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Thoracic Trauma

Advanced Care Paramedicine

Module: 08

Section: 08

Introduction

- Thoracic cavity contains many vital structures
  - Heart, great vessels, esophagus, tracheobronchial tree, and lungs
- 25% of MVC deaths are due to thoracic trauma
  - Usually an injury to the heart or great vessels
- Abdominal injuries are common with chest trauma

Blunt Trauma

- Results from kinetic energy forces transmitted through the tissues
- Blasts
  - Pressure wave causes tissue disruption
  - Tear blood vessels & disrupt alveolar tissue
  - Disruption of tracheobronchial tree
  - Traumatic diaphragm rupture
- Crush (compression)
  - Body is compressed between an object and a hard surface
  - Direct injury of chest wall and internal structures

FIGURE 25-1 An example of blunt trauma to the chest.

Blunt Trauma

- Deceleration
  - Body in motion strikes a fixed object
  - Blunt trauma to chest wall
  - Internal structures continue in motion
    - Ligamentum Arteriosum shears aorta
- Age Factors
  - Pediatric Thorax
    - More cartilage allows it to absorbs forces
    - Increased likelihood of underlying injuries
  - Geriatric Thorax
    - Calcification and osteoporosis increases likelihood of fractures

FIGURE 25-2 Frontal impact auto collisions frequently result in chest trauma.

Penetrating Trauma

- Low Energy
  - Arrows, knives, handguns
  - Injury caused by direct contact and cavitation
- High Energy
  - Military, hunting rifles and high powered hand guns
  - Extensive injury due to high pressure cavitation

FIGURE 25–3 Penetrating (stab) wound to the chest.

Penetrating Trauma

- Shotgun
  - Injury severity based upon the distance between the victim and shotgun & caliber of shot
  - Type I: >7 meters from the weapon
    - Soft tissue injury
  - Type II: 3-7 meters from weapon
    - Penetration into deep fascia and some internal organs
  - Type III: <3 meters from weapon
    - Massive tissue destruction

Chest Wall Injuries

- Most common injuries encountered in blunt chest trauma
- Intact chest required for adequate ventilation
  - Respiratory insufficiency
- Contusions
- Rib fractures
- Sternal fractures/dislocations
- Flail chest

Signs and Symptoms of Chest Wall Injuries

- Blunt or penetrating trauma to chest
- Erythema
- Ecchymosis
- Dyspnea
- Pain on breathing
- Limited breath sounds
- Hypoventilation
- Crepitus
- Paradoxical movement of chest wall

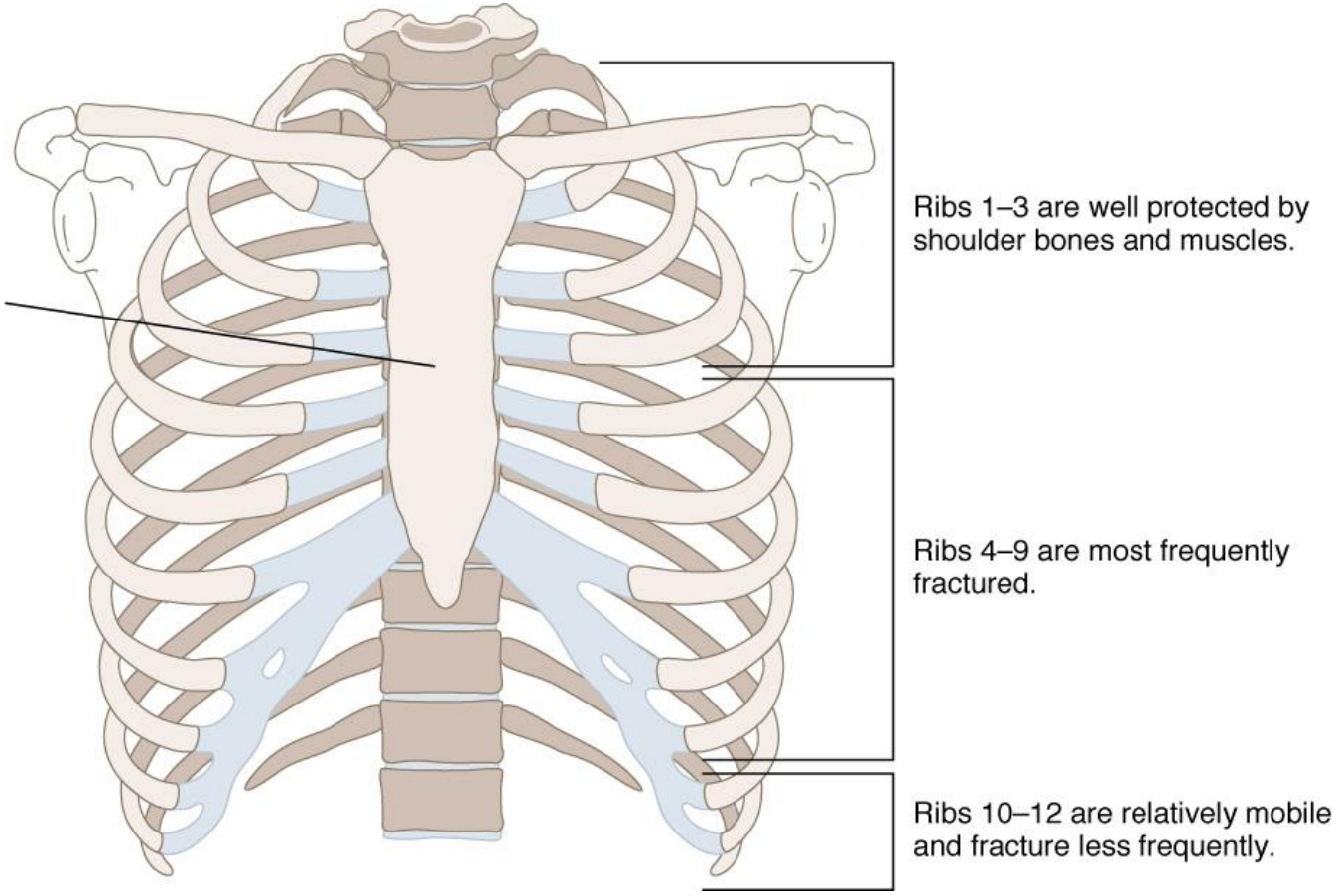
Contusions

- Most common chest wall injury
- Injury to soft tissue covering thoracic cage
  - Pain with respiratory effort
  - May lead to hypoventilation
  - At risk patients with pre-existing conditions
- Erythema, ecchymosis

Rib Fractures

- >50% of significant chest trauma cases due to blunt trauma
- Compressional forces flex and fracture ribs at weakest points
- Hypoventilation is common due to pain
- Mortality goes up with:
  - Number of fractures
  - Extremes of age
  - Associated disease

Rib fractures



Rib Fractures

- Ribs 1-3
  - Require great force to fracture
  - Possible underlying lung injury
- Ribs 4-8
  - Least protected
  - Most commonly fractured
- Ribs 9-12
  - Less likely to be fractured
  - Transmit energy of trauma to internal organs
  - If fractured, suspect liver and spleen injury

Sternal Fracture & Dislocation

- Associated with severe blunt anterior trauma
- Area well protected
  - Fractures result from severe impacts
  - Typical mechanism is a direct blow (e.g. steering wheel)
- Low incidence (5-8%)
- Mortality high (25-45%) because of underlying injuries
  - Myocardial contusion
  - Pericardial tamponade
  - Cardiac rupture
  - Pulmonary contusion
- Dislocation uncommon but same MOI as fracture
  - Tracheal depression if posterior

Flail Chest

- Segment of the chest that becomes free to move with the pressure changes of respiration
- Three or more adjacent rib fracture in two or more places
- Serious chest wall injury with underlying pulmonary injury
  - Reduces volume of respiration
  - Adds to increased mortality

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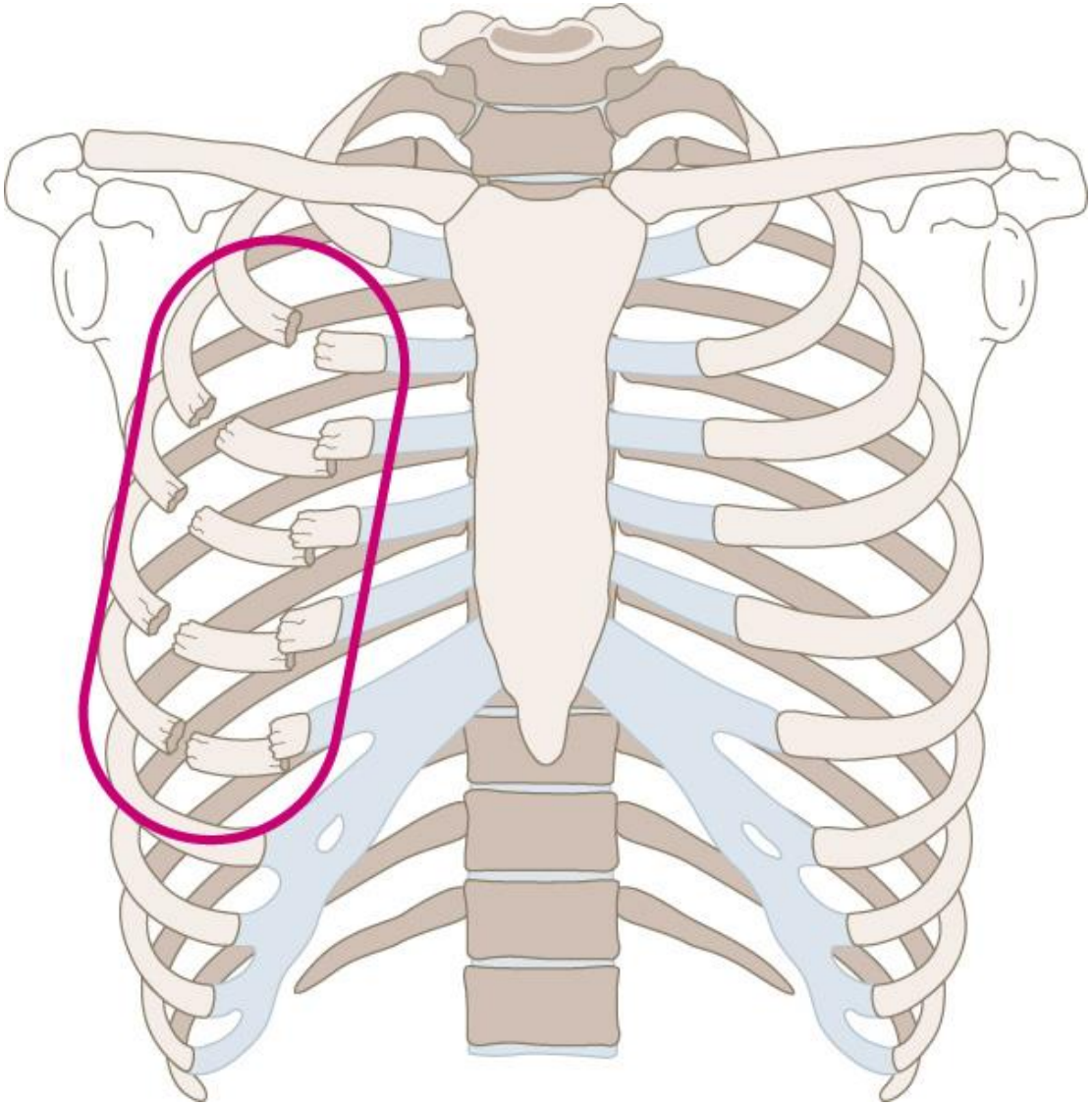
Flail Chest

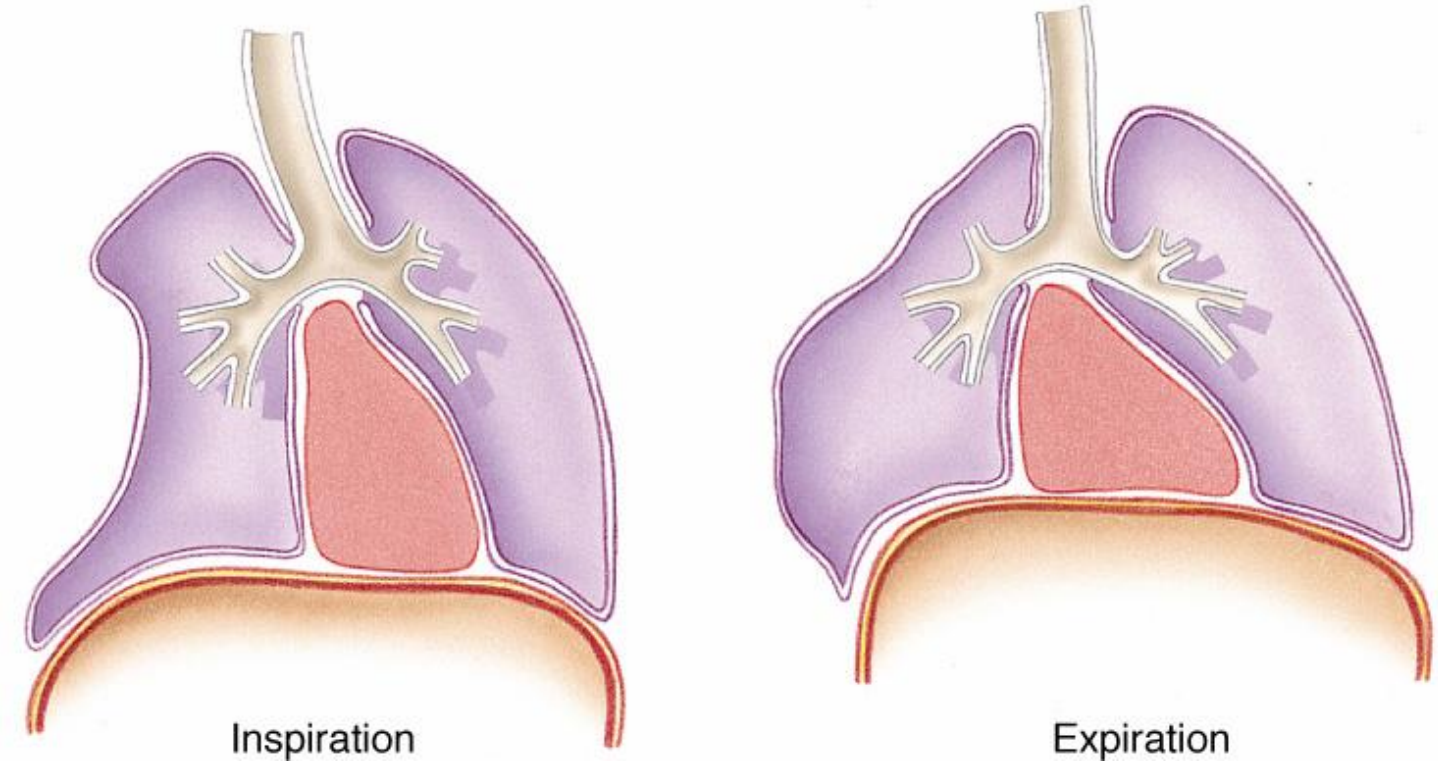


Flail Chest

- Paradoxical flail segment movement
- Chest muscles will initially splint the flail segment
  - Over time muscles will fatigue
  - Flail segment will become more evident
- Positive pressure ventilation can restore tidal volume

Flail segment

- Paradoxical movement of the chest wall seen in a flail segment



Pulmonary Injuries

- Injuries to
  - Lung tissue
  - System that holds lungs to interior of the thoracic cavity
- Simple pneumothorax
- Open pneumothorax
- Tension pneumothorax
- Hemothorax
- Pulmonary contusion

Simple Pneumothorax

- Lung tissue is disrupted and air leaks into the pleural space
- Typical mechanism is a paper bag syndrome
- Progressive Pathology
  - Air accumulates in pleural space
  - Lung collapses
  - Alveoli collapse (atelectasis)
  - Reduced oxygen and carbon dioxide exchange
  - Ventilation/Perfusion Mismatch
    - Increased ventilation but no alveolar perfusion
- Reduced respiratory efficiency results in hypoxia

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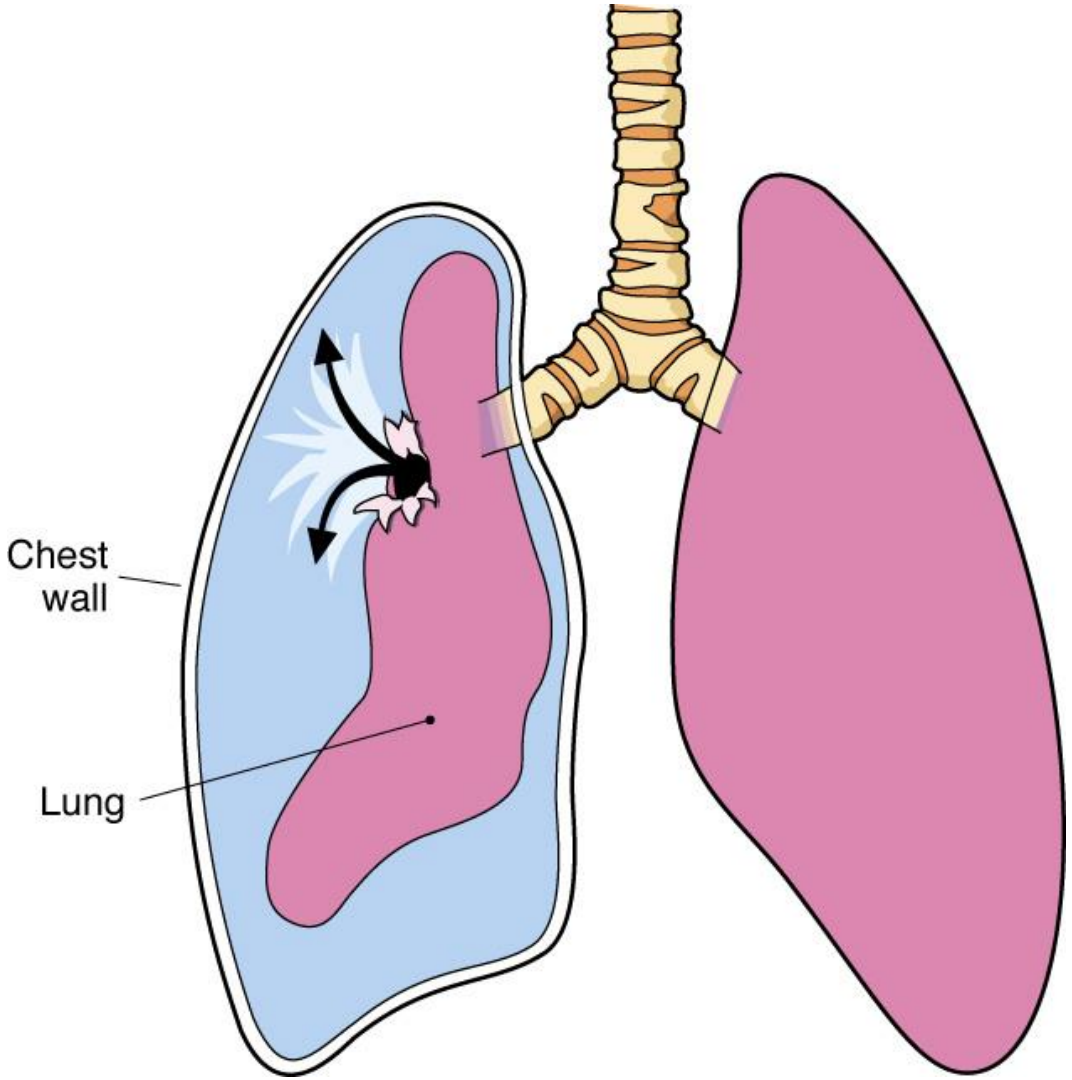
Simple Pneumothorax



Open Pneumothorax

- Free passage of air between atmosphere and pleural space
- Air replaces lung tissue
- Mediastinum shifts to uninjured side
- Air will be drawn through wound if wound is 2/3 diameter of the trachea or larger
- Signs and symptoms
  - Penetrating chest trauma
  - Sucking chest wound
  - Frothy blood at wound site
  - Severe dyspnea
  - Hypovolemia

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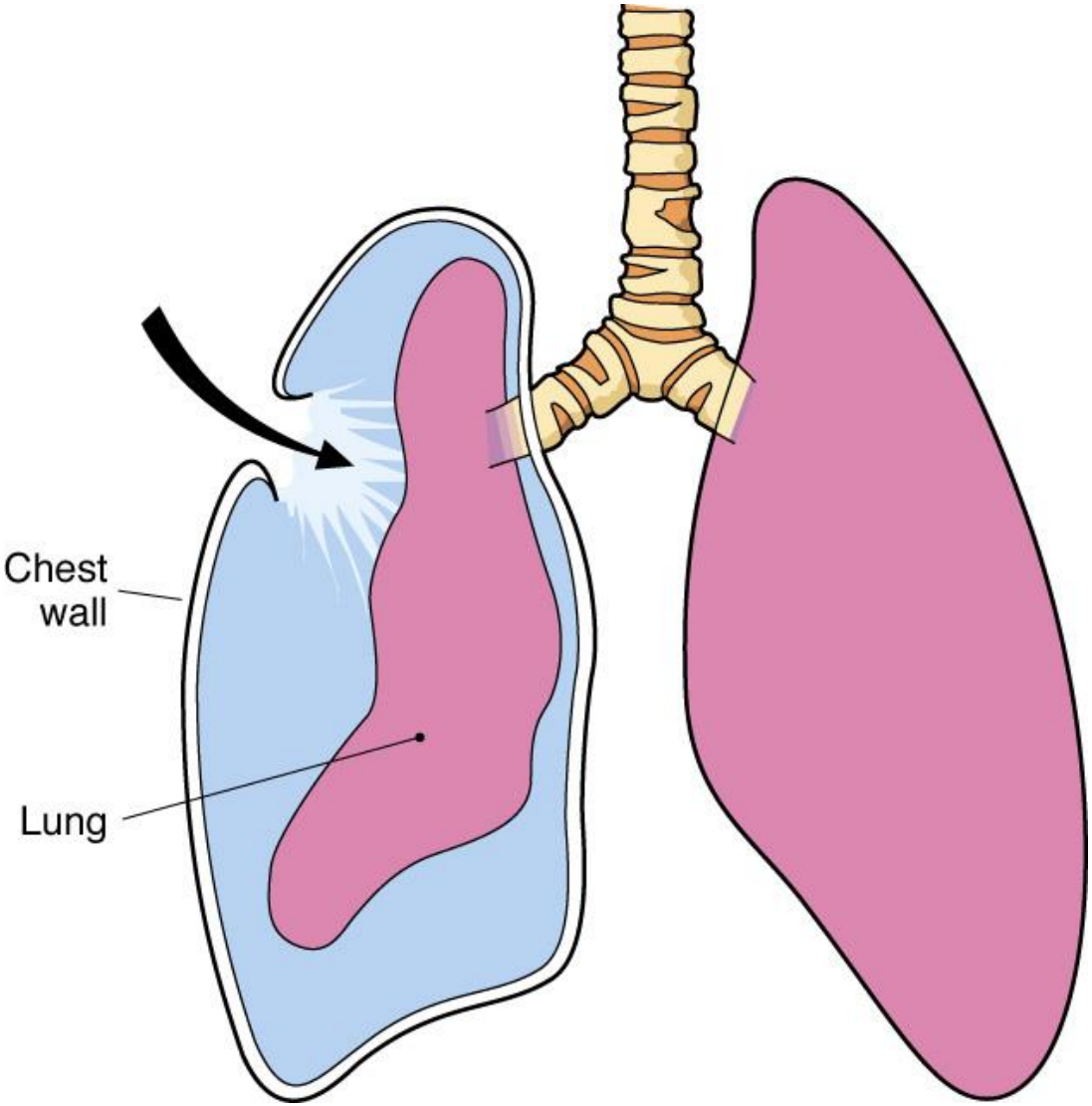
Open Pneumothorax



Tension Pneumothorax

- Progression of a simple or open pneumothorax
- Creates a on-way pressure valve within the thorax
- Generates/maintains pressure greater than atmospheric pressure
  - Reduces effectiveness of respiration
  - Air is unable to escape from inside the pleural space
  - Compresses on other structures in the chest

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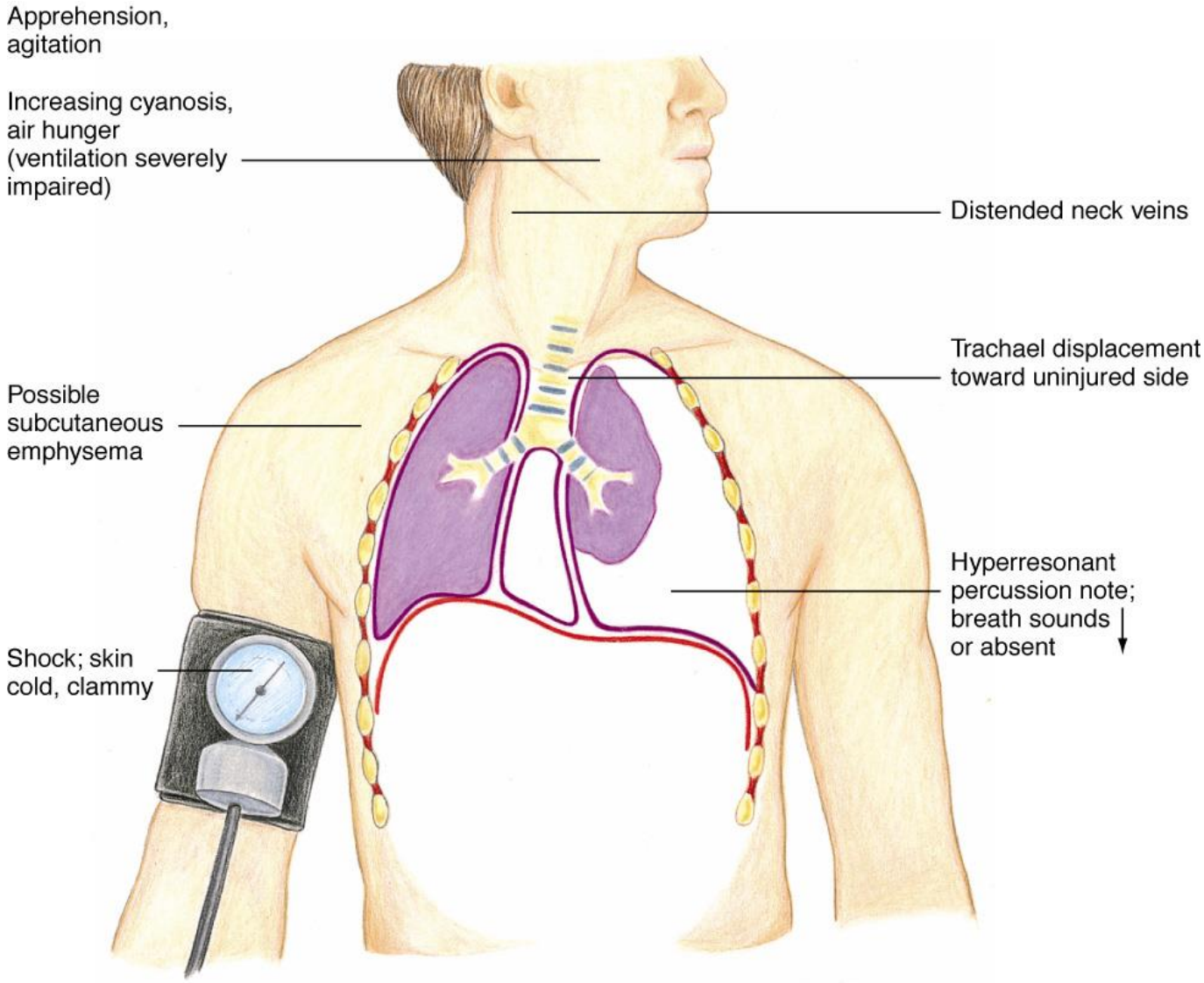
Physical findings of a tension pneumothorax



Sign and Symptoms

- Serious and immediate life-threat
- Dyspnea
  - Tachypnea at first
- Progressive ventilation/perfusion mismatch
  - Atelectasis on uninjured side
- Hypoxemia
- Hyperinflation of injured side of chest
- Hyperresonance of injured side of chest

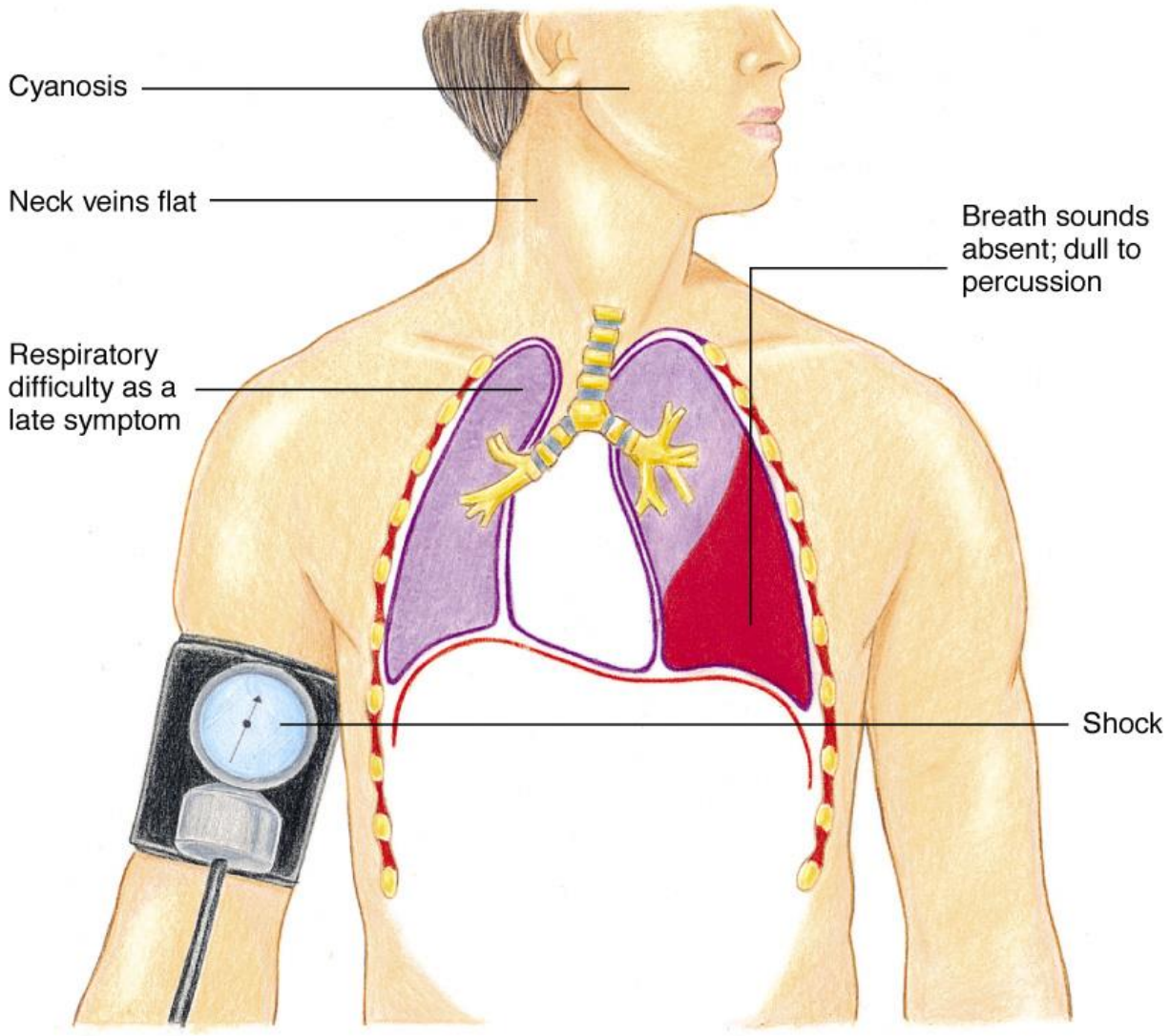
Sign and Symptoms

- Diminished then absent breath sounds on injured side
- Cyanosis
- Diaphoresis
- AMS
- JVD
- Hypotension
- Hypovolemia
- Tracheal shift (late sign)

Hemothorax

- Accumulation of blood in the pleural space
  - Serious hemorrhage may accumulate 1,500 mL of blood
  - Each side of thorax may hold up to 3,000 mL
- Mortality rate of 75%
- Blood loss in thorax causes a decrease in tidal volume
  - Ventilation/perfusion mismatch and shock
- Typically accompanies pneumothorax
  - Hemopneumothorax

Physical findings of a hemothorax



Sign and Symptoms

- Blunt or penetrating chest trauma
- Shock
  - Dyspnea
  - Tachycardia
  - Tachypnea
  - Diaphoresis
  - Hypotension (flat jugular veins)
- Dull to percussion over injured side

Pulmonary Contusion

- Soft tissue contusion of the lung
- 30-75% of patients with significant blunt chest trauma
- Frequently associated with rib fracture
- Microhemorrhage
  - May account for 1- 1 ½ L of blood loss in alveolar tissue
- Progressive deterioration of ventilatory status
- Hemoptysis typically present

Sign and Symptoms

- Blunt or penetrating chest trauma
- Increasing dyspnea
- Hypoxia
- Increasing crackles
- Diminishing breath sounds
- Hemotypsis
- Signs and symptoms of shock

Cardiovascular Injuries

- Subset of thoracic trauma that leads to the most fatalities
- Myocardial contusion
- Pericardial tamponade
- Myocardial aneurysm or rupture

Myocardial Contusion

- Occurs in 76% of patient with sever blunt thoracic trauma
- Heart is relatively mobile within the chest
  - Strikes the anterior chest during blunt trauma
  - May be compressed between sternum and thoracic spine
- Right atrium and ventricle is commonly injured
- Injury may reduce strength of cardiac contractions
  - Reduced cardiac output
- Electrical disturbances due to irritability of damaged myocardial cells

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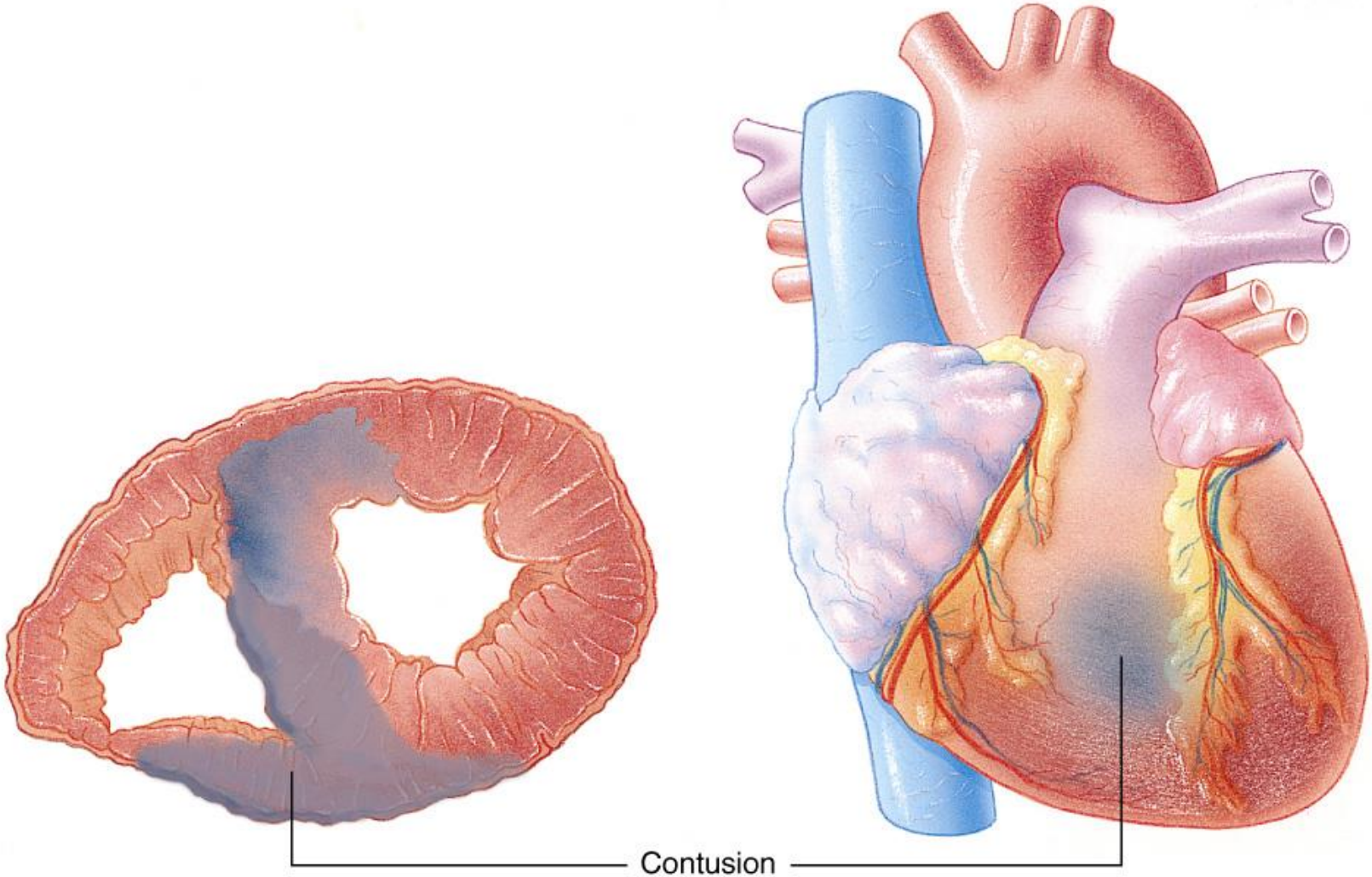
Myocardial Contusion



Myocardial Contusion

- Progressive Problems
  - Hematoma
  - Hemoperitoneum
  - Myocardial necrosis
  - Dysrhythmias
  - Heart failure and/or cardiogenic shock
- Signs and symptoms
  - Blunt injury to the chest
  - Bruising of chest wall
  - Rapid (irregular) heart rate
  - Severe nagging pain unrelieved by rest or oxygen

Pericardial Tamponade

- Restriction to cardiac filling caused by blood or other fluid within the pericardium
- Occurs in <2% of all serious chest trauma
  - Very high mortality
- Results from tear in the coronary artery or penetration of myocardium
  - Blood seeps into pericardium and is unable to escape
  - 200-300 ml of blood can restrict effectiveness of cardiac contractions
  - Removing as little as 20 ml can provide relief

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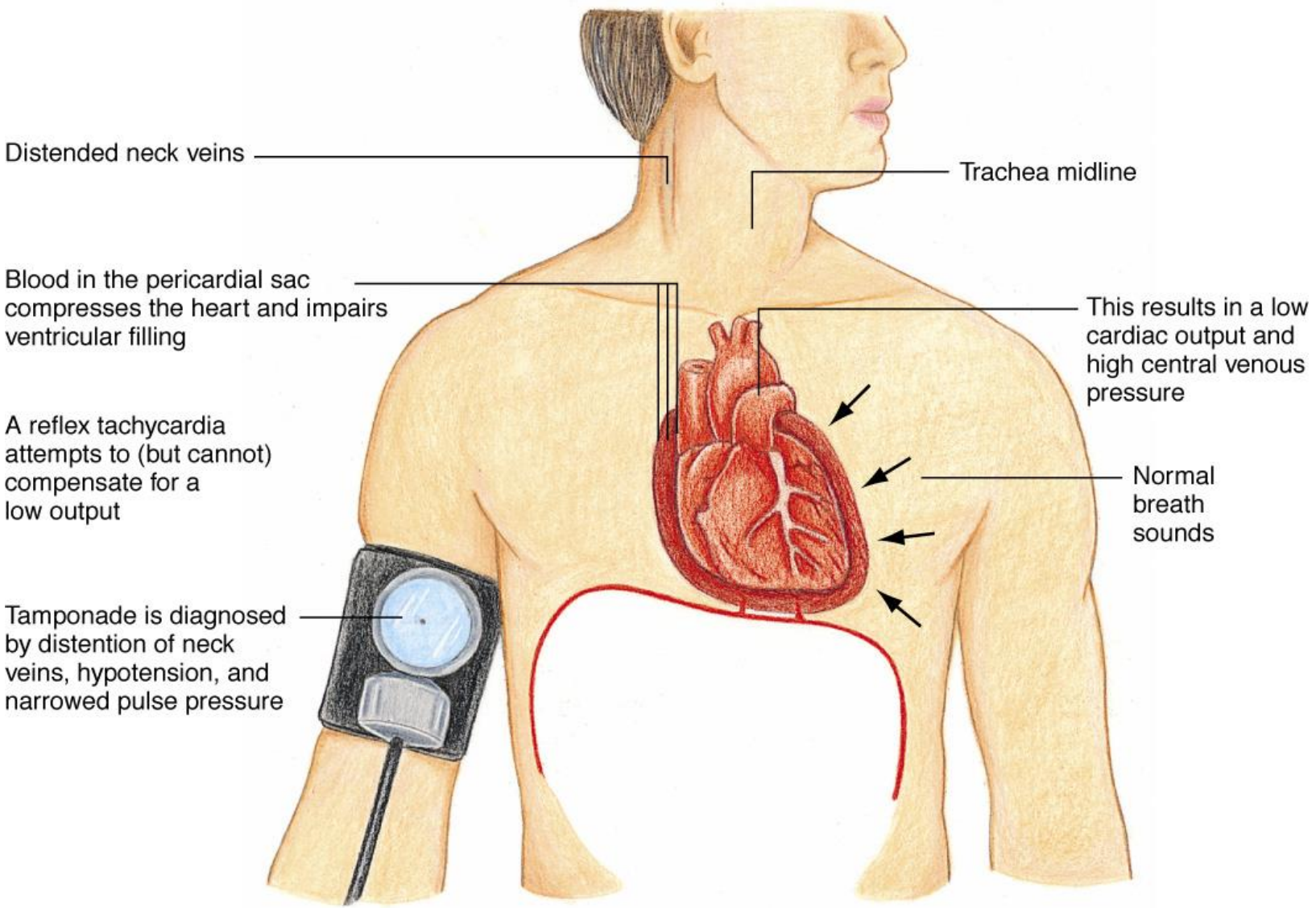
Physical findings of pericardial tamponade



Signs and Symptoms

- Dyspnea
- Possible cyanosis
- Beck's Triad
  - JVD
  - Distant heart sounds
  - Hypotension or narrowing pulse pressure
- Weak, thready pulse
- Shock

Signs and Symptoms

- Kussmaul's sign
  - Decrease or absence of JVD during inspiration
- Pulsus Paradoxus
  - Drop in SBP >10 during inspiration
  - Due to increase in CO2 during inspiration
- Electrical Alterans
  - P, QRS, & T amplitude changes in every other cardiac cycle
- PEA

Myocardial Aneurysm or Rupture

- Occurs almost exclusively with extreme blunt thoracic trauma
- Secondary due to necrosis resulting from MI
- Signs and symptoms
  - Severe rib or sternal fracture
  - Possible signs and symptoms of cardiac tamponade
  - Signs & symptoms of right or left heart failure
  - Absence of vital signs

Traumatic Aneurysm or Aortic Rupture

- Aorta most commonly injured in severe blunt or penetrating trauma
  - 85-95% mortality
- Typically patients will survive the initial injury insult
  - 30% mortality in 6 hrs
  - 50% mortality in 24 hrs
  - 70% mortality in 1 week
- Injury may be confined to areas of aorta attachment
- Signs & Symptoms
  - Rapid and deterioration of vitals
  - Pulse deficit between right and left upper or lower extremities

Other Vascular Injuries

- Rupture or laceration
  - Superior vena cava
  - Inferior vena cava
  - General thoracic vasculature
- Blood localizing in mediastinum
- Compression of:
  - Great vessels
  - Myocardium
  - Esophagus
- General signs and symptoms
  - Penetrating trauma
  - Hypovolemia and shock
  - Hemothorax or hemomediastinum

FIGURE 25-16 Penetrating stab wound to the chest involving the heart.

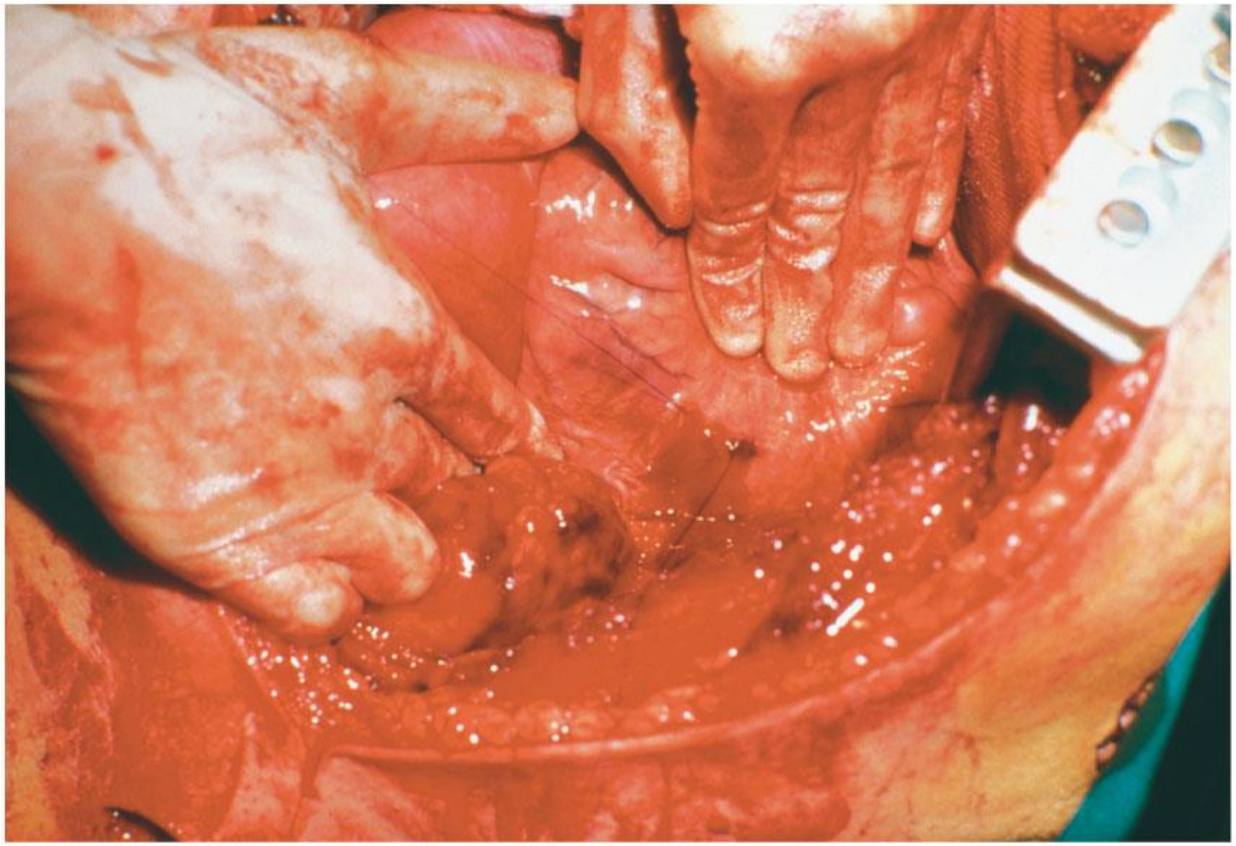


FIGURE 25-17 Stab wound that penetrated the pericardium.

Diaphragmatic Rupture

- Occurs in high pressure blunt chest trauma and penetrating trauma
- Most common in patients with lower chest injury
- Most often occurs on left side
- Similar to tension presentation as pneumothorax

Signs and Symptoms

- Herniation of abdominal organs into thorax
- Restriction of ipsilateral lung
- Displacement of mediastinum
- Abdomen may appear hollow
- Bowel sounds may be noted in thorax
- Dyspnea, hypotension & JVD

Traumatic Esophageal Rupture

- Rare complication of blunt thoracic trauma
- 30% mortality
- Contents in esophagus/stomach may move into mediastinum
  - Serious Infection occurs
  - Chemical irritation
  - Damage to mediastinal structures
  - Air enters mediastinum
  - Subcutaneous emphysema and penetrating trauma present

Tracheobronchial Injury

- 50% of patients with injury die within 1 hr of injury
- Disruption can occur anywhere in tracheobronchial tree
- Signs and symptoms
  - Dyspnea
  - Cyanosis
  - Hemoptysis
  - Massive subcutaneous emphysema
  - Suspect/evaluate for other closed chest trauma

Traumatic Asphyxia

- Results from severe compressive forces applied to the thorax
- Causes backwards flow of blood from right side of heart into superior vena cava and the upper extremities
- Signs and symptoms
  - Head and neck become engorged with blood
  - Skin becomes deep red, purple, or blue
  - Not respiratory related
  - JVD
  - Hypotension, hypoxemia, shock
  - Face and tongue swollen
  - Bulging eyes with conjunctival hemorrhage

Assessment of Thoracic Trauma

- Scene assessment
- Primary assessment
- Rapid trauma assessment
  - Observe
    - JVD, SQ Emphysema, Expansion of chest
  - Question
  - Palpate
  - Auscultate
- Ongoing assessment

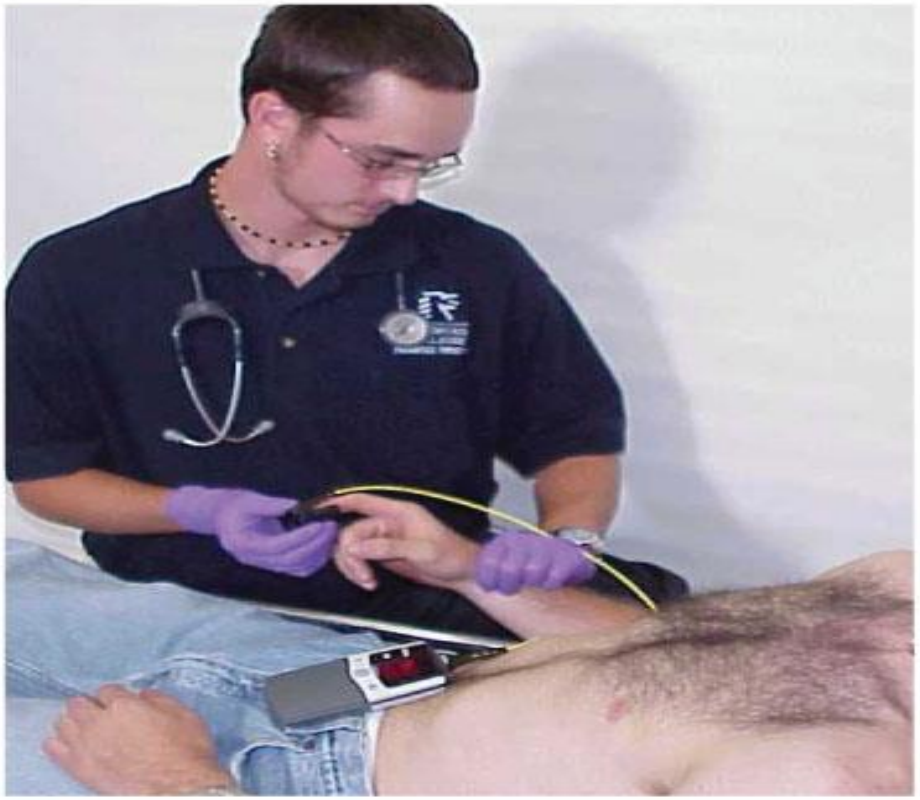


FIGURE 25-18 With pulse oximetry, you can continuously monitor the percentage of the patient's oxygen saturation.

FIGURE 25-13 Carefully palpate the thorax of a patient with a suspected injury to the region.

FIGURE 25-14 Place your hands on the lower thorax, and let them rise and fall with respiration.

Auscultate frequently

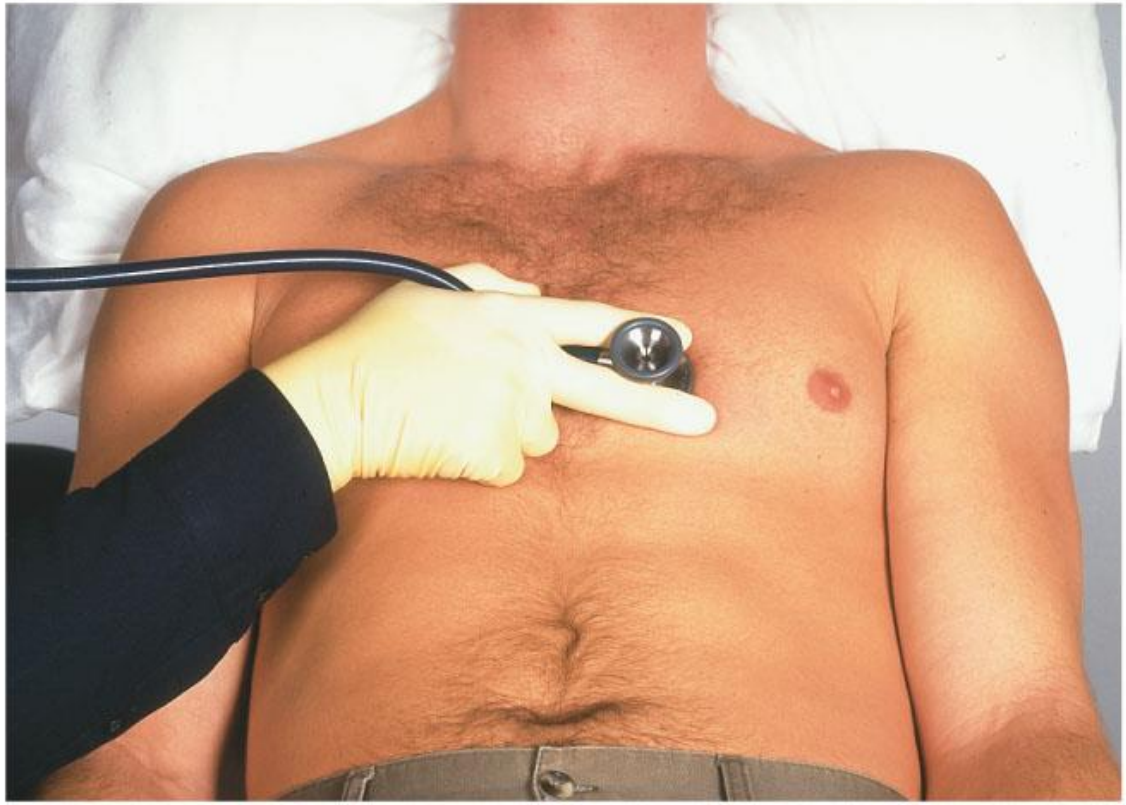


FIGURE 25-15 Auscultate all lung lobes, both anteriorly and posteriorly.

General Management

- Ensure ABC's
  - High flow O_2 via NRB
  - Intubate if indicated
    - Consider RSI
  - Consider overdrive ventilation
    - If minute volume less than 6,000 mL
    - BVM at a rate of 12-16
  - May be beneficial for chest contusion and rib fractures
  - Promotes oxygen perfusion of alveoli and prevents atelectasis

General Management

- Anticipate myocardial compromise
- Shock management
- Serial auscultation
- Specific procedures
  - Needle decompression
  - Pericardiocentesis

Management

- Rib fractures
  - Supportive O_2 therapy
  - Consider analgesics for pain and to improve chest excursion
- Sternoclavicular Dislocation
  - Supportive O_2 therapy
  - Evaluate for concomitant injury

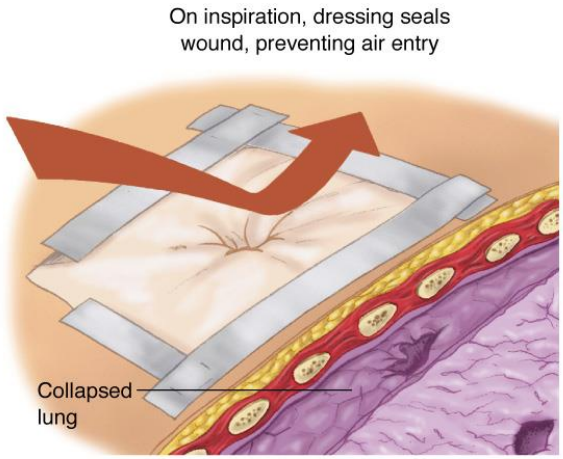
Management

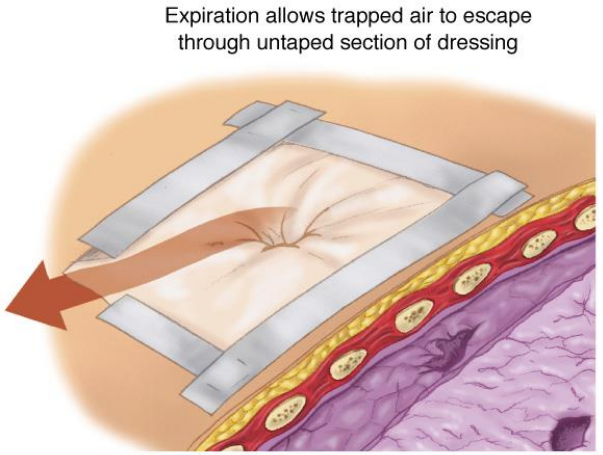
- Flail Chest
  - Place patient on side of injury
    - Only if spinal injury is not suspected
  - Expose injury site
  - Dress with bulky bandage against flail segment
    - Gentle splinting
    - Stabilizes fracture site
    - Sandbags are contraindicated
  - High flow O_2
  - Consider PPV or ET if decreasing respiratory status

FIGURE 25-19 Flail chest should be treated with administration of oxygen and gentle splinting of the flail segment with a pillow or pad.

Management

- Open Pneumothorax
  - High flow O_2
  - Cover site with sterile occlusive dressing taped on three sides
  - Progressive airway management if indicated





Tension Pneumothorax

- Confirmation
  - Auscultation and physical signs
- Oxygen therapy
  - Consider overdrive ventilations/intubation
- Pleural Decompression
  - 2nd intercostal space in mid-clavicular line
  - Top of the third rib
  - Consider multiple decompression sites if patient remains symptomatic
  - Large over the needle catheter: 14 ga
  - Create a one-way-valve: Glove tip or Heimlich valve

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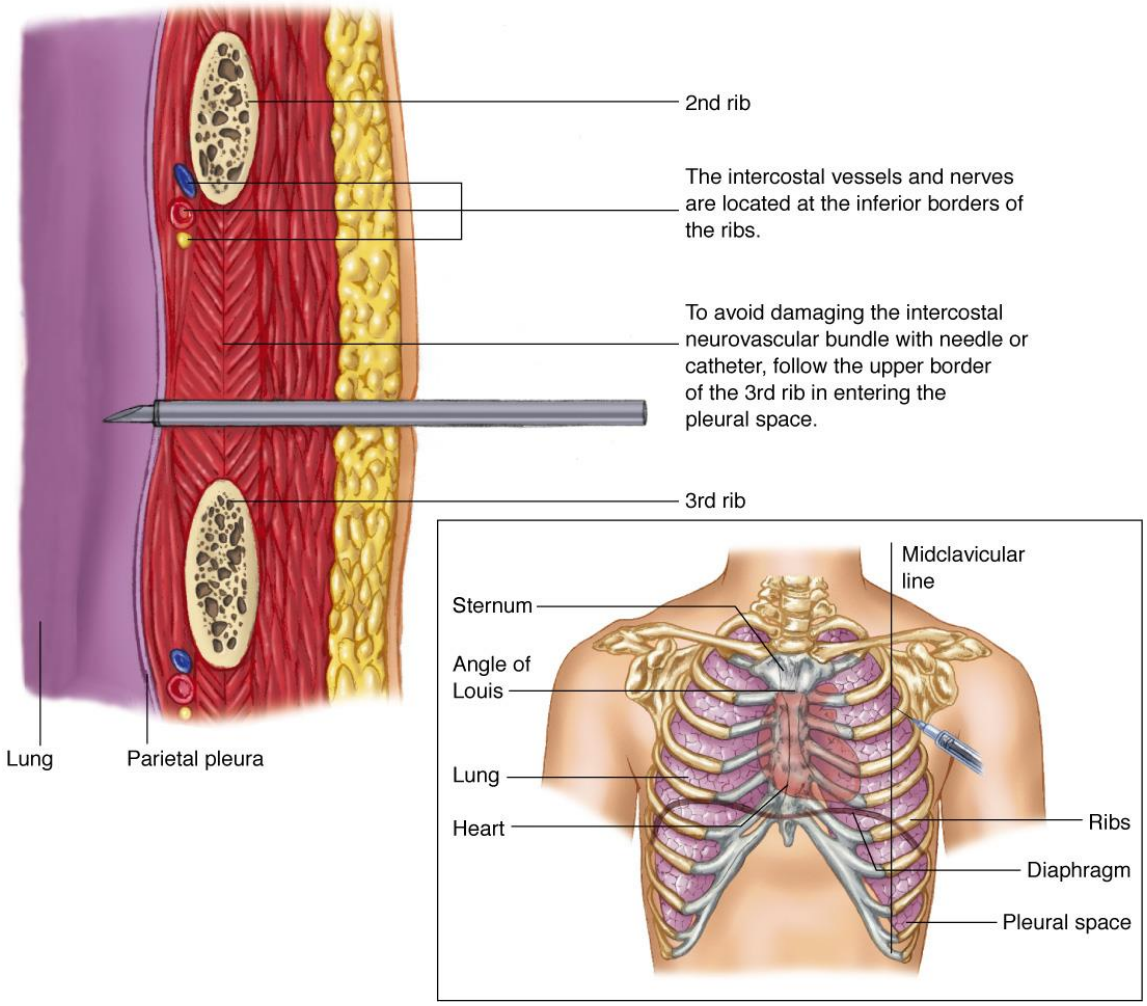
Needle Decompression



Management

- Hemothorax
  - Supportive O_2 therapy
  - Fluid resuscitation
  - Evaluate breath sounds for fluid overload
- Myocardial Contusion
  - Monitor ECG
  - Alert for dysrhythmias
  - IV if antidysrhythmics are needed

Management

- Pericardial Tamponade
  - Supportive O_2 therapy
  - IV therapy
  - Consider pericardiocentesis if within scope/skill
- Aortic Aneurysm
  - Avoid jarring or rough handling
  - Initiate IV therapy enroute
    - Mild hypotension may be protective
    - Rapid fluid bolus if aneurysm ruptures
  - Keep patient calm

Management

- Tracheobronchial Injury
  - Airway management/consider intubation
  - Supportive O_2 therapy
  - Observe for development of tension pneumothorax and SQ emphysema
- Traumatic Asphyxia
  - Support airway
  - Supportive O_2 therapy, consider PPV with BVM
  - 2 large bore IV's
  - Evaluate and treat for concomitant injuries
  - Consider Sodium Bicarbonate for patients trapped