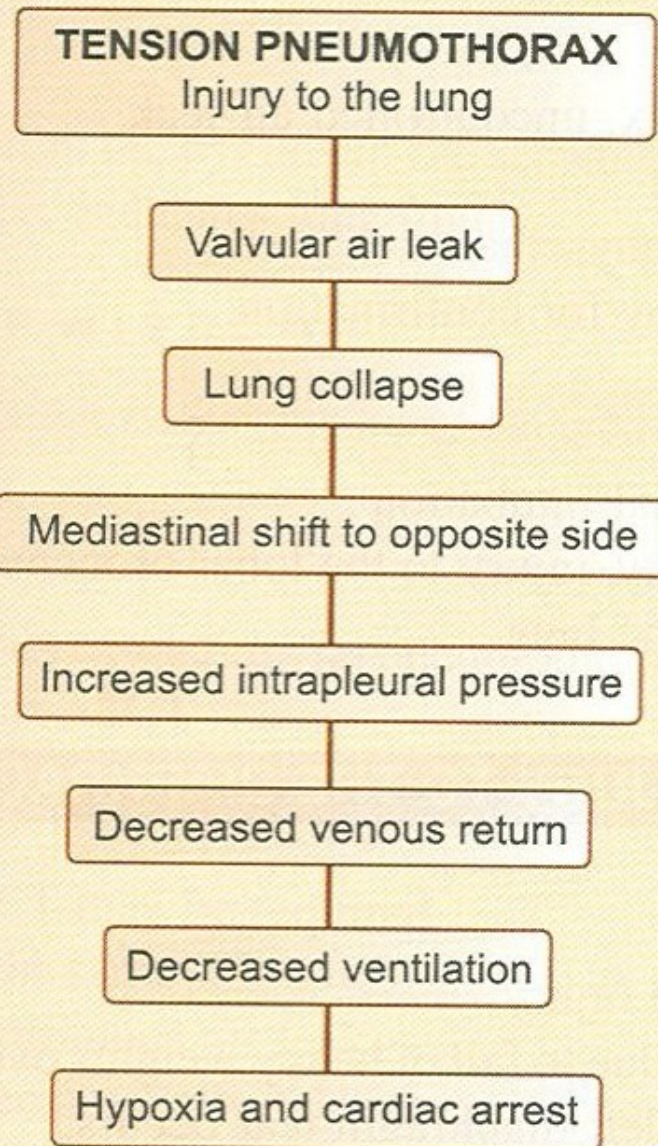
Mediastinal shift to opposite side

Increased intrapleural pressure

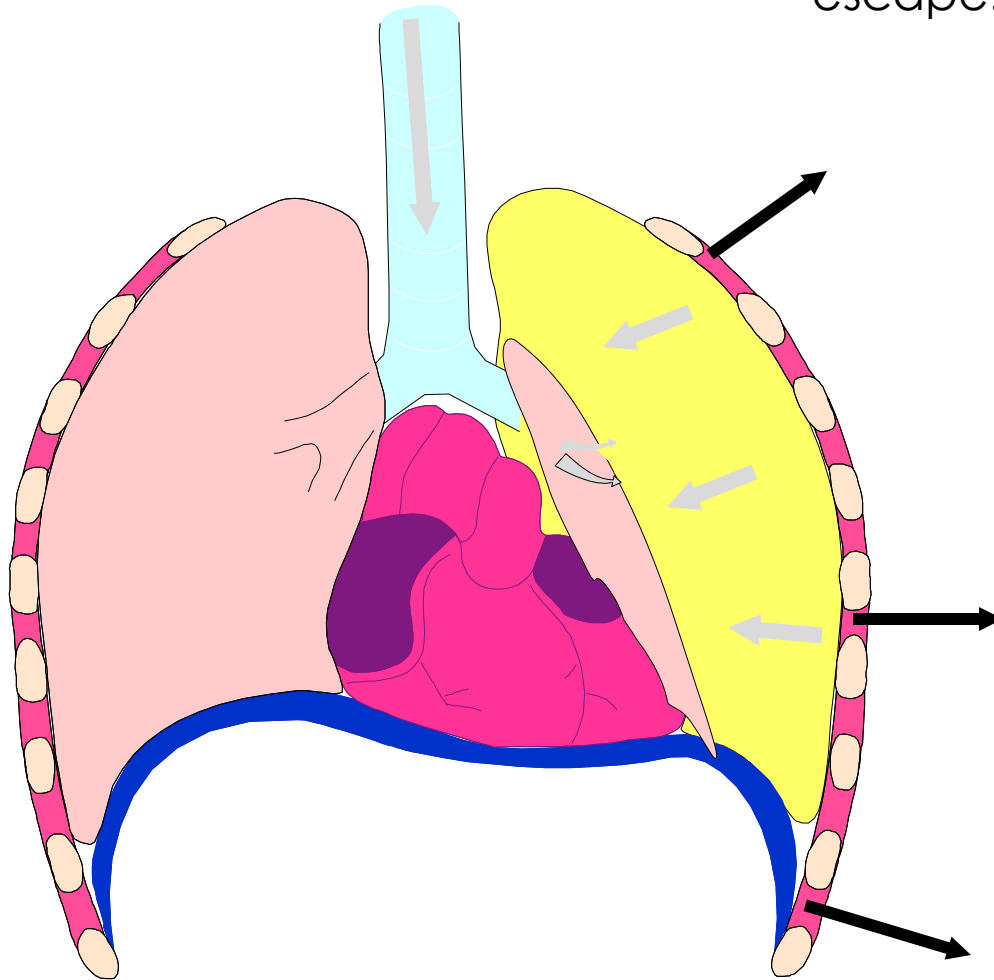
Decreased venous return

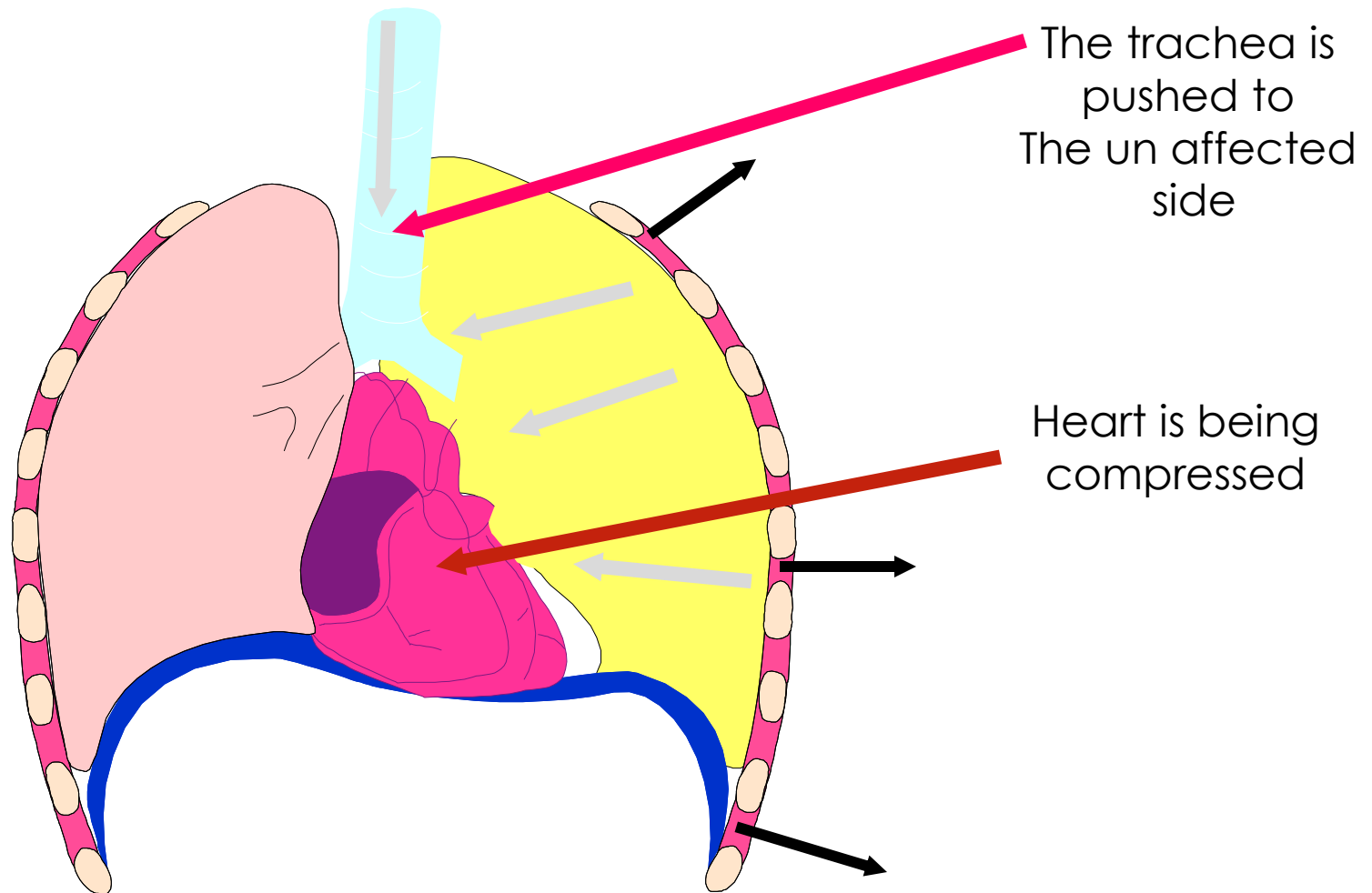
Decreased ventilation

Hypoxia and cardiac arrest



Each time patient inhale,
the lung collapses further. There
is no place for the air to
escape.

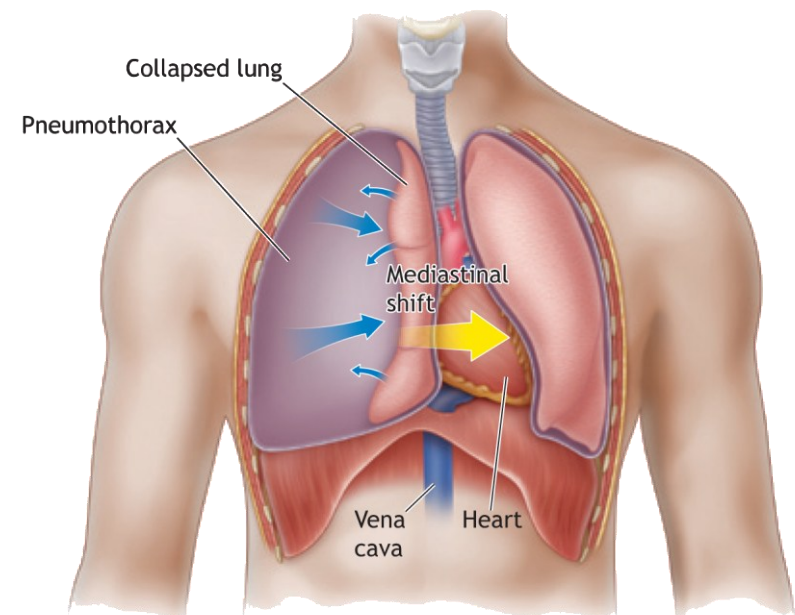




Diagnosis is clinical: '4T's

- Tachypnea
 - Tachycardia
 - Total absent of BS
 - Tracheal shift
-
- Hypotension
 - Distended neck veins
 - Hyper resonance

Clinical diagnosis



NO x-ray

Management

No time for radiography

Immediate decompression by rapid insertion of a **large-bore needle** into the **safe triangle** of the affected hemithorax.

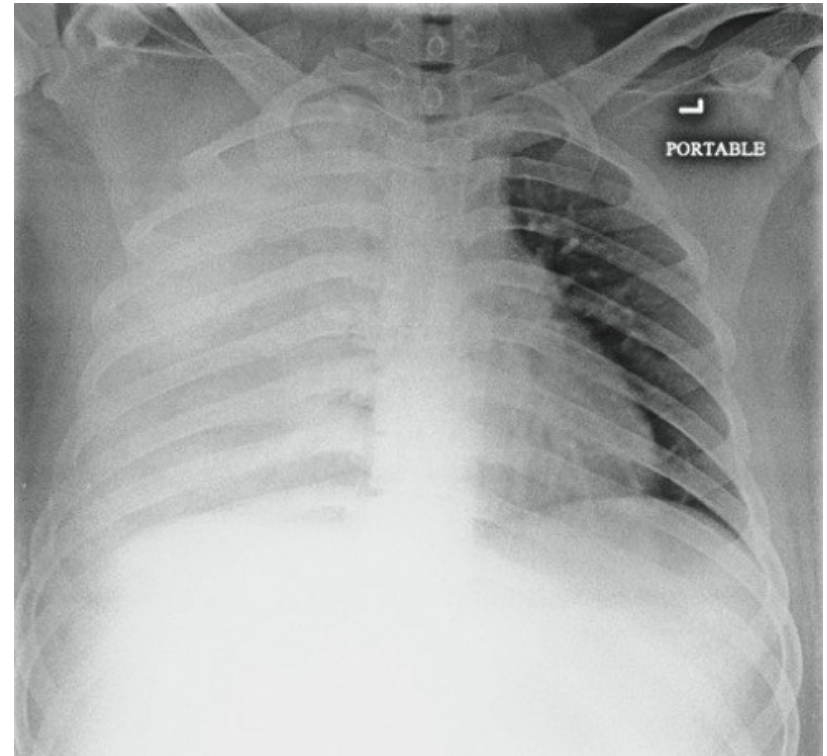
This is immediately followed by insertion of a **chest tube** through the **5th** intercostal space in the **mid axillary** line.



HEMOTHORAX

Source of bleeding

- ✓ Intercostal vessels
- ✓ Internal mammary vessels
- ✓ pulmonary vessels



Management

❖ ATLS i.e.

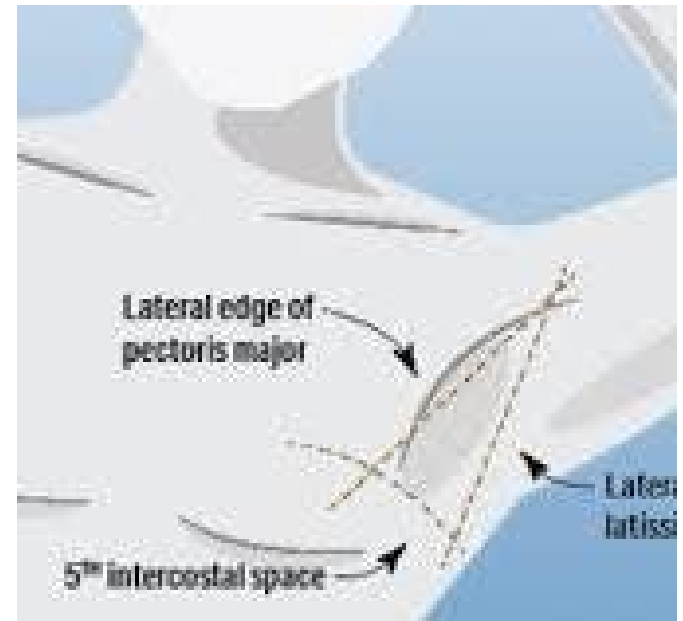
- ABC's of life with C-spine control
- Secure airway, assist ventilation
- Secure IV line for fluid resuscitation (hypotension)
- Blood transfusion if necessary
- Treat the underline cause

❖ Definitive treatment

✓ Chest tube insertion

- Indicated when there is air or fluid in the pleural cavity
- Should be inserted in the 'safe triangle'
 - anterior to the mid-axillary line;
 - above the level of the nipple;
 - below and lateral to the pectoralis major muscle

✓ thoracotomy





Follow-up of chest tube:

- ✓ Ask the patient for
 - Degree of respiratory embarrassment
 - Degree of pain
- ✓ Follow **vital signs**
- ✓ Follow degree of **chest re-expansion**
- ✓ Look for oscillation & bubbling
- ✓ Measure the drain **out put**

Indications for chest tube removal:

➤ Clinical Improvement

- * Patient will no longer be short of breath
 - * Bilateral breath sounds heard
 - * Symmetrical rise of the chest on inspiration
 - * percussion note is normal
-
- when the drainage is <50 ml in 24 hour
 - No more blood or pus is coming out
 - No bubbling or fluctuation in the water-seal chamber

Complications of chest tube:

- Bleeding
- Aspiration
- Damage to diaphragm
- Infection
- Subcutaneous emphysema

Contraindications of chest tube insertion:

- Refractory coagulopathy
- Diaphragmatic hernia
- Hepatic hydrothorax
- Adhesion in the pleural space

SUCKING CHEST WOUND [OPEN PNEUMOTHORAX]

- Caused by penetrating injuries that makes a hole in the chest cavity which is greater **3 cm** in diameter
- Collapsed lungs
- Sharp pain on chest and difficulty breathing
- Results to death if left untreated



Management

- closing the defect with a **sterile occlusive plastic dressing** taped on **3** sides to act as a flutter-type valve.
- Chest tube is inserted in a site remote from the wound site
- Definitive treatment may warrant debridement and closure

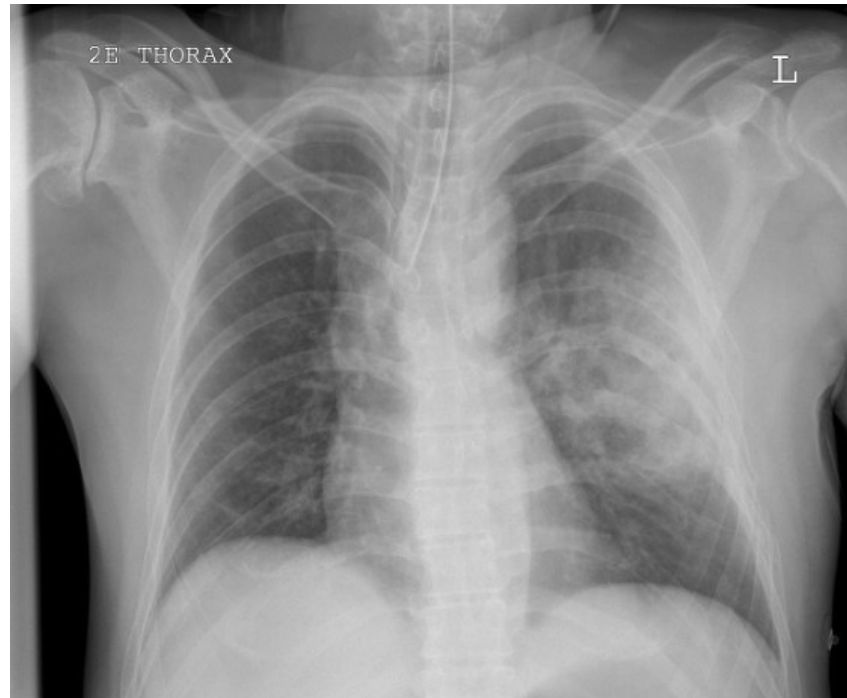


PULMONARY CONTUSION

- There is injury to the lung parenchyma leading to **edema & blood** collection in the alveolar space.
- This leads to loss of normal lung *structure* and *function*.
- Frequently manifests itself as **hypoxemia**
- **Mostly it is self limiting**

◆ Causes

- ✓ Blunt trauma (most common)
- ✓ Penetrating trauma



Diagnosis:

- Dyspnea
- Chest pain & cough
- Hemoptysis
- Vital sign deranged
- Chest tenderness

Chest X-ray: non lobular patchy consolidation

Management:

- fluid restriction, supplemental oxygen, vigorous chest physiotherapy, adequate analgesia
- Most common complications are pneumonia & ARDS

CARDIAC TAMPONADE

- There is build up of fluid around the heart within in pericardiac sac causing compression of the heart.
- Normal pericardial fluid 15-20 ml.
- In acute cases >100 cc of blood can lead to cardiac tamponade.
- In chronic cases pericardium can accommodate up to 2 liters of fluid with out tamponade effect.

CARDIAC TAMPONADE

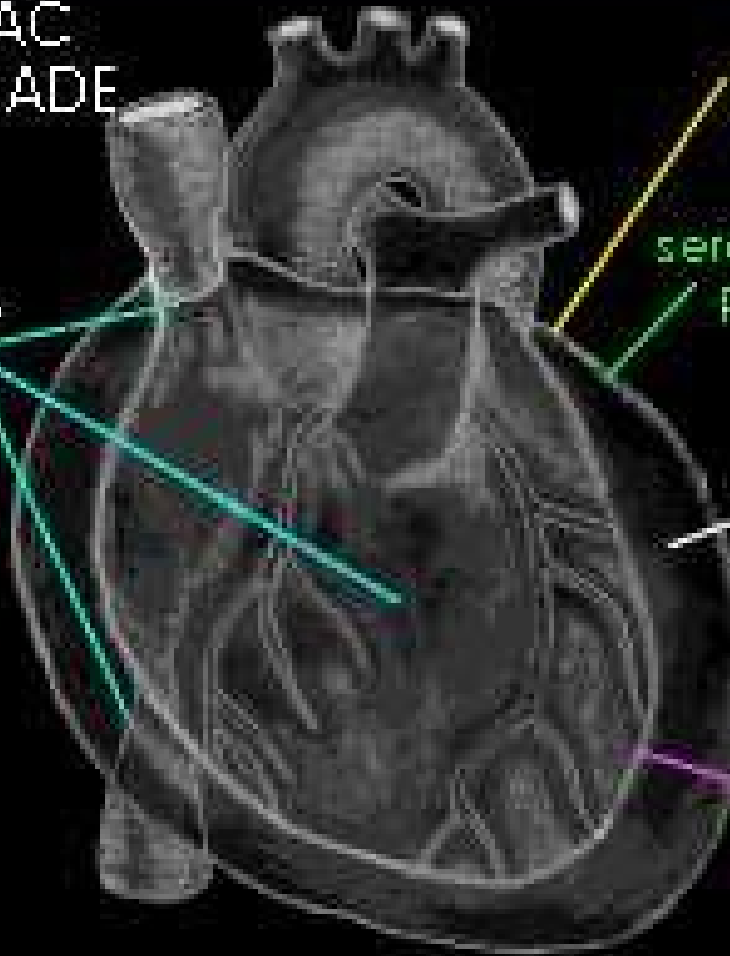
constrictive
effects

fibrous
pericardium

serous pericardium
parietal layer

pericardial
space
with too much
fluid

serous
pericardium
visceral layer



- **All patients with penetrating injury anywhere near the heart plus shock must be considered to have cardiac injury until proven otherwise**
- **Clinical presentation**
 - *Beck's triad*
 - Dilated neck veins
 - Muffled heart sounds
 - Hypotension
- **Treatment**
 - Initially pericardiocentesis under ECG monitoring plus rapid volume resuscitation to increase preload
 - definitive sternotomy or left thoracotomy

TRACHEO-BRONCHIAL INJURIES

- Penetrating :- 75-80% → Cervical trachea
- Blunt :- 75-80% → Bronchial
- Frequently Fatal
- **Severe subcutaneous emphysema with respiratory distress & Hamman's sign**
- **Bronchoscopy diagnostic**
- Associated injuries
- **Treatment:**
 - ABCs
 - Urgent Repair

THORACIC GREAT VESSEL INJURIES

- 8-9% - of all Vascular injuries
- Prevalence - 0.3-10%
- Mechanism:-
 - Penetrating:- 90%
 - Blunt :- Deceleration, Chest compression
- **15%** reach hospital, **2/3rd** die in 14 days
- Physical clues:
 - Chest wall trauma
 - Massive hemothorax
 - Excessive entry site bleeding
 - Expanding apical chest hematoma / neck mass
- **Management:** resuscitation, thoracotomy

AORTIC RUPTURE

- **Aorta most commonly injured in severe blunt or penetrating trauma**
- The most common site of aortic injury following blunt trauma is at the **ligamentum arteriosum**
- **85-95% mortality**
- Usually result in disruption of intima & media

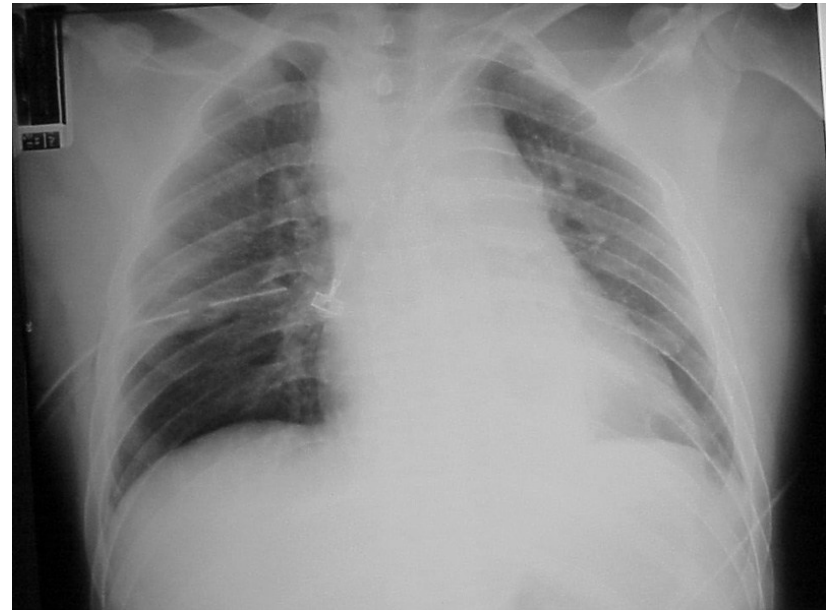
- **Diagnosis:**

- Rapid deterioration of VS
- Pulse difference between upper or lower extremities

- **CXR**

- **wide mediastinum**
- abnormal aortic contour
- Rt tracheal deviation
- Lt “apical cap”

- **Gold standard diagnostic modality is aortography or CT scan**



ESOPHAGEAL RUPTURE

- Rare complication of blunt thoracic trauma
- **Clinical presentation vary, based on site of injury**
- Esophageal contents escape into mediastinum & results in:
 - Serious infection
 - Chemical irritation
 - Damage to mediastinal structures
 - Air entering in mediastinum
- **Clinical features:** Subcutaneous emphysema, dysphagia, chest or epigastric pain.
- **Treatment:** early repair & drainage or esophagostomy

DIAPHRAGMATIC RUPTURE

- A tear in the diaphragm that allows the abdominal organs to enter the chest cavity
- **More common on left side** due to liver protecting the right side of diaphragm
- Associated with multiple injury patients
- results from blunt trauma to the chest and abdomen, producing a *radial tear* in the diaphragm, beginning at the esophageal hiatus.

- **Clinical features:**
 - Abdominal pain
 - Shortness of breath
 - Decreased breath sounds on side of rupture
 - **Bowel sounds heard in chest cavity**
-
- **Diagnosis: CXR or laparotomy**
 - shows evidence of the stomach or colon in the chest
- **Treatment:** General supportive treatment, repair of tear.

CASE SCENARIO

- **27-year-old male was unrestrained driver in high-speed, frontal-impact collision**
- **Blood pressure: 90/70; heart rate: 110; respiratory rate: 36**
- **Initial assessment: GCS score 15, patent airway**

What leads you to suspect thoracic injury in this patient?

How would you evaluate this patient for potential thoracic injuries?

The End!