

The Dirty Dozen



Beyond the Basics of Thoracic Trauma

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Thoracic Trauma

Objectives

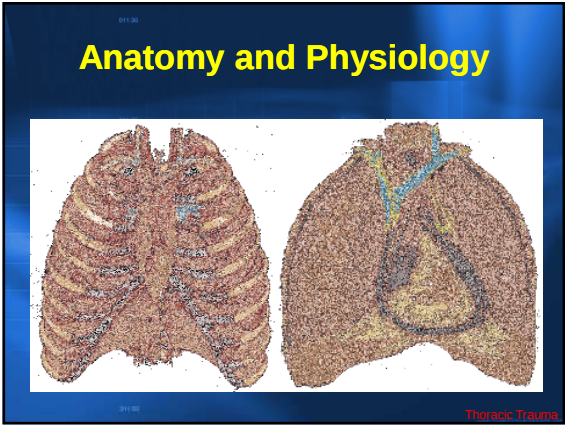
- ✦ Review the epidemiology of thoracic trauma.
- ✦ Review the pathophysiology of thoracic trauma resulting from blunt and penetrating mechanisms.
- ✦ Discuss and describe clinical syndromes in various types of thoracic trauma.
- ✦ Discuss current treatment and management of the various types of thoracic trauma.

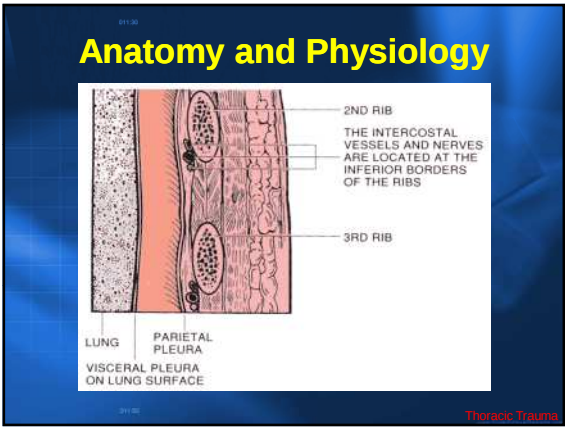
Thoracic Trauma

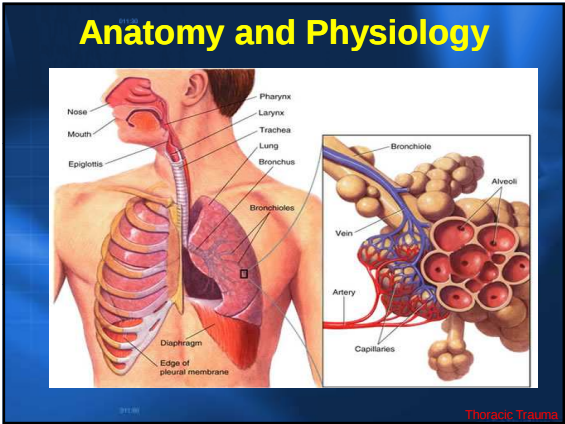
Epidemiology

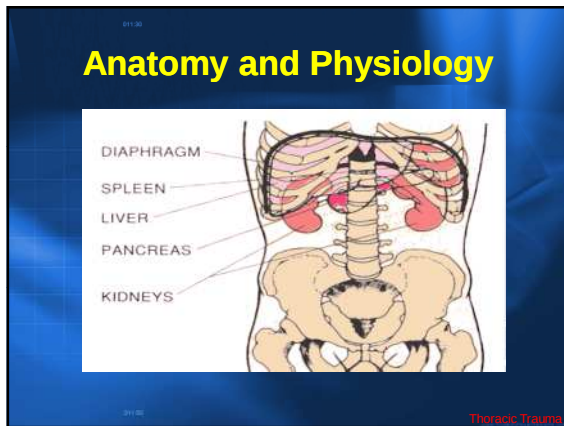
- ✦ Second leading cause of trauma deaths
- ✦ 25% of all trauma deaths
- ✦ 45 – 50% of unrestrained drivers have thoracic injuries
- ✦ 50% of all trauma patients have associated thoracic injuries
- ✦ 2/3 reach the Emergency Department alive
- ✦ Only 15% require surgery

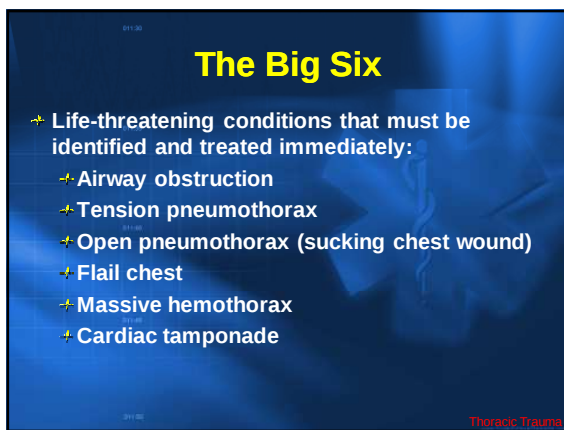
Thoracic Trauma

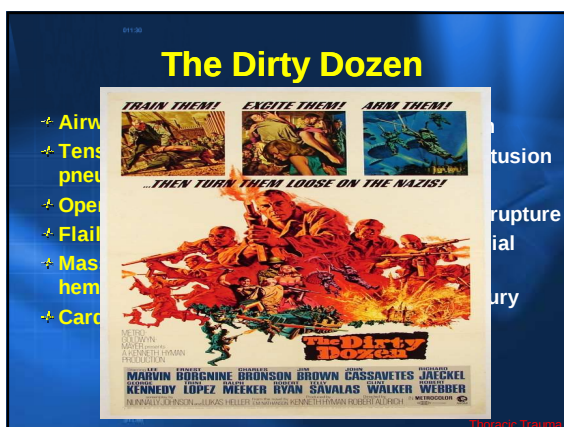


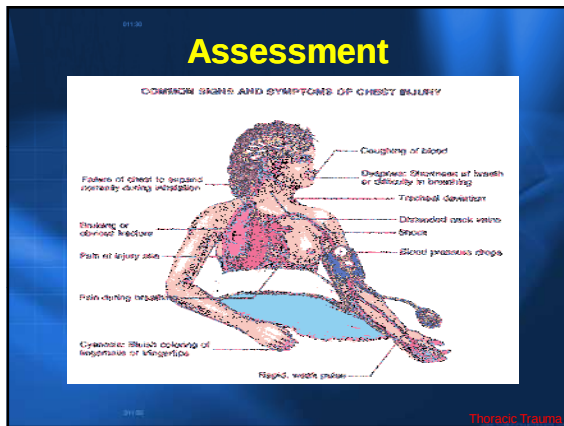




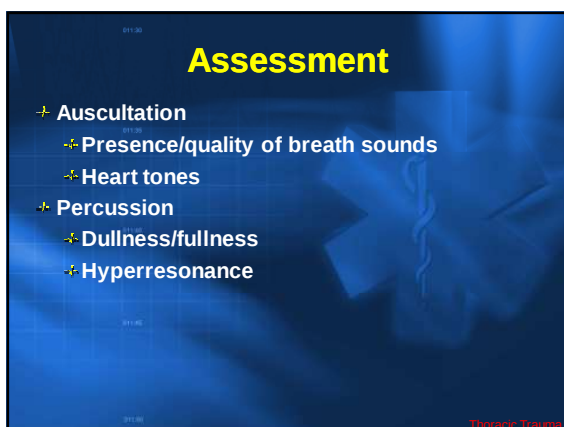












Airway Obstruction

- + Follow the Airway Continuum
 - + Suction
 - + BLS adjuncts
 - + Supraglottic airways
 - + Endotracheal intubation
 - + Cricthyoidotomy



Remember, supraglottic airways only manage a supraglottic obstruction!

Thoracic Trauma

Management

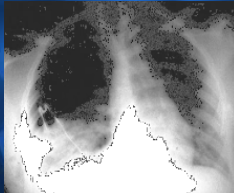
- + The Gold Standard of airway management is not a tool, it's an outcome.
- + The goal is effective oxygenation and ventilation.



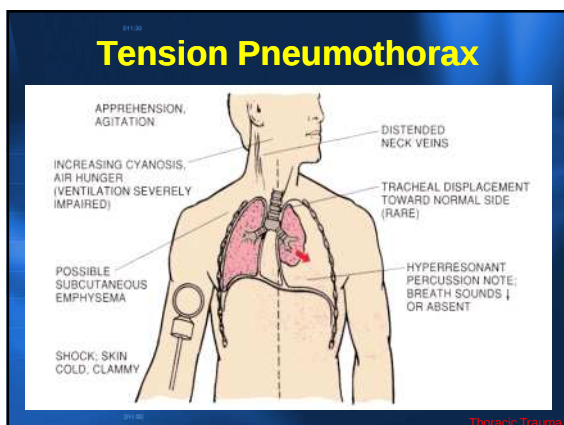
Thoracic Trauma

Tension Pneumothorax

- + Blunt or penetrating trauma
- + Hypoventilation
 - + Hypoxia
 - + Hypercapnea
- + Cardiovascular compromise
 - + Shock
 - + Cardiovascular collapse
- + Life-threatening if not treated early



Thoracic Trauma



Simple Pneumothorax vs Tension Pneumothorax

Simple	Tension
✦ Degree of hypoxia directly related to size of lung area affected	✦ Severe hypoxia
✦ Responds well to supplemental oxygen	✦ Worsens despite supplemental oxygen
✦ Little or no hemodynamic compromise	✦ Poor ventilatory compliance
✦ Requires no EMS intervention other than oxygenation	✦ Severe hemodynamic compromise
	✦ Life-threatening if not treated immediately

Thoracic Trauma

Likely Assessment Findings

- ✦ Severe respiratory distress
- ✦ Restlessness, anxiety, agitation
- ✦ Decreased or absent breath sounds
- ✦ Shock
- ✦ Subcutaneous emphysema
 - ✦ Axillae
 - ✦ Neck
- ✦ Cardiovascular collapse
 - ✦ Tachycardia
 - ✦ Weak pulse
 - ✦ Hypotension
 - ✦ Narrow pulse pressure

Thoracic Trauma

Unlikely Assessment Findings

- ✦ Jugular venous distension
 - ✦ absent if also hypovolemic
- ✦ Hyper-resonance to percussion
- ✦ Contralateral tracheal deviation
 - ✦ Late sign
 - ✦ Subtle finding
- ✦ Cyanosis (late)

Thoracic Trauma

Progression of Tension Pneumothorax

- ✦ **Early**
 - ✦ Unilaterally decreased breath sounds
 - ✦ Worsening dyspnea despite treatment
- ✦ **Middle:**
 - ✦ Increased respirations
 - ✦ Subcutaneous emphysema
 - ✦ Poor ventilatory compliance
- ✦ **Late:**
 - ✦ Jugular venous distention
 - ✦ Tracheal deviation
 - ✦ Acute hypoxia
 - ✦ Narrowing pulse pressure
 - ✦ Decompensated shock

Thoracic Trauma



Pathophysiology

- + Air trapped in pleural space from damaged lung or chest wall
- + Pressure collapses ipsilateral lung
- + Contralateral mediastinal shift
- + Reduction in cardiac output
 - + Increased intrathoracic pressure
 - + Vena cava kinks, reducing preload



Thoracic Trauma

Management

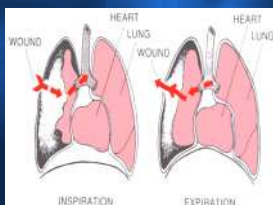
- + Maintain airway
 - + Consider ETI
- + High flow O₂
- + Ventilate PRN
- + Needle thoracentesis
 - + 2nd or 3rd ICS
 - + Angle of Louis
 - + No flutter valve necessary
 - + Catheter length < 2 inches resulted in failure to reach pleural cavity in 65% of cases
- + Treat shock



Thoracic Trauma

Open Pneumothorax

- + Penetrating trauma
- + Sucking chest wounds
 - + Air enters pleural space via hole in chest wall
 - + Hole has to be large to suck air
- + Impaled objects
- + Avulsed wounds and open rib fractures due to blunt or crushing trauma.



Thoracic Trauma

Assessment

- + Opening in the chest wall
- + Sucking sound on inhalation
- + Tachycardia
- + Tachypnea
- + Respiratory distress
- + SQ emphysema
- + Decreased lung sounds on affected side



Thoracic Trauma

Pathophysiology

- + Allows communication between pleural space and atmosphere
- + Prevents development of negative intrathoracic pressure
 - + Profound hypoventilation
 - + V/Q mismatch
 - + Shunting
 - + hypoxia
 - + large functional dead space
- + Pressure may build within pleural space
- + Return from Vena cava may be impaired
- + Results in ipsilateral lung collapse due to ineffective ventilation

Thoracic Trauma

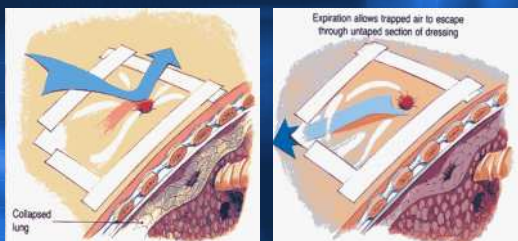
Management

- + Occlusive dressing
- + High flow O₂
- + Assisted ventilations PRN
- + Be alert for tension pneumothorax
 - + Burp dressing
 - + Needle decompression



Thoracic Trauma

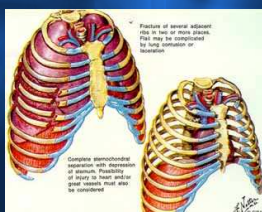
Management



Thoracic Trauma

Flail Chest

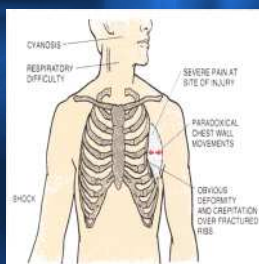
- + 3 or more ribs broken in 2 or more places
- + Free floating segment of chest wall
- + Paradoxical motion
- + Pulmonary contusion
- + Mortality rate 20-40% due to associated injuries



Thoracic Trauma

Assessment Findings

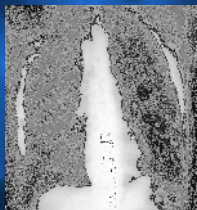
- + Chest wall contusion
- + Respiratory distress
- + Pleuritic chest pain
- + Splinting of affected side
- + Crepitus
- + Tachypnea, tachycardia
- + Paradoxical movement (possible)



Thoracic Trauma

Pathophysiology

- ✦ Impairment of bellows system
- ✦ Inadequate diaphragmatic movement
- ✦ Pain and increased work of breathing
- ✦ Intra-alveolar bleeding
- ✦ Hypoventilation:
 - ✦ Hypoxia
 - ✦ Hypercapnea



Thoracic Trauma

Management

- ✦ Suspect spinal injuries
- ✦ Establish airway
- ✦ High flow O₂
- ✦ Assisted ventilations
 - ✦ Treat hypoxia
 - ✦ Promote full lung expansion
 - ✦ Consider ETI and PEEP
- ✦ Mechanical stabilization does not work



Thoracic Trauma

Massive Hemothorax

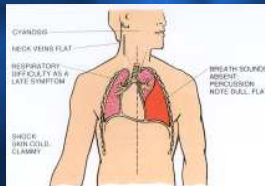
- ✦ If due to great vessel or cardiac injury:
 - ✦ 50% die immediately
 - ✦ 25% live 5-10 minutes
 - ✦ 25% may live > 30 minutes
- ✦ Blood loss results in
 - ✦ Hypovolemia
 - ✦ Decreased ventilation of affected lung



Thoracic Trauma

Assessment Findings

- ✦ Tachypnea /dyspnea
- ✦ Tachycardia
- ✦ Shock
 - ✦ Directly correlates to amount of blood loss
- ✦ Pleuritic chest pain
- ✦ Decreased lung sounds
- ✦ Collapsed neck veins
- ✦ Dullness on percussion
- ✦ Bleeding may be severe enough to mimic tension pneumothorax



Thoracic Trauma

Pathophysiology

- ✦ Accumulation of blood in pleural space
 - ✦ Each side can hold up to 3000 ml blood
- ✦ Penetrating or blunt lung injury
 - ✦ Laceration of:
 - ✦ Chest wall vessels
 - ✦ intercostal vessels
 - ✦ Myocardium
- ✦ Massive hemothorax indicates great vessel or cardiac injury
- ✦ Intercostal artery can bleed 50 cc/min
- ✦ Results in collapse of lung

Thoracic Trauma

Management

- ✦ Establish airway
- ✦ High flow O₂
- ✦ Assisted ventilation PRN
- ✦ Needle thoracentesis if tension suspected
- ✦ Chest tube or surgery in hospital



Thoracic Trauma

Cardiac Tamponade

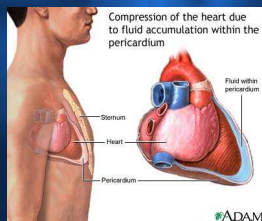
- + Rapid accumulation of blood in the inelastic pericardium
- + Usually associated with penetrating trauma
- + Rare in blunt trauma
- + Occurs in < 2% of thoracic trauma
- + GSW wounds have higher mortality than stab wounds
- + Lower mortality rate if isolated tamponade



Thoracic Trauma

Assessment

- + **Beck's Triad (hallmark sign)**
 - + Hypotension
 - + Jugular venous distension
 - + Muffled heart sounds
- + Narrowing pulse pressure
- + Pulsus paradoxus
 - + Radial pulse weakens on inhalation
- + Pulsus alternans
- + Electrical alternans



Thoracic Trauma

Electrical Alternans



Thoracic Trauma

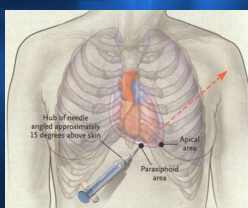
Pathophysiology

- ✦ Heart is compressed, resulting in:
 - ✦ Impairment of Frank Starling mechanism
 - ✦ Decreased preload
 - ✦ Decreased stroke volume
- ✦ Myocardial perfusion decreased due to
 - ✦ pressure effects on walls of heart
 - ✦ decreased diastolic pressures
- ✦ Ischemic dysfunction may result in injury
- ✦ Removal of as little as 20 ml of blood may drastically improve cardiac output

Thoracic Trauma

Management

- ✦ Secure airway
- ✦ High flow O₂
- ✦ Pericardiocentesis
 - ✦ Rarely done by EMS, primarily reserved for cardiac arrest
 - ✦ Needle-guided
 - ✦ Echocardiogram-guided
 - ✦ Removal of as little as 20 ml blood can improve CO greatly



Thoracic Trauma

Pulmonary Contusion

- ✦ Blunt trauma to the chest from:
 - ✦ Rapid deceleration forces
 - ✦ High energy shock waves
 - ✦ high velocity projectiles
 - ✦ Low velocity projectile
- ✦ Most common injury from blunt thoracic trauma
- ✦ 30-75% of blunt trauma
- ✦ Mortality 14-20%



Thoracic Trauma

Assessment Findings

- ✦ Tachypnea or respiratory distress
- ✦ Tachycardia
- ✦ Evidence of blunt chest trauma
- ✦ Cough and / or hemoptysis
- ✦ Apprehension
- ✦ Cyanosis

Thoracic Trauma

Pathophysiology

- ✦ Rib fractures in many but not all cases
 - ✦ Rib fractures less common in children
- ✦ Alveolar rupture with hemorrhage and edema
 - ✦ increased capillary membrane permeability
- ✦ Large vascular shunts develop
 - ✦ Gas exchange disturbances
 - ✦ Hypoxemia
 - ✦ Hypercapnea

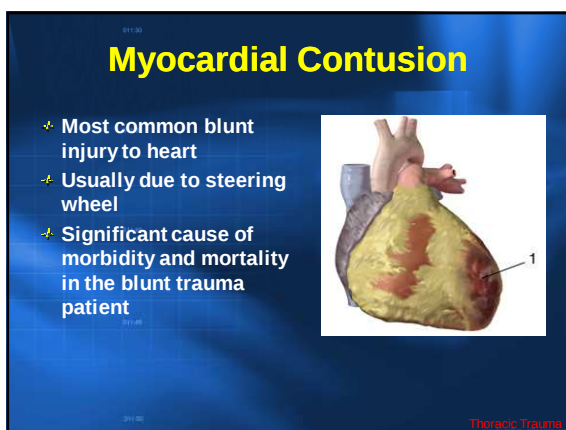
Thoracic Trauma

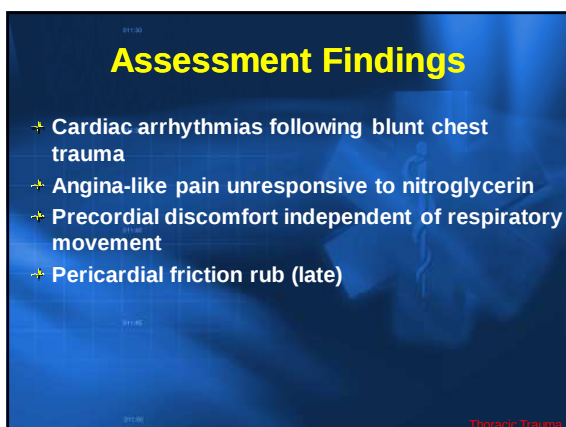
Management

- ✦ Supportive therapy
- ✦ Early use of positive pressure ventilation reduces ventilator therapy duration
- ✦ Avoid aggressive crystalloid infusion
- ✦ Severe cases may require ventilator therapy
- ✦ Emergent transport

Thoracic Trauma

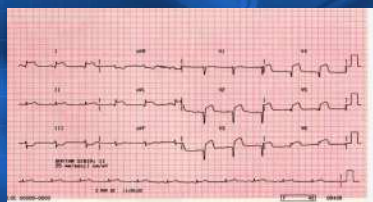






EKG Findings

- + Persistent tachycardia
- + ST elevation, T wave inversion
- + Atrial flutter or fibrillation
- + RBBB
- + PVCs
- + PACs



Thoracic Trauma

Management

- + Establish airway
- + High flow O₂
- + Be cautious with fluid boluses
- + 12 Lead ECG if time permits
- + Standard antiarrhythmic therapy as needed
- + Consider vasopressors for hypotension
- + Emergent transport

Thoracic Trauma

Aortic Dissection

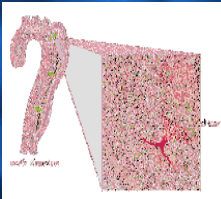
- + 15% of all blunt trauma deaths
- + 1 of 6 MVC fatalities had aortic rupture
 - + 85% die on scene
 - + 10-15% survive to hospital
 - + 1/3 die within 6 hours
 - + 1/3 die within 24 hours
 - + 1/3 survive 3 days or longer



Thoracic Trauma

Assessment Findings

- ✦ Retrosternal or interscapular pain
- ✦ Pain in lower back or one leg
- ✦ Respiratory distress
- ✦ Asymmetrical perfusion
 - ✦ BP difference between arms
 - ✦ Ipsilateral pulse deficit
- ✦ Upper extremity hypertension with
 - ✦ Decreased femoral pulses, OR
 - ✦ Absent femoral pulses
- ✦ Dysphagia



Thoracic Trauma

Pathophysiology

- ✦ Separation of the tunica intima and media
 - ✦ Tears due to high-speed deceleration
 - ✦ Descending aorta at the isthmus distal to left subclavian artery is most common site
 - ✦ Fixation point – ligamentum arteriosum
- ✦ Blood enters tunica media through a small intimal tear
 - ✦ Forms a false lumen between layers
 - ✦ Lumen expands and lengthens with each beat
- ✦ Rupture results in circulatory collapse within seconds

Thoracic Trauma

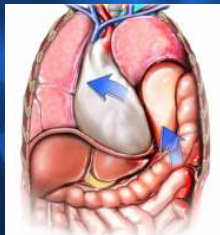
Management

- ✦ Establish airway
- ✦ High flow O₂
- ✦ Vascular access, *but...*
- ✦ ... NS at TKO rate only!
- ✦ ... the only fluid you should bolus is diesel!
- ✦ Transport to trauma center with vascular surgery



Thoracic Trauma

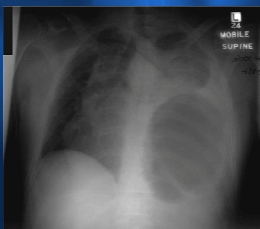
Diaphragmatic Herniation



Thoracic Trauma

Assessment Findings

- + Decreased breath sounds
 - + Usually unilateral
 - + Dullness to percussion
- + Dyspnea
- + Scaphoid abdomen (hollow appearance)
- + Suspect with lower rib fractures
- + Bowel sounds resemble a diesel engine



Thoracic Trauma

Pathophysiology

- + Compression to abdomen resulting in increased intra-abdominal pressure
 - + Abdominal contents rupture through diaphragm into chest
 - + Bowel obstruction and strangulation
 - + Restriction of lung expansion
 - + Mediastinal shift
- + 90% occur on left side due to protection of right side by liver

Thoracic Trauma

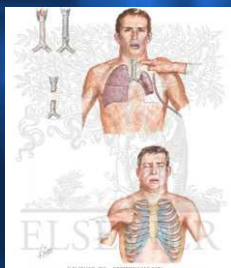
Management

- ✦ Establish airway
- ✦ Assist ventilations with high flow O₂
- ✦ Vascular access
- ✦ Monitor ECG
- ✦ Nasogastric tube if possible
 - ✦ Distal tip in pleural space on CXR is diagnostic
- ✦ Avoid
 - ✦ PASG
 - ✦ Trendelenburg

Thoracic Trauma

Tracheobronchial Rupture

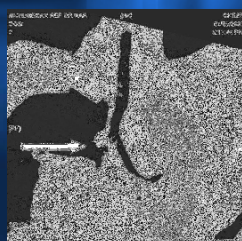
- ✦ < 3% of thoracic trauma
- ✦ Blunt or penetrating injury
- ✦ High mortality rate (>30%)
- ✦ Associated with fracture of upper 3 ribs



Thoracic Trauma

Assessment Findings

- ✦ Tachypnea
- ✦ Dyspnea
- ✦ Obvious SQ emphysema
- ✦ Bright red hemoptysis
- ✦ Signs of tension pneumothorax unresponsive to needle decompression



Thoracic Trauma

Pathophysiology

- ✦ Majority (80%) occur at or near carina
- ✦ Rapid movement of air into pleural space
- ✦ Tension pneumothorax refractory to needle decompression
- ✦ Continuous flow of air from needle of decompressed chest

Thoracic Trauma

Management

- ✦ Establish airway
- ✦ Assisted ventilation
- ✦ Consider early ETI
- ✦ Intubate the mainstem bronchus!



Thoracic Trauma

Esophageal Injury

- ✦ Penetrating injury most frequent cause
 - ✦ Iatrogenic (Boerhaave Syndrome)
 - ✦ Rare in blunt trauma
- ✦ Can perforate spontaneously
 - ✦ Violent emesis (Mallory Weiss tear)
 - ✦ Carcinoma

Thoracic Trauma

Assessment Findings

- ✦ Pain and local tenderness
- ✦ Hoarseness and dysphagia
- ✦ Respiratory distress
- ✦ Resistance of neck on passive motion
- ✦ Mediastinal esophageal perforation
 - ✦ Mediastinal emphysema
 - ✦ Mediastinitis
 - ✦ Pneumomediastinum
 - ✦ SQ emphysema
 - ✦ Splinting of chest wall
- ✦ Shock

Management

- ✦ Establish airway
 - ✦ ETI
 - ✦ Avoid supraglottic airways
- ✦ IV crystalloids titrated to BP 90-100 systolic
- ✦ Emergent transport
 - ✦ Trauma center with surgical capability

Summary

- ✦ Thoracic trauma results in significant morbidity and mortality.
- ✦ Rapid recognition and treatment of the Big Six can save lives.
- ✦ Airway management and ventilation are the keys to proper care.





