SOCIETY OF TRAUMA NURSES

THE ELECTRONIC LIBRARY OF

TRAUMA LECTURES

THE ELECTRONIC LIBRARY OF

TRAUMA LECTURES

Thoracic Trauma

SOCIETY OF TRAUMA NURSES

Objectives

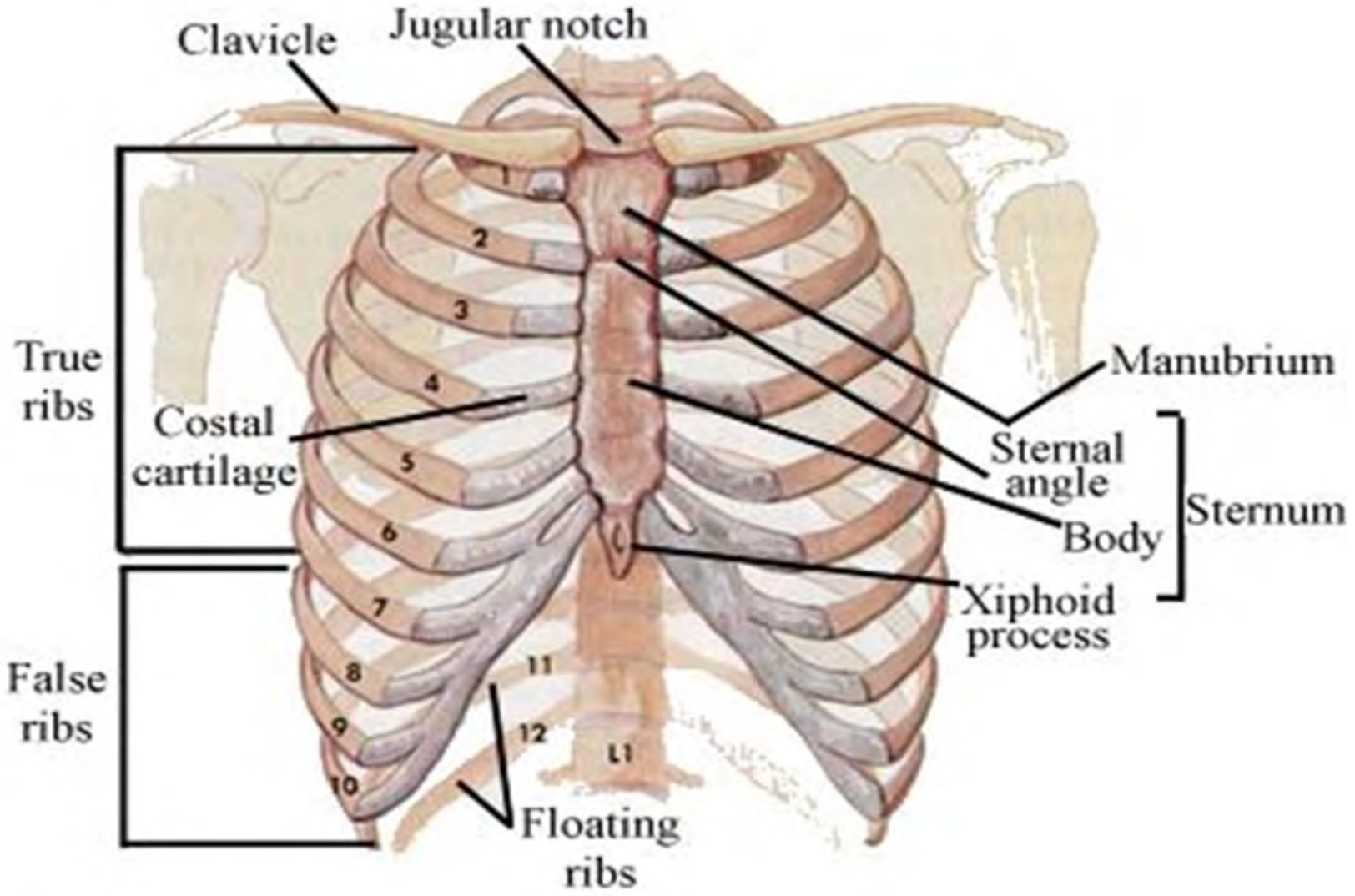
At the conclusion of this presentation the participant will be able to:

- Identify anatomy within the thorax
- List life-threatening injuries that should be identified during the primary survey
- Describe resuscitative interventions for patients with thoracic trauma
- Explain clinical manifestations associated with life-threatening injuries
- Identify general treatment for patients with thoracic trauma

Incidence

- Common in blunt and penetrating trauma
- Some of the most deadly and dramatic injuries
- Early recognition and treatment are crucial
- Basic interventions can save lives

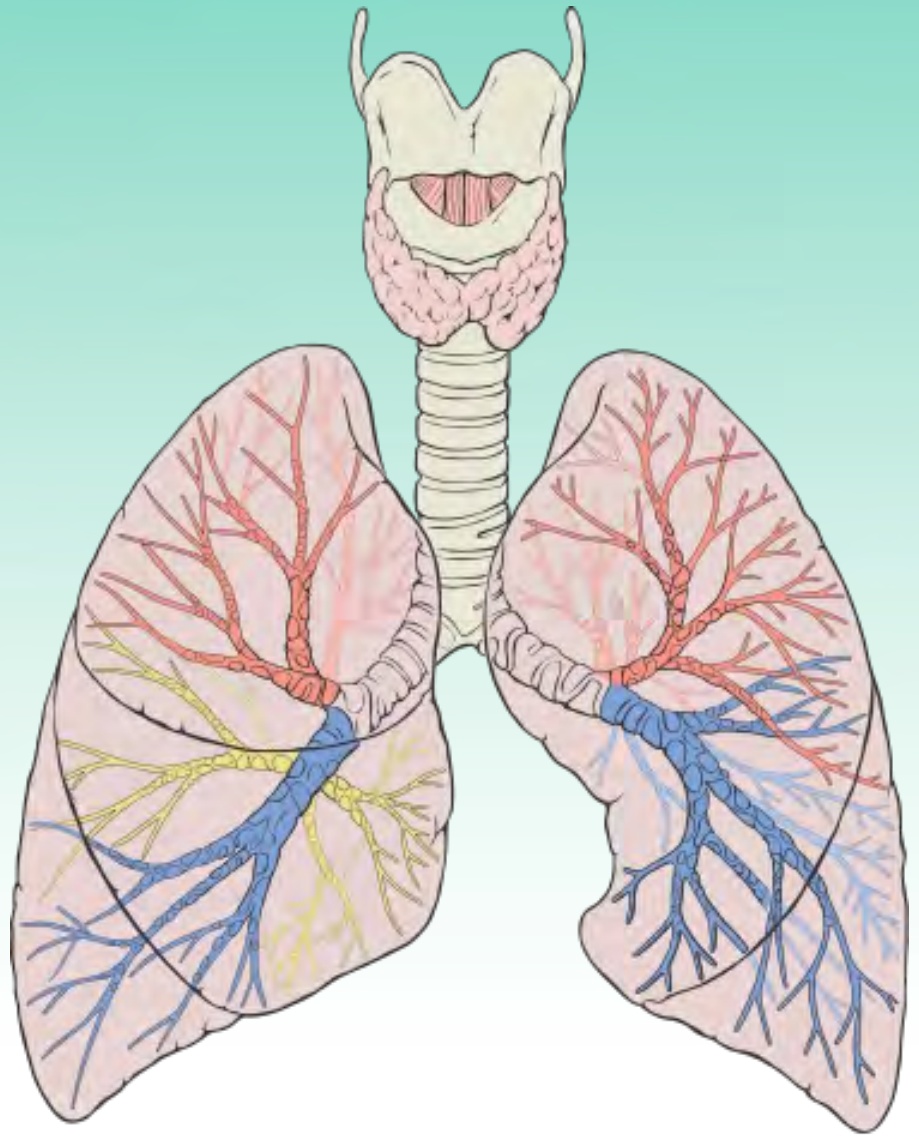
Thoracic Anatomy



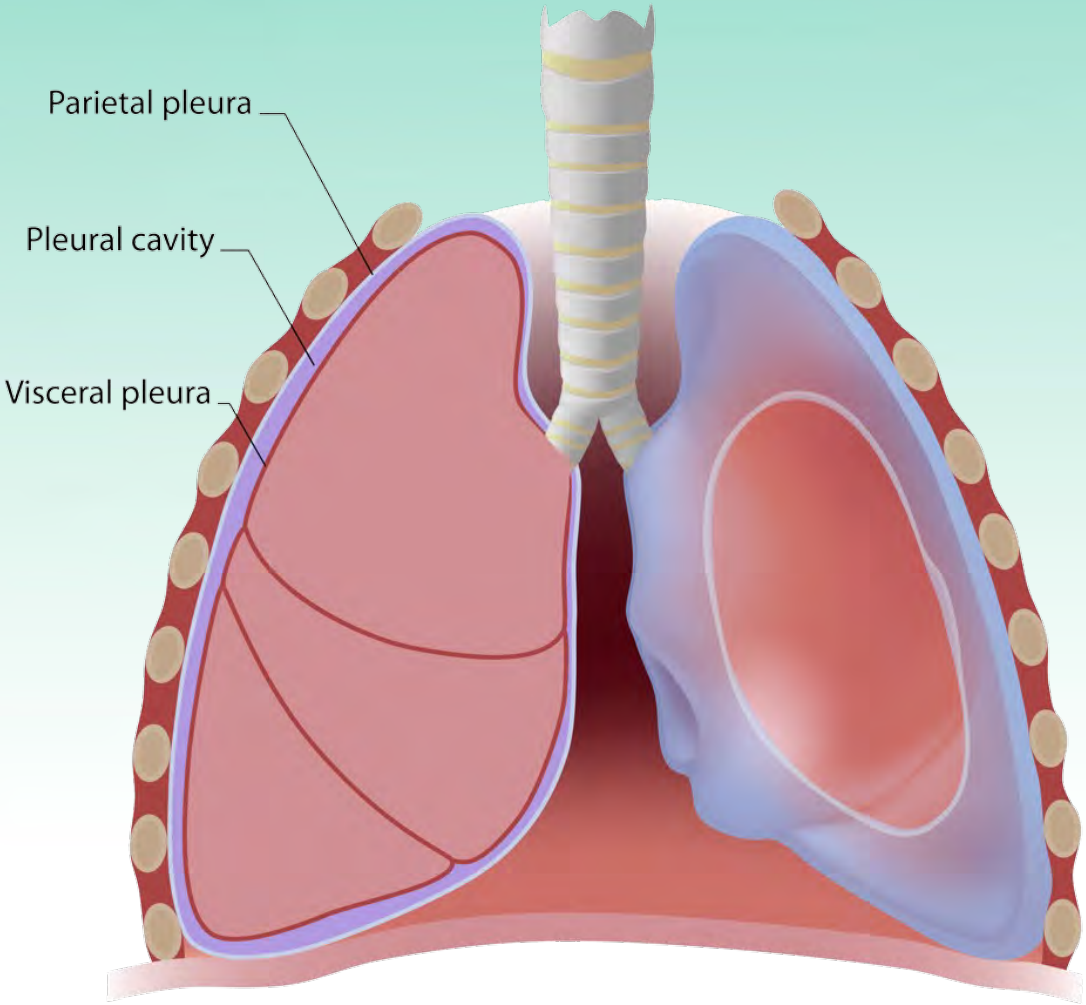
http://www.daviddarling.info/encyclopedia/R/rib-cage.html

Lungs

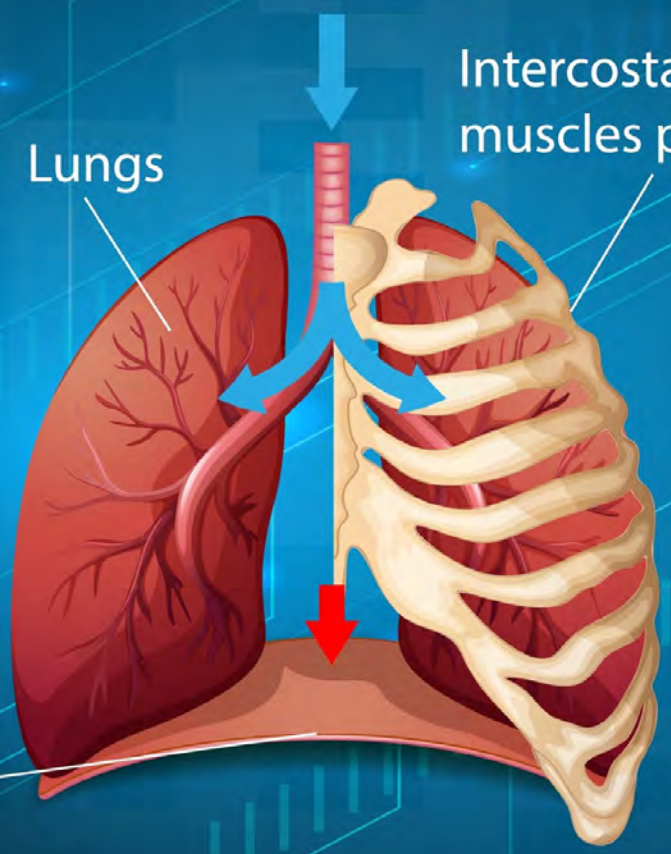
- Cone shaped organs
- Separated by heart and pulmonary vessels
- Hilum is entry point for bronchi and blood vessels



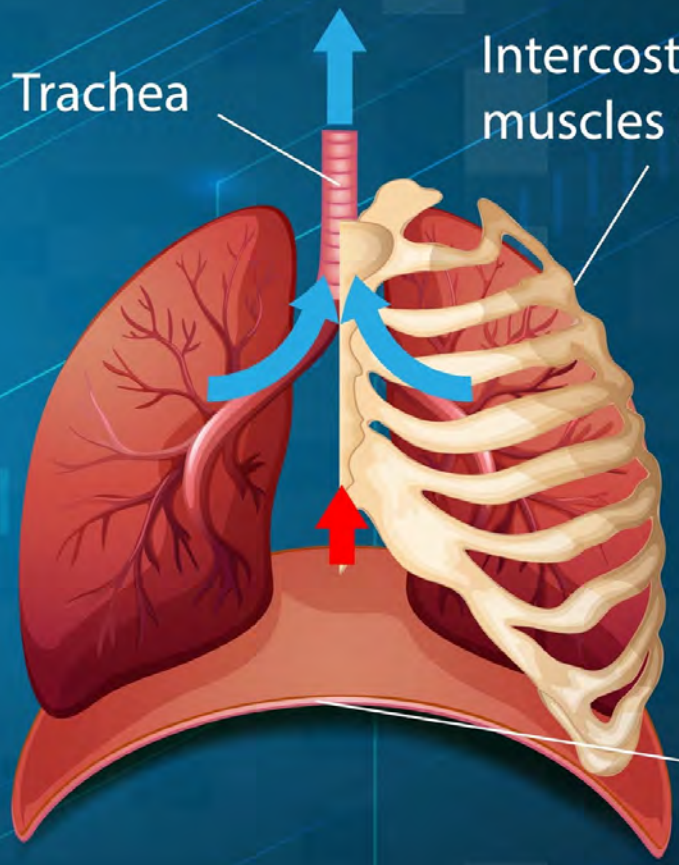
Pleura



THE DIAPHRAGM FUNCTIONS IN BREATHING



Inhalation



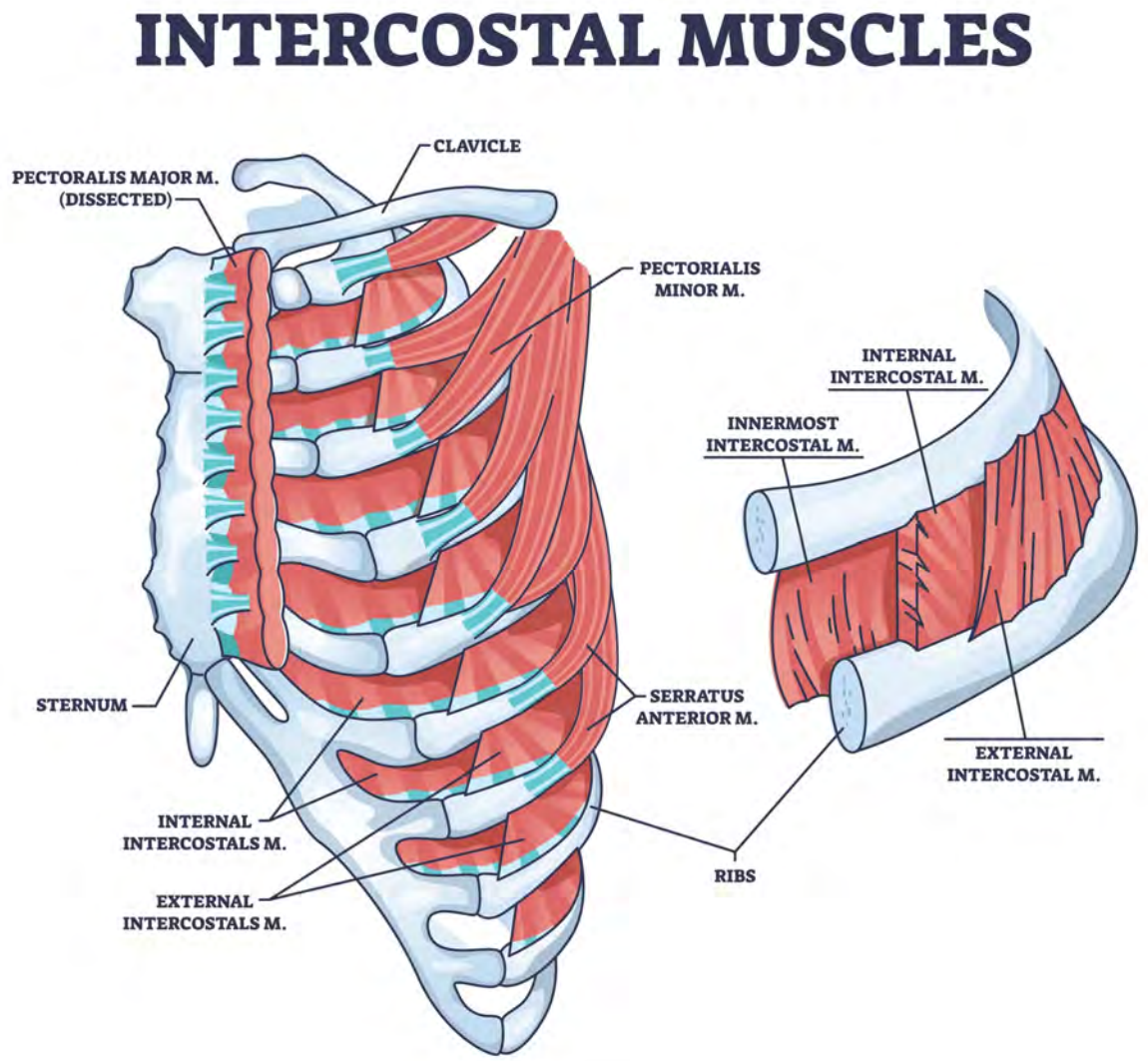
Exhalation

Muscles of Ventilation

Rib cage muscles

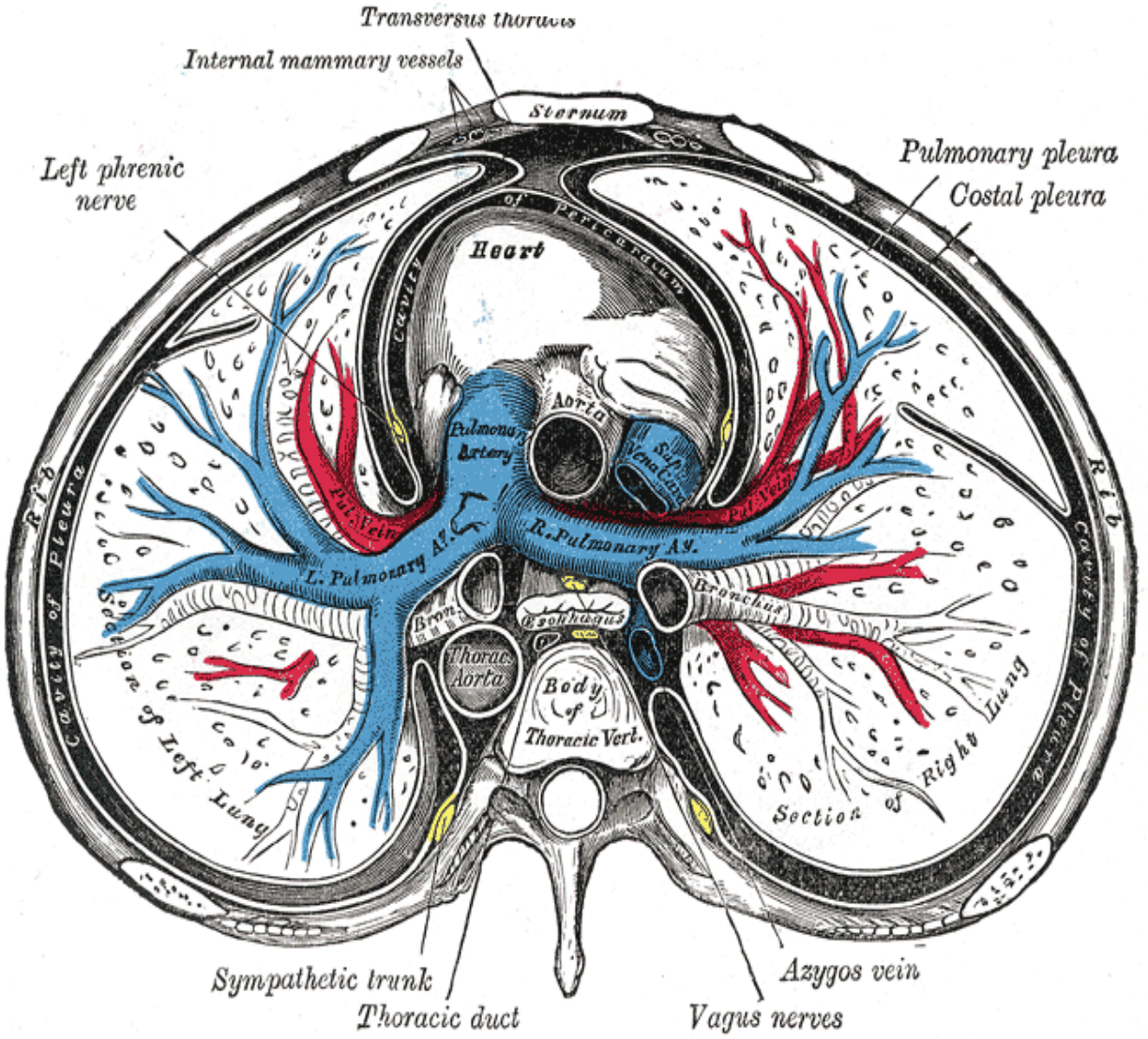
- **Intercostal muscles**
  - External & internal
  - Lift ribs to enlarge thorax
  - Innervated by intercostal nerves
- **Parasternal muscles**
- **Scalene and neck**

Abdominal muscles



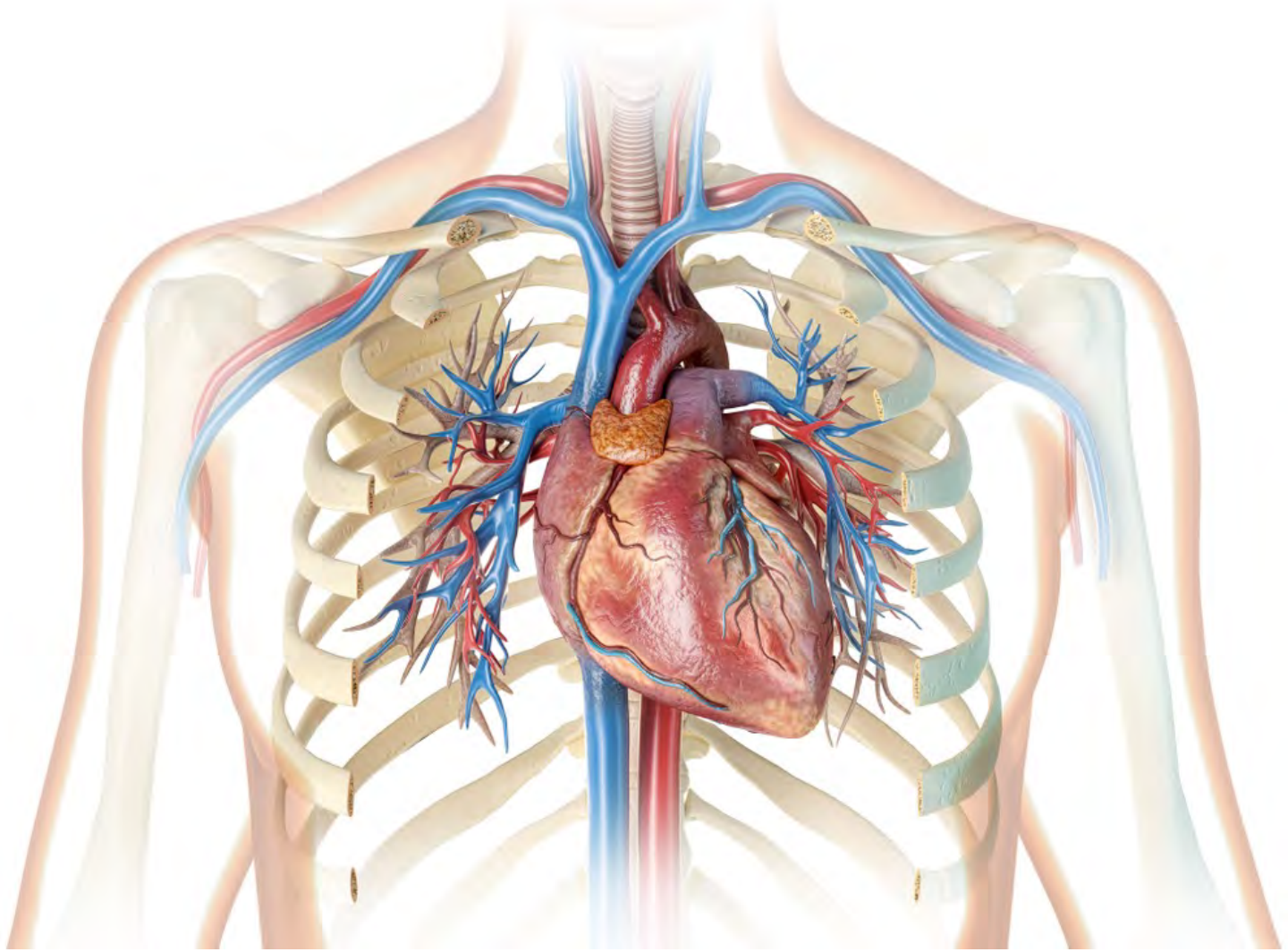
Mediastinum

- Heart
- Thymus
- Great Vessels
- Trachea
- Thoracic duct
- Lymph nodes
- Vagus & phrenic nerves
- Sympathetic trunks

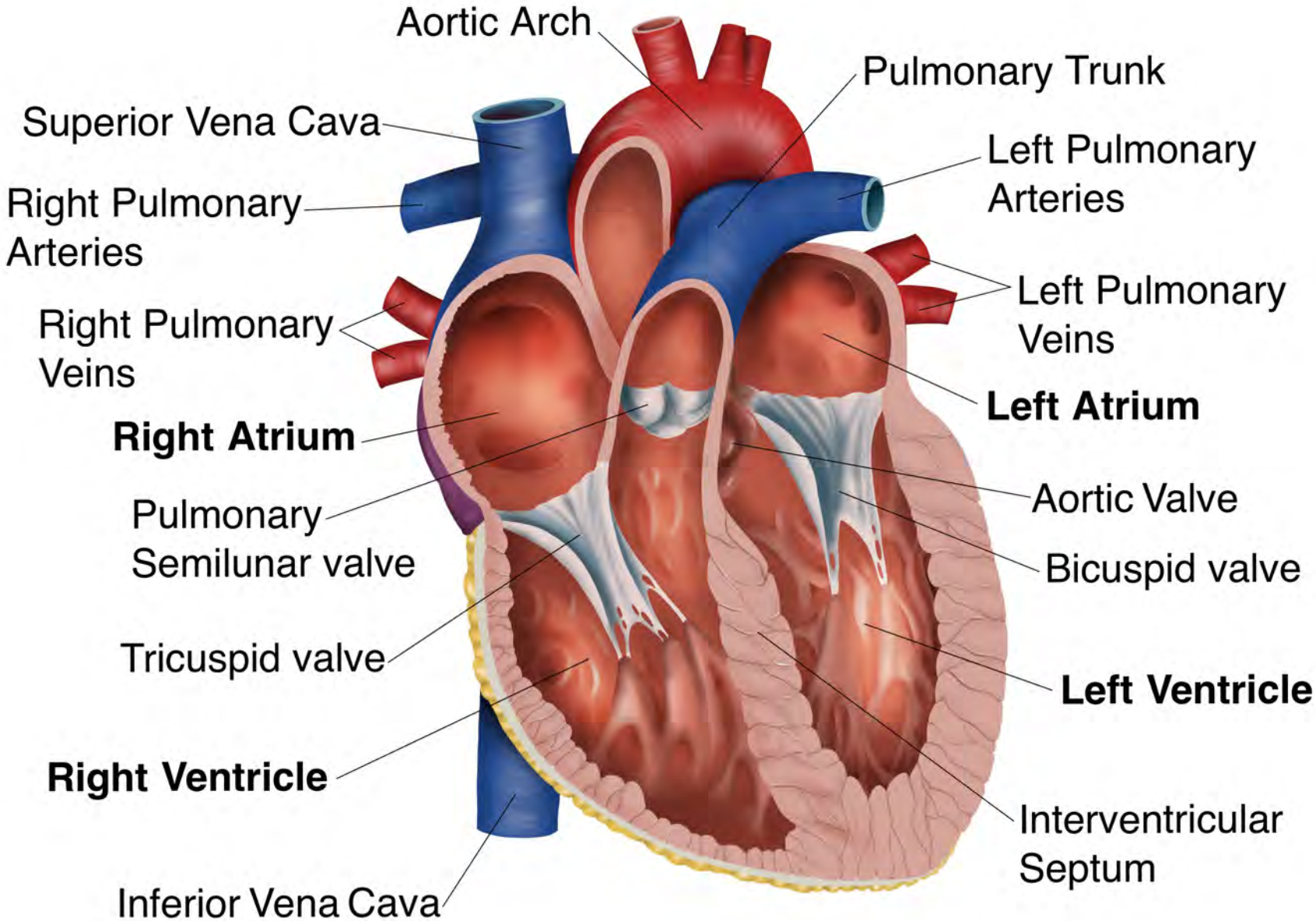


By Henry Vandyke Carter - Henry Gray (1918) Anatomy of the Human Body, https://commons.wikimedia.org/w/index.php?curid=519720

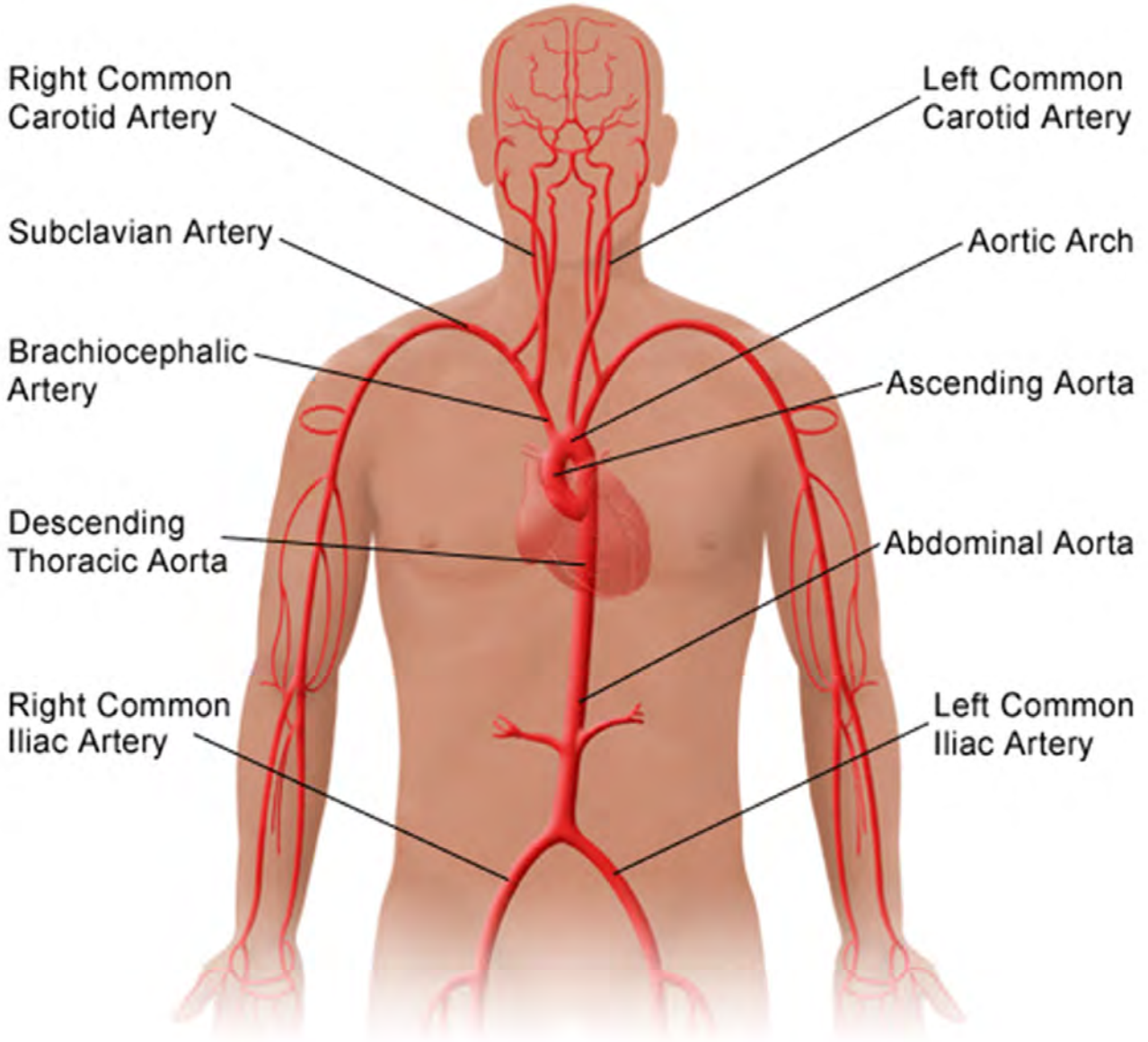
Heart and Great Vessels



- Heart
- Aorta
- Subclavian
- Jugular

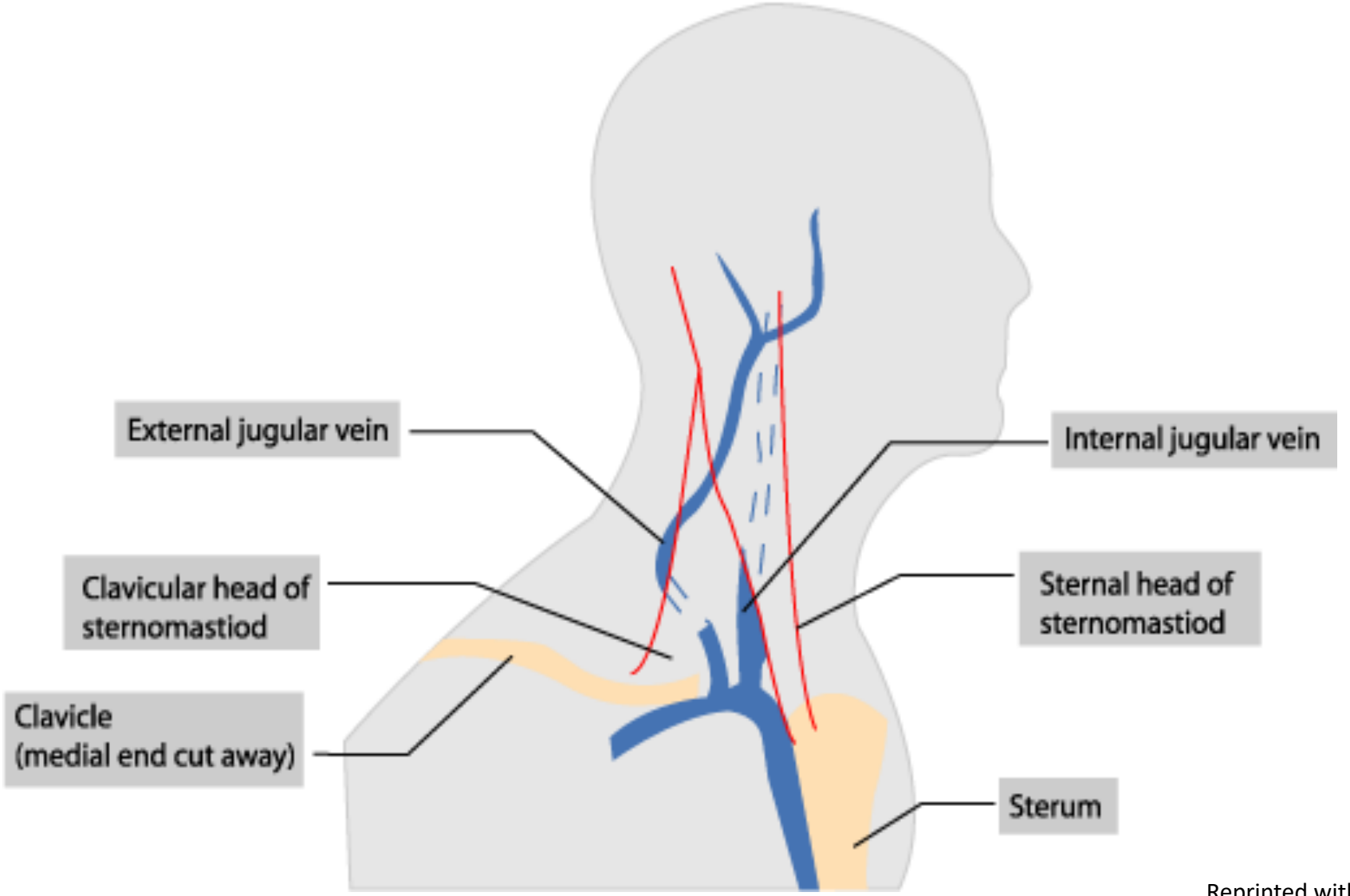

Aortic Arch
Pulmonary Trunk
Superior Vena Cava
Left Pulmonary Arteries
Right Pulmonary Arteries
Left Pulmonary Veins
Right Pulmonary Veins
Left Atrium
Right Atrium
Aortic Valve
Pulmonary Semilunar valve
Bicuspid valve
Tricuspid valve
Left Ventricle
Right Ventricle
Interventricular Septum
Inferior Vena Cava

Anatomy of the Aorta



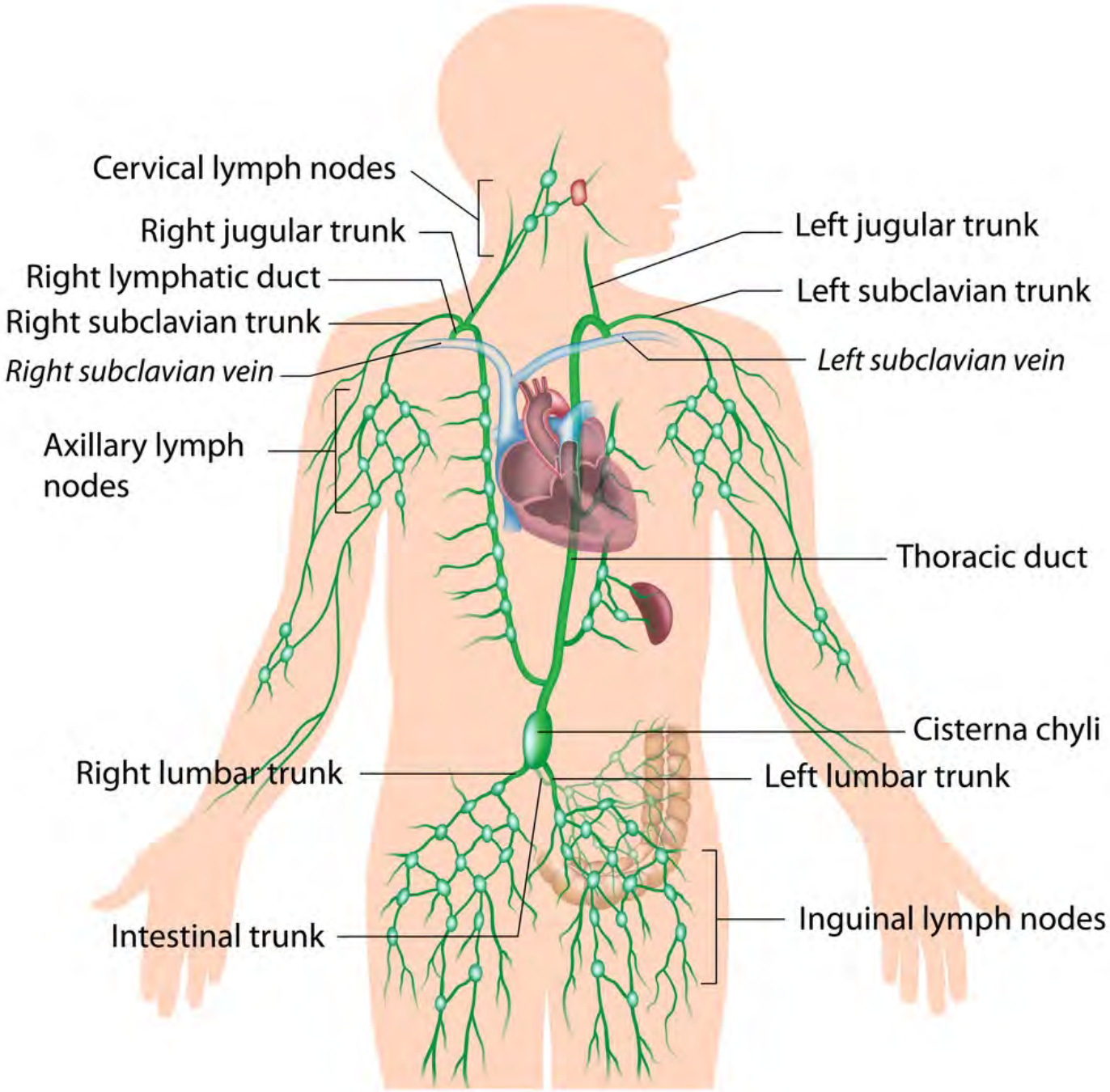
Reprinted with permission (Darling, 2011).

Jugular Veins



Reprinted with permission (Darling, 2011).

Thoracic Duct



- Lymphatic Duct
- Empties into venous system
- Protected by spine posteriorly
- Mediastinum anteriorly

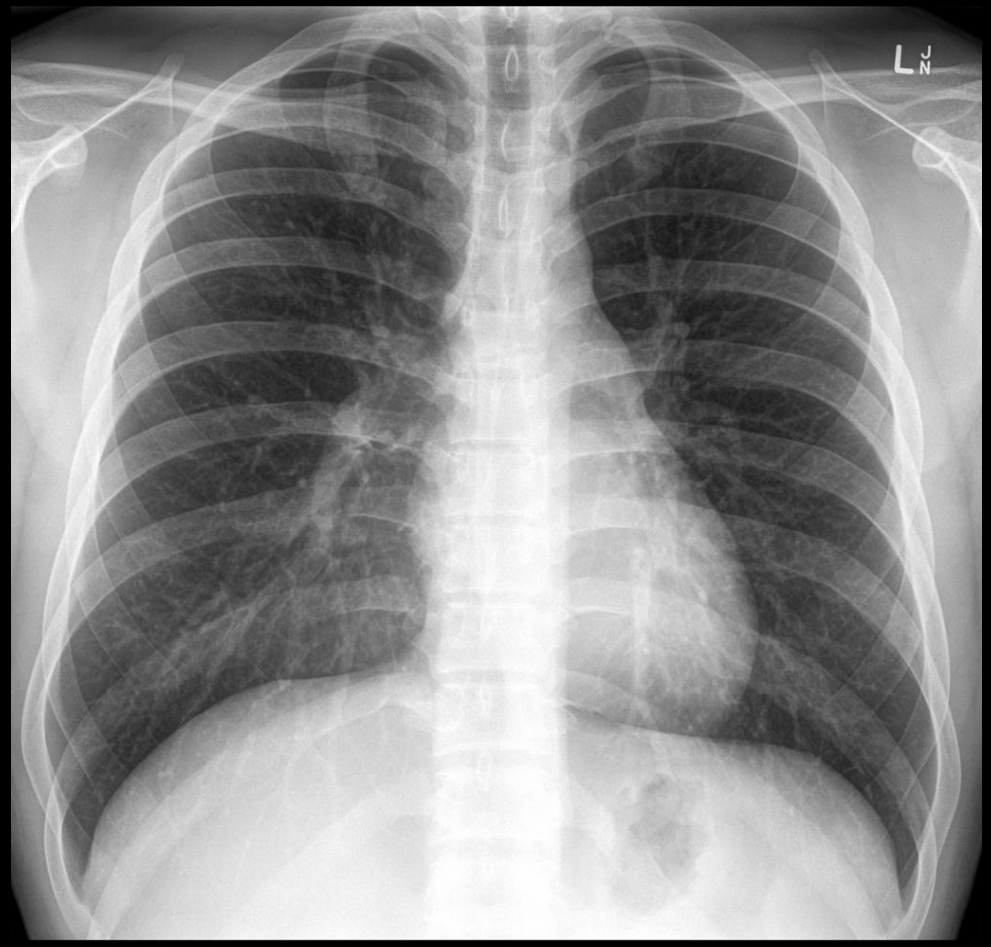
Thoracic Assessment

- Primary & Secondary Survey with ABC's
- Interventions for any life-threatening injuries

https://studylib.net/doc/9855207/initial-assessment-of-suspected-chest-trauma

Diagnostics

- Chest X-Ray
- Focused Assessment with Sonography for Trauma (FAST)
- Computed Tomography
- Arteriography and other diagnostics




N781ON

Immediately Life Threatening

- Airway obstruction
- Tracheobronchial tree Injury
- Tension pneumothorax
- Open pneumothorax
- Massive hemothorax
- Cardiac tamponade
- Traumatic circulatory arrest

Airway Obstruction

High index of suspicion if:

- Secretions/blood/vomitus in airway
- Direct laryngeal/neck trauma
- Expanding neck hematoma

Symptoms

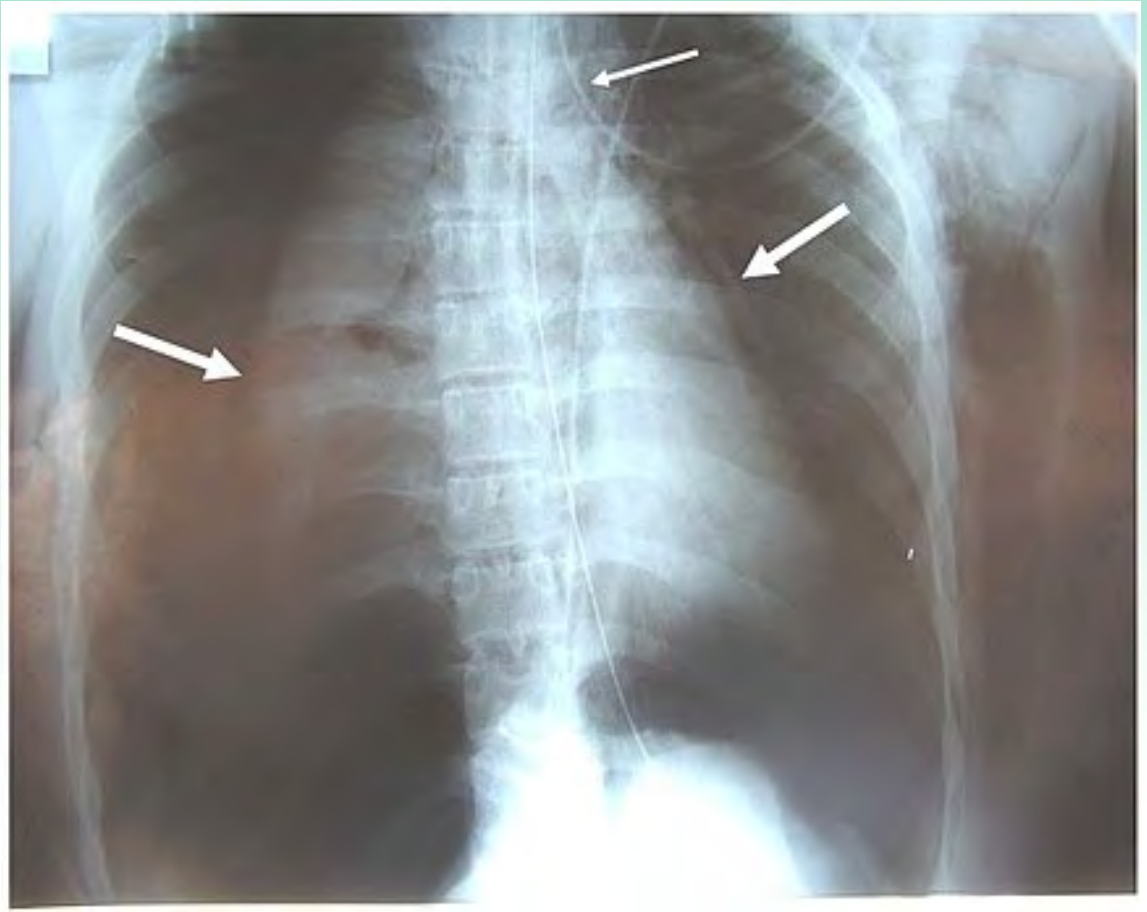
- Tachypnea
- Hypoxia
- Agitation
- Hoarseness and dysphonia
- Stridor
- Subcutaneous emphysema
- Palpable fracture crepitus
- Low oxygen saturation (late sign)

Treatment

- Control airway in primary survey
- Utilize adjuncts
- Intubate cautiously or perform a tracheostomy

Tracheobronchial Tree Injury

- Dyspnea and respiratory distress
- Hemoptysis
- Cervical subcutaneous emphysema
- Tension pneumothorax
- Cyanosis
- Dysphonia
- Hoarseness



Tracheobronchial Tree Injury

Treatment

- Chest tube placement
- Bronchoscopy
- Immediate surgical intervention

Bronchoscopy Procedure, South West Acute Hospital, Uploaded by: WesternTrust, Mar 15, 2017

Tension Pneumothorax

Increase in intrapleural pressure

↓

Collapsed lung on affected side

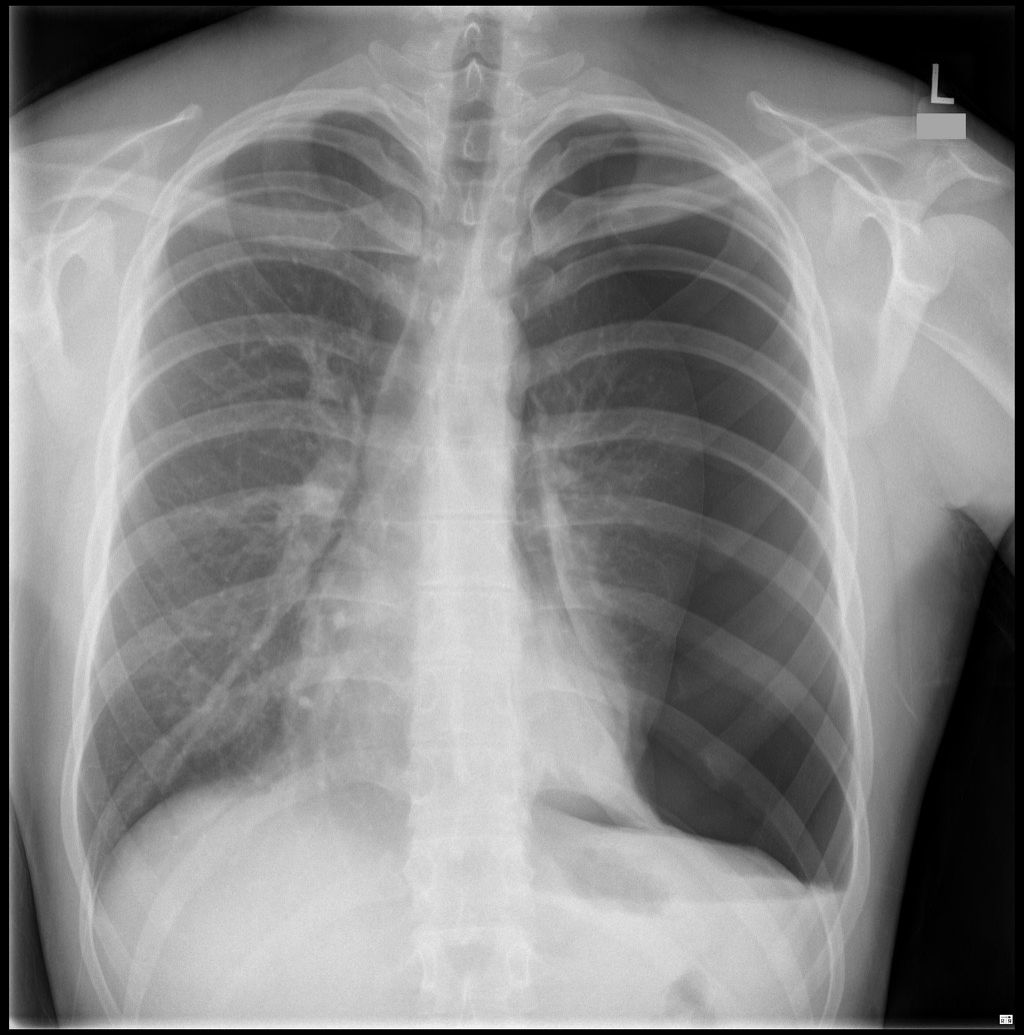
↓

Shift mediastinum to opposite side

↓

High intrathoracic pressures

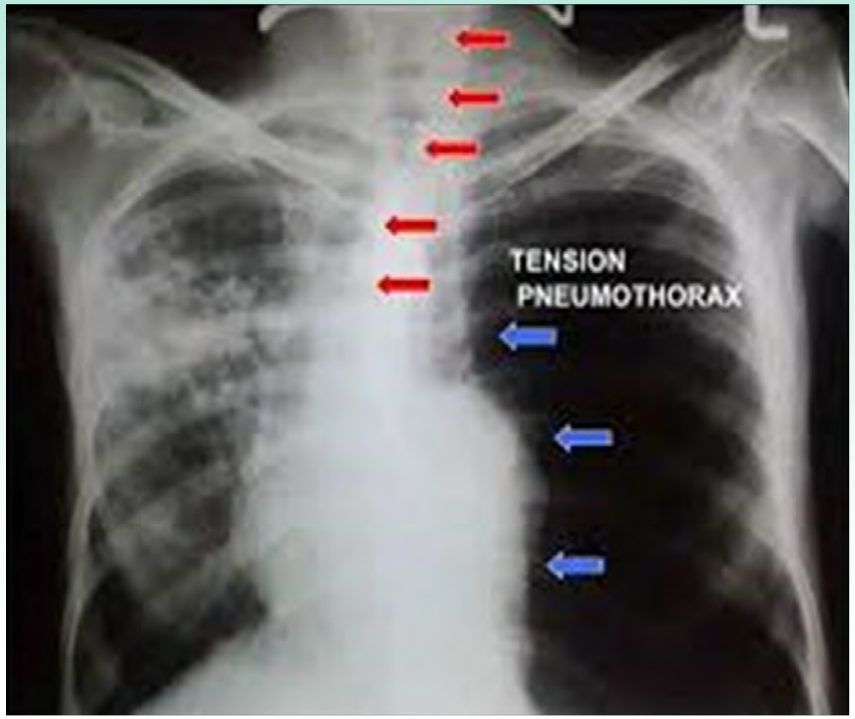
Risk for Tension Pneumothorax



- Extension from simple pneumothorax
- Tracheobronchial tree injuries
- Rib fractures
- Lung parenchyma injury
- Barotrauma
- Clogged/clamped chest tube

Foster, T. Tension pneumothorax. Case study, Radiopaedia.org. (accessed on 13 Jan 2022) https://doi.org/10.53347/rID-73655

Simple vs. Tension PTX



Tension Pneumothorax

Symptoms

- Respiratory distress
- Absent/decreased breath sounds on affected side
- Asymmetric chest movement
- Jugular vein distention
- Tracheal deviation (late sign)
- Shock (late sign)
- Diagnosis should be made on clinical presentation

Tension Pneumothorax

Treatment

- Immediate needle decompression
  - Large-caliber needle
  - Between 4th and 5th intercostal space midaxillary line
- Chest tube insertion
  - Tube thoracostomy
  - Insert at 4th or 5th intercostal space between the anterior and midaxillary line

https://www.dopamed.id/2020/12/28/needle-decompression/

Open Pneumothorax

“Sucking Chest Wound”

- Pain
- Difficulty breathing
- Tachypnea
- Decreased breath sounds on the affected side
- Noise movement of air

U.S. Navy photo by Mass Communication Specialist 1st Class Brian S. Finney/Released)

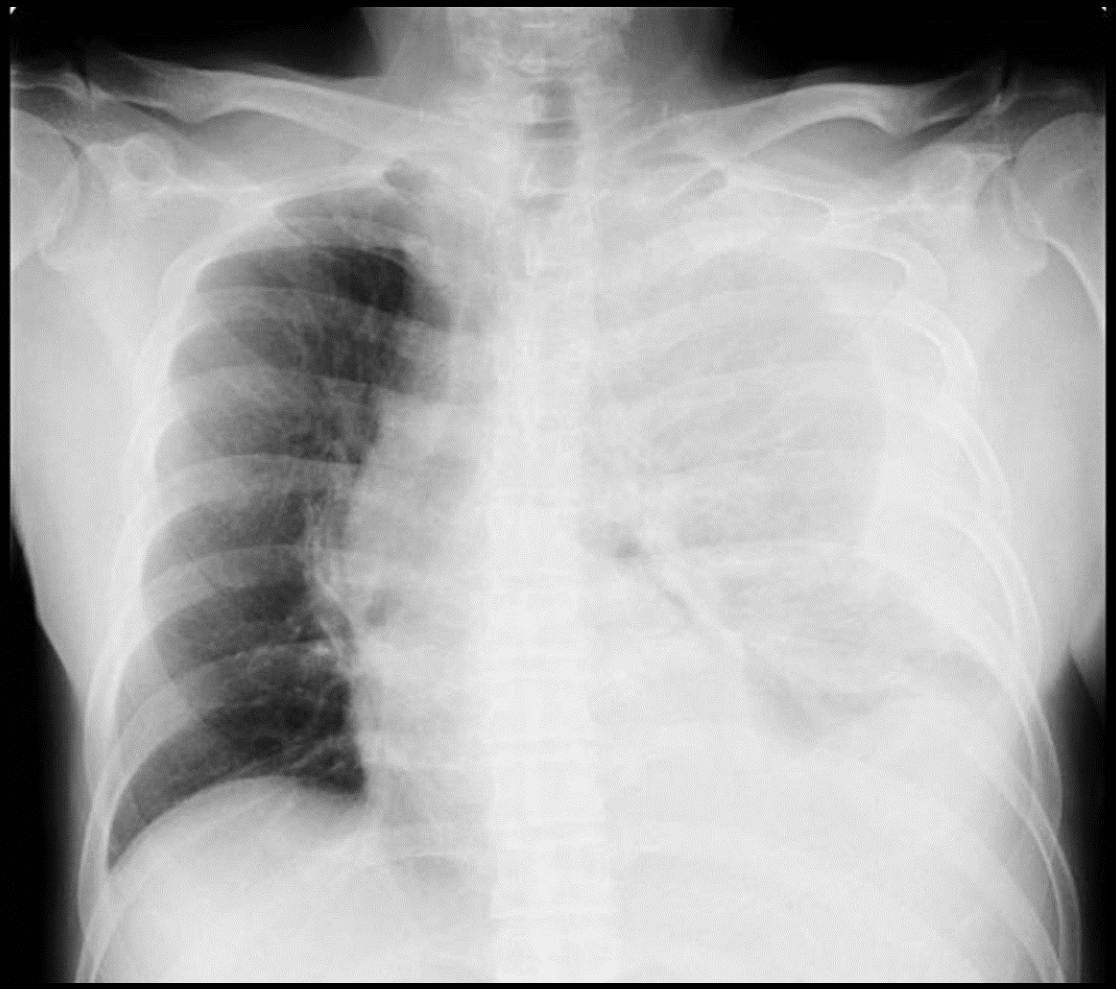
Open Pneumothorax

Treatment

- Chest tube is the emergent treatment.
- Monitor for re-expansion of lung or for development of tension pneumothorax.

Massive Hemothorax

- Accumulation of a large amount of blood (> 1.5 L) in the pleural space
- Common in penetrating trauma with hilar or systemic vessel disruption
- May be caused by major blunt chest trauma
- CXR will show unilateral “white out”



Massive Hemothorax

Treatment

- Chest tube placement
- Set up for autotransfusion if appropriate
- Administer blood as indicated
- Potential thoracotomy

Cardiac Tamponade

Commonly result of penetrating trauma

Symptoms:

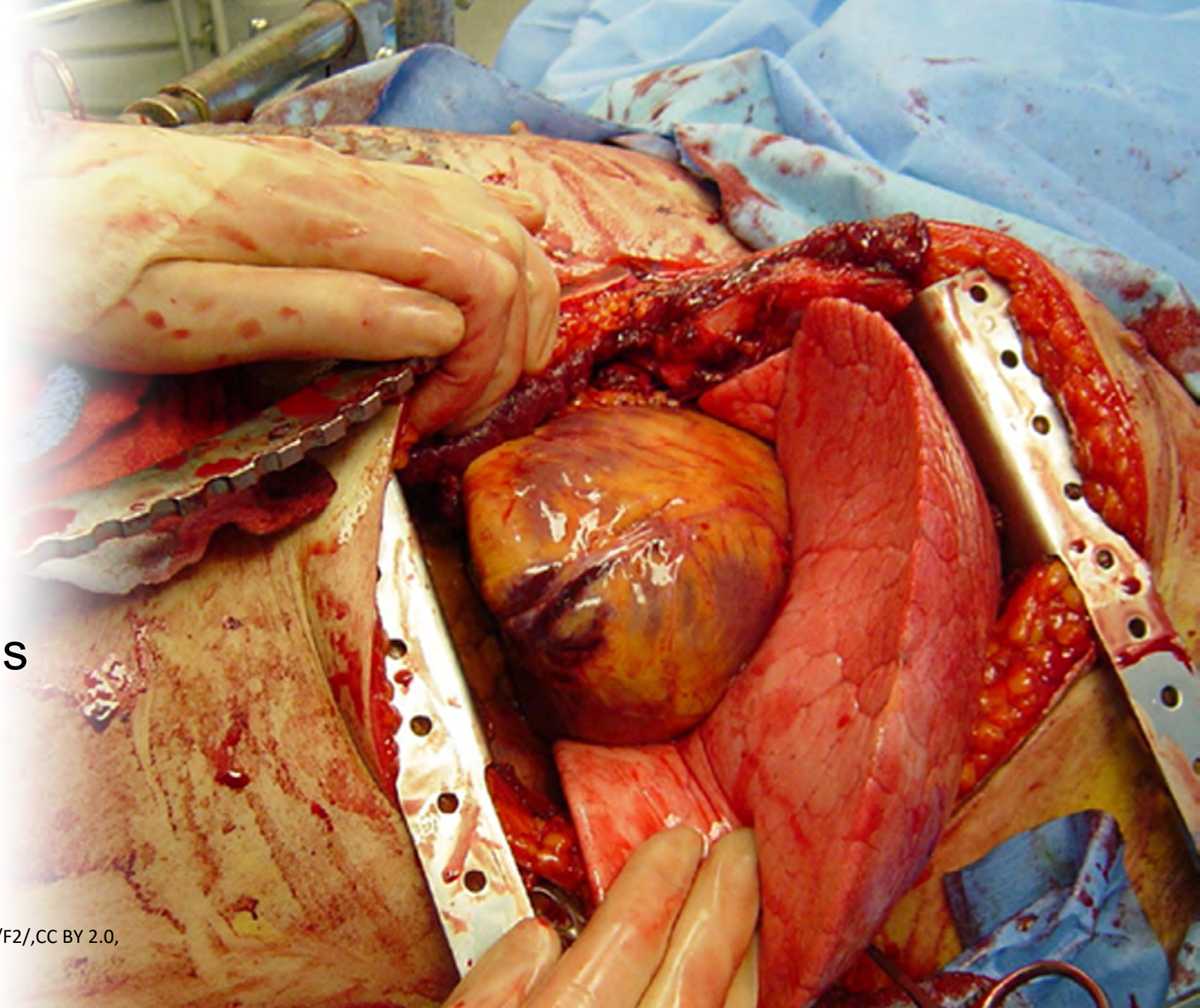
- Reluctant to lie flat
- Feeling of “impending doom”
- May have “Beck’s triad”
  - Distended neck veins
  - Hypotension
  - Muffled heart sounds
- +Fast exam

Cardiac Tamponade

Cardiac Tamponade

Treatment

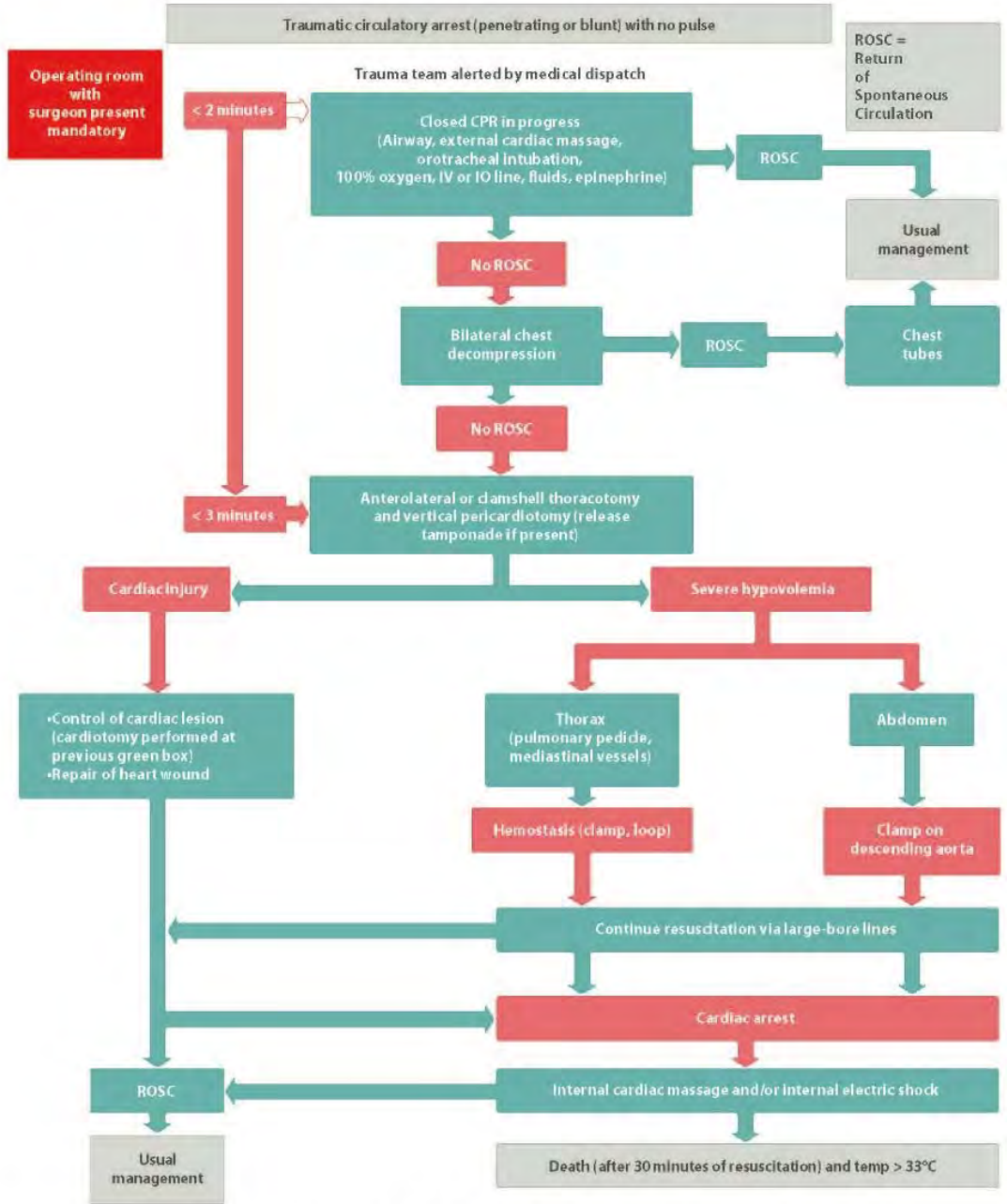
- Emergent thoracotomy or sternotomy
- Pericardiocentesis



Traumatic Circulatory Arrest

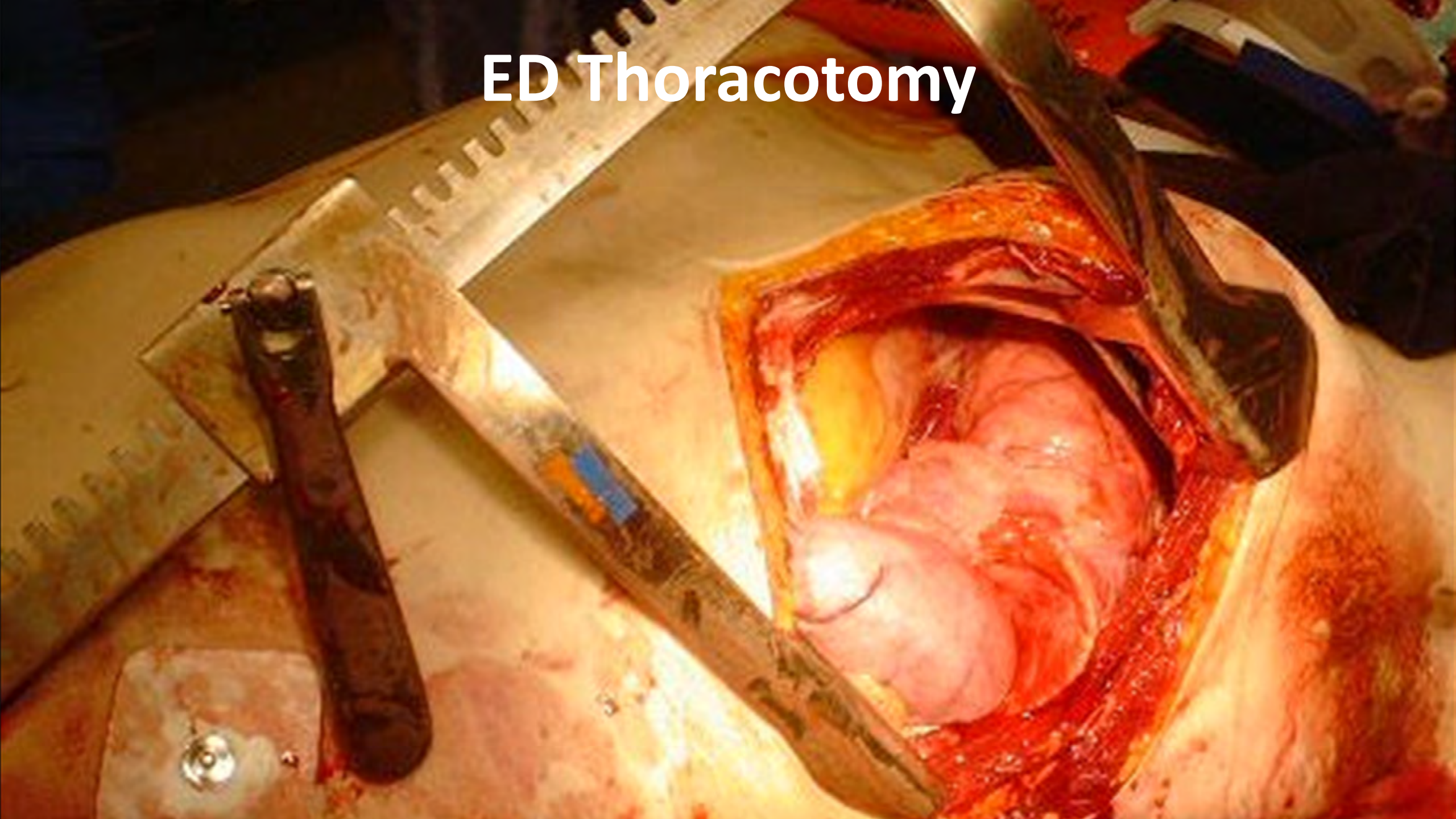
Causes:

- Severe hypoxia
- Tension pneumothorax
- Profound hypovolemia
- Cardiac tamponade
- Cardiac herniation
- Severe myocardial contusion



Algorithm for management of traumatic circulatory arrest. ECM = external cardiac massage; OTI = orotracheal intubation; IVL = intravenous line; IOL = intraosseous line.

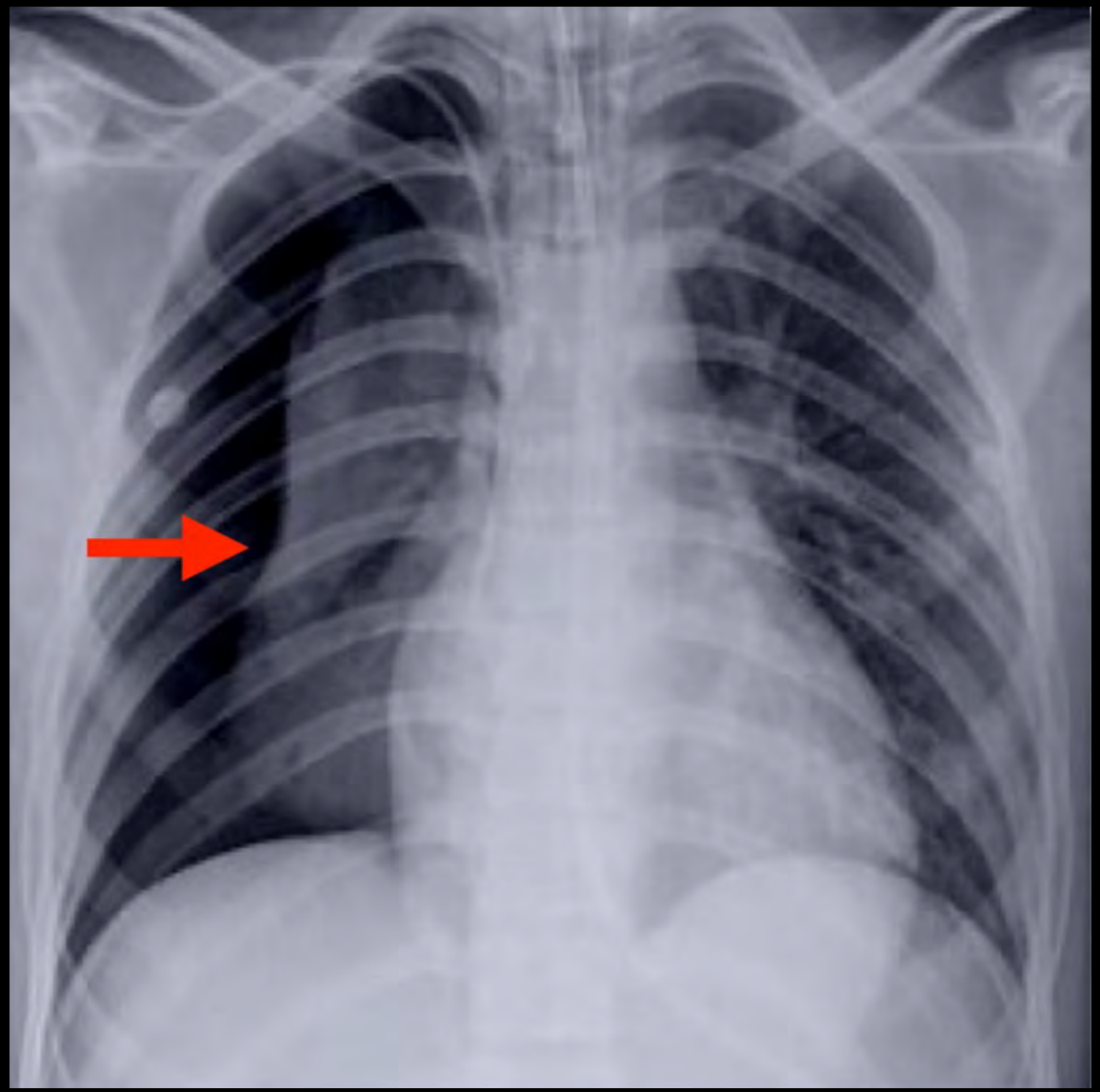
ED Thoracotomy



Potentially Life Threatening

- Pneumothorax
- Hemothorax
- Pulmonary Contusion
- Flail Chest
- Blunt Cardiac Injury
- Aortic Disruption
- Diaphragmatic Injury
- Esophageal Rupture

Pneumothorax



Etiology:

- **Blunt**
- **Penetrating**

Collection of Air in:

- Pleural space
- Visceral pleura
- Parietal pleura

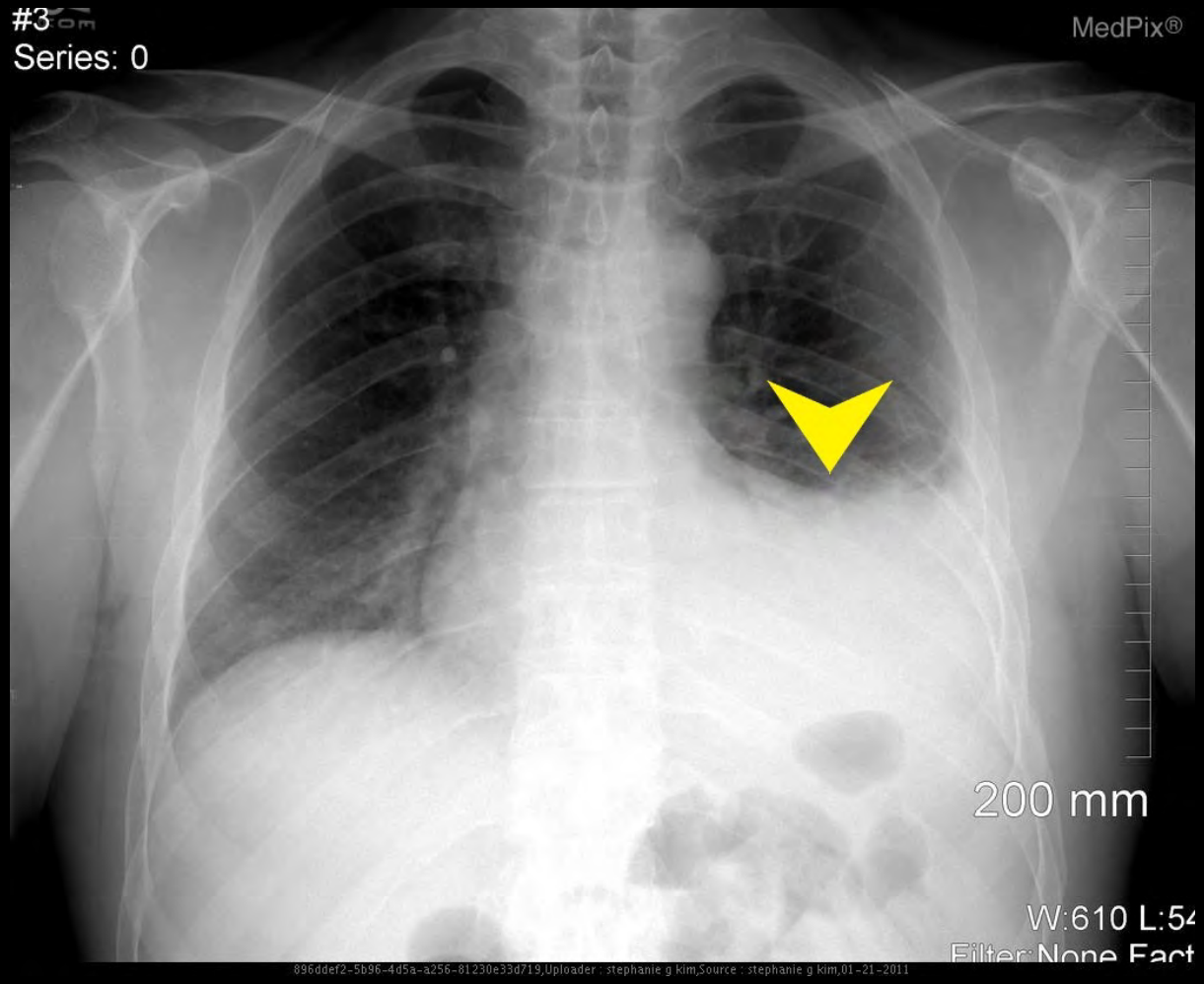
Hemothorax

Etiology:

- Lung laceration
- Intercostal vessel laceration
- Internal mammary artery laceration
- Thoracic spine fracture/dislocation

- Collection of Blood or other fluid in pleural cavity

  (< 1500ml)



Xray showing left sided hemothorax (yellow arrowhead) secondary to multiple rib fractures after fall from skiing (Picture courtesy: MedPix)

Pleural Space Management

- Small pneumo/hemothorax may be monitored with serial chest x-rays.
  - Usually spontaneously reabsorbs
- Chest tube required for moderate to large pneumo/hemothorax.
  - Monitor output for amount and color.
  - Monitor air leaks.
  - Assess insertion site and connections.
- Apply supplemental oxygen.

Chest Tube Insertion

Complications

- Laceration of intrathoracic and/or abdominal organs
- Pleural infection
- Damage to intercostal nerve, artery, vein
- Intercostal neuritis/neuralgia
- Incorrect tube position
- Persistent PTX

Chest Tube Management

- Chest x-ray post insertion
- Monitor chest tube output
- Provide amount of suction per physician's order
- Chest tube dressing per hospital protocol
- Evaluate effectiveness of chest tube

Troubleshooting Chest Tube

CT falls out:

- Apply dressing with pressure at end-expiration
- Ensure tight seal with tape
- Call physician immediately
- Monitor patient's condition

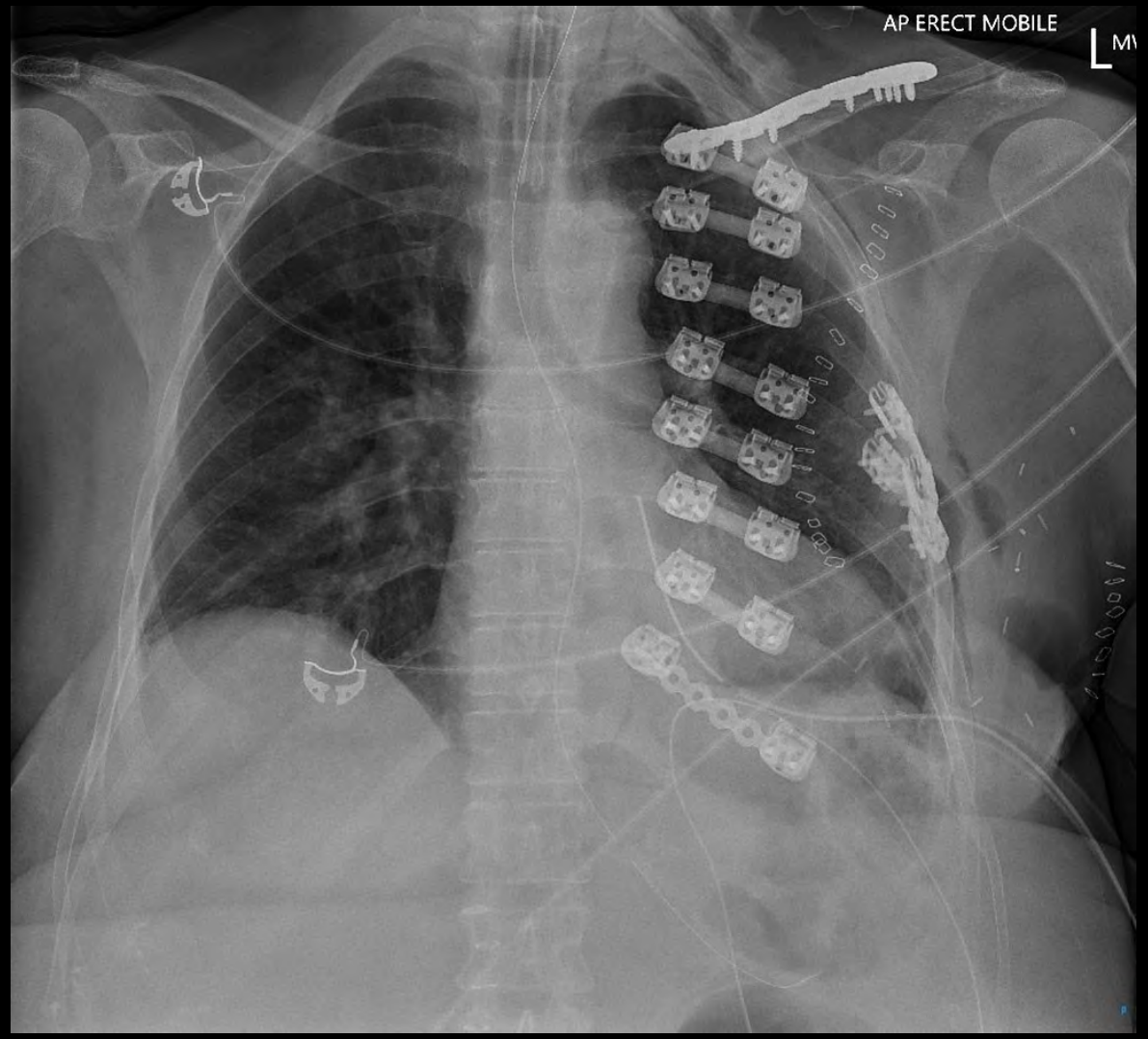
No drainage with continued presence of HTX

- Assess tubes for kinks, disconnection
  - Do not milk tubing
- Raise HOB and lower pleurovac
- Turn patient to affected side
- Consider patient's condition

Flail Chest

- Usually results from direct, high-energy impact
- Two or more adjacent ribs fractured at two (or more) points
- Paradoxical motion
- Labored breathing
- Ventilation and perfusion mismatch

Flail Chest



Treatment

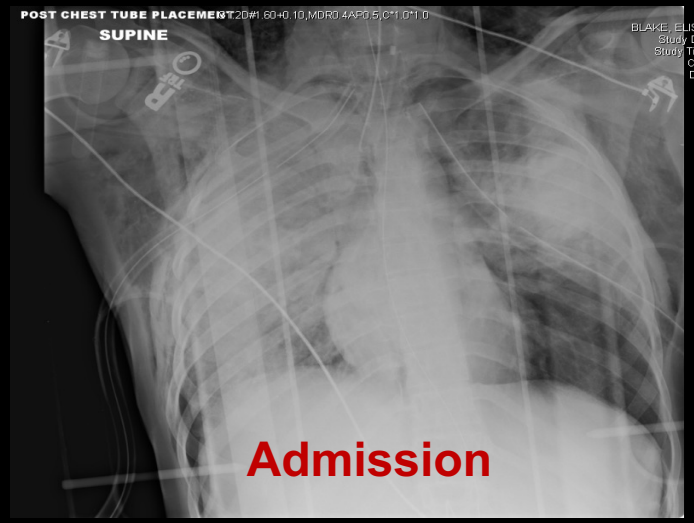
- Humidified oxygen
- Cautious fluid resuscitation
- Intubate if respiratory distress
- Control pain
- Potential for operative fixation
  - Rib plating

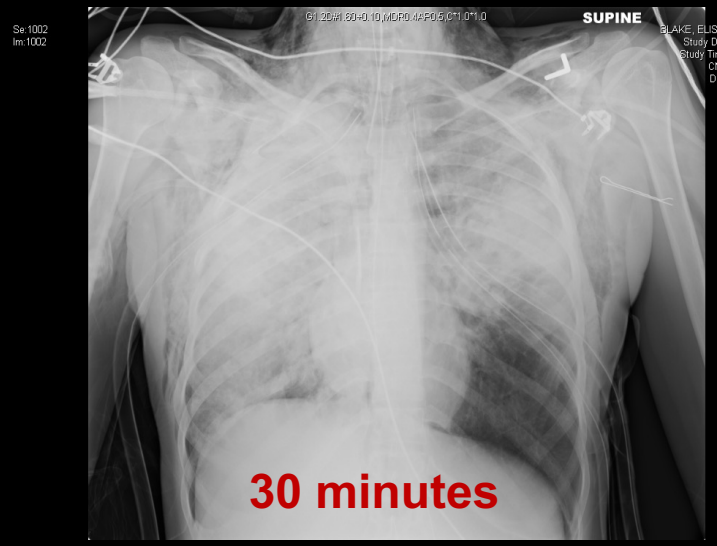
Hacking, C. Extensive rib plating for flail segment. Case study, Radiopaedia.org. (accessed on 13 Jan 2022) https://doi.org/10.53347/rID-84918

Pulmonary Contusion

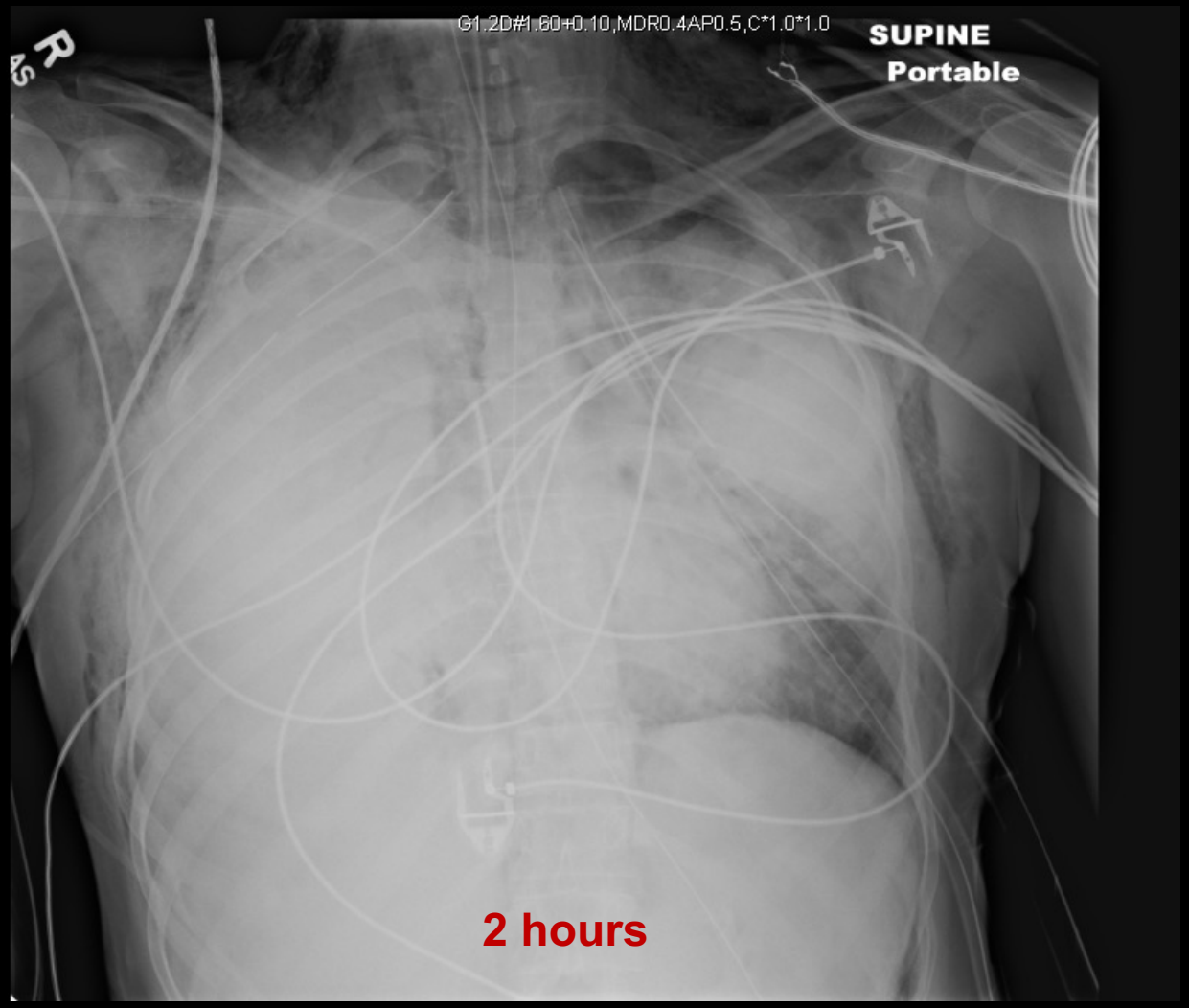
- Bruising of the lung tissue
- Occurs over time following thoracic trauma
- Blood and other fluids accumulate in lung tissue
- This interferes with ventilation and leads to hypoxia.

Pulmonary Contusion





Se:1001
Im:1001



Assessment and Treatment

- Hypoxemia and respiratory compromise
- Bloody sputum, secretions
- Chest x-ray: patchy infiltrates or consolidation hours after injury
- Oxygen therapy and aggressive pulmonary toilet
- Judicious use of fluids in resuscitation
- Ventilator strategies

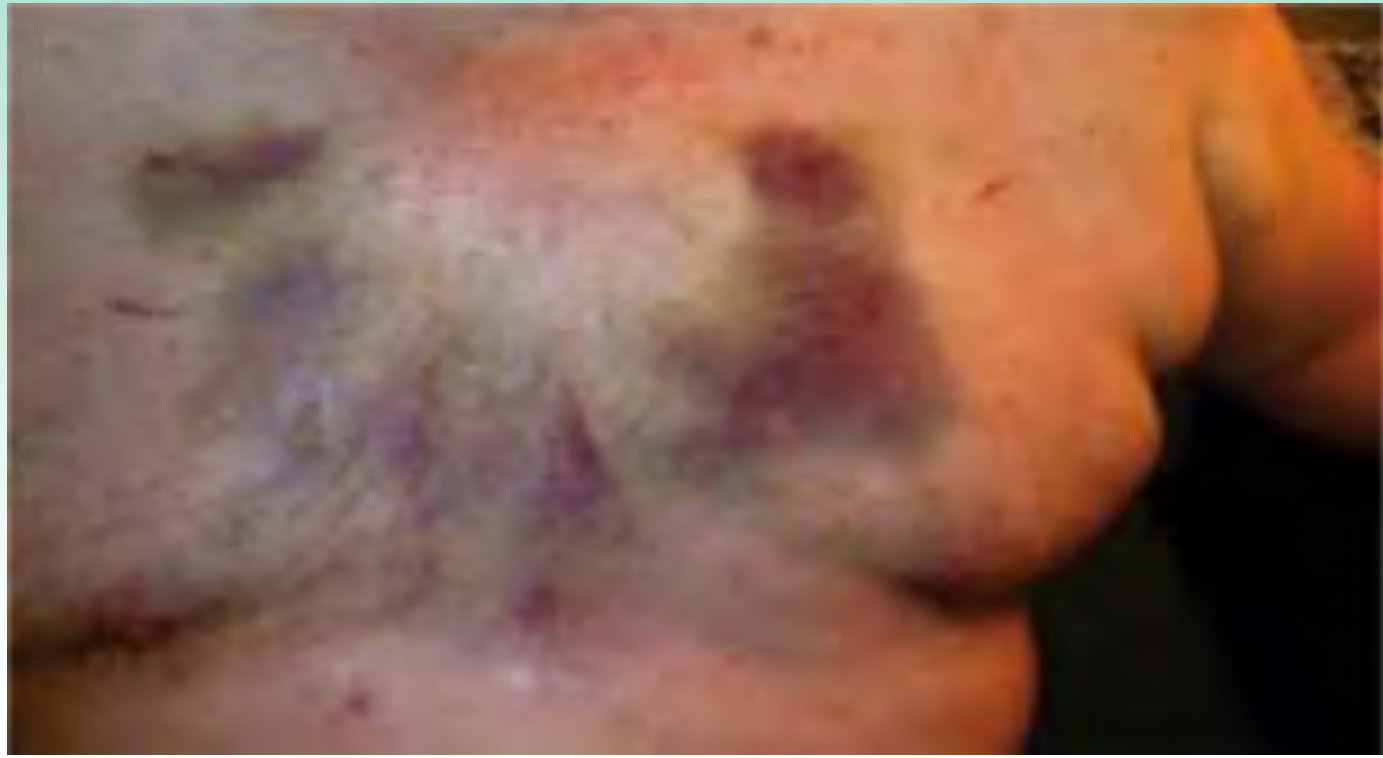
Blunt Cardiac Injury

- Mild tenderness to chamber rupture
- Types of injuries
  - Compression
  - Deceleration
  - Blast
  - Direct impact

https://dailybolusoflr.wordpress.com/2018/07/10/ed-evaluation-for-blunt-cardiac-injury/

Assessment

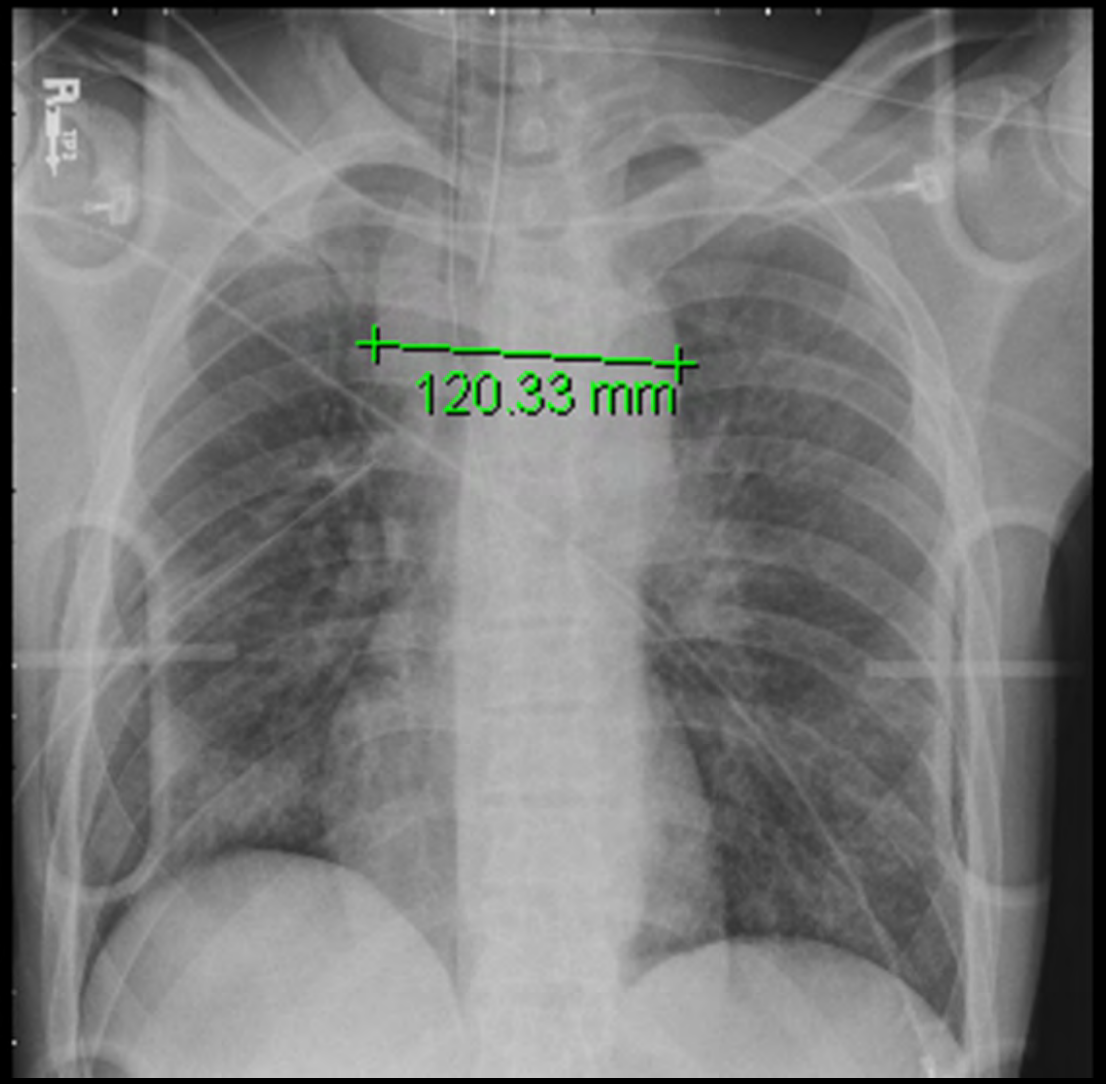
- Chest pain
- Arrhythmias
- Electrocardiogram
- Echo
- Lab panel
- Patients with changes/ abnormalities must be monitored for the first 24 hours



Traumatic Aortic Disruption

- Common cause of death at scene
- Survivors may have incomplete laceration or hematoma
- Most common site is distal to left subclavian artery
- Not always with specific symptoms
- Maintain high index of suspicion for deceleration type of injuries

Traumatic Aortic Disruption

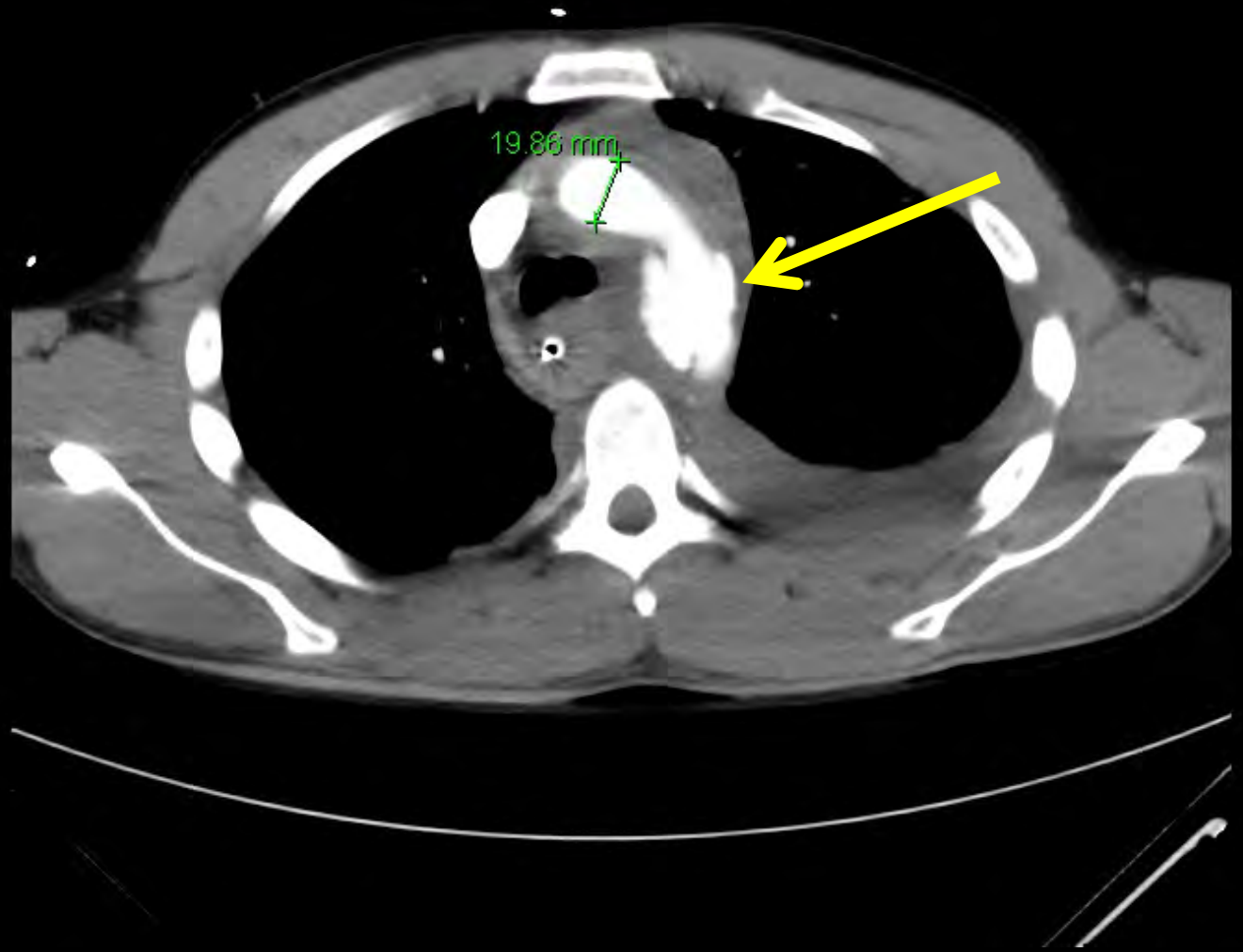


Assessment

- Patient complaints
- Clinical signs

Diagnostics

- CXR – widened mediastinum
- CT angiography
- Transesophageal echocardiography


19.86 mm

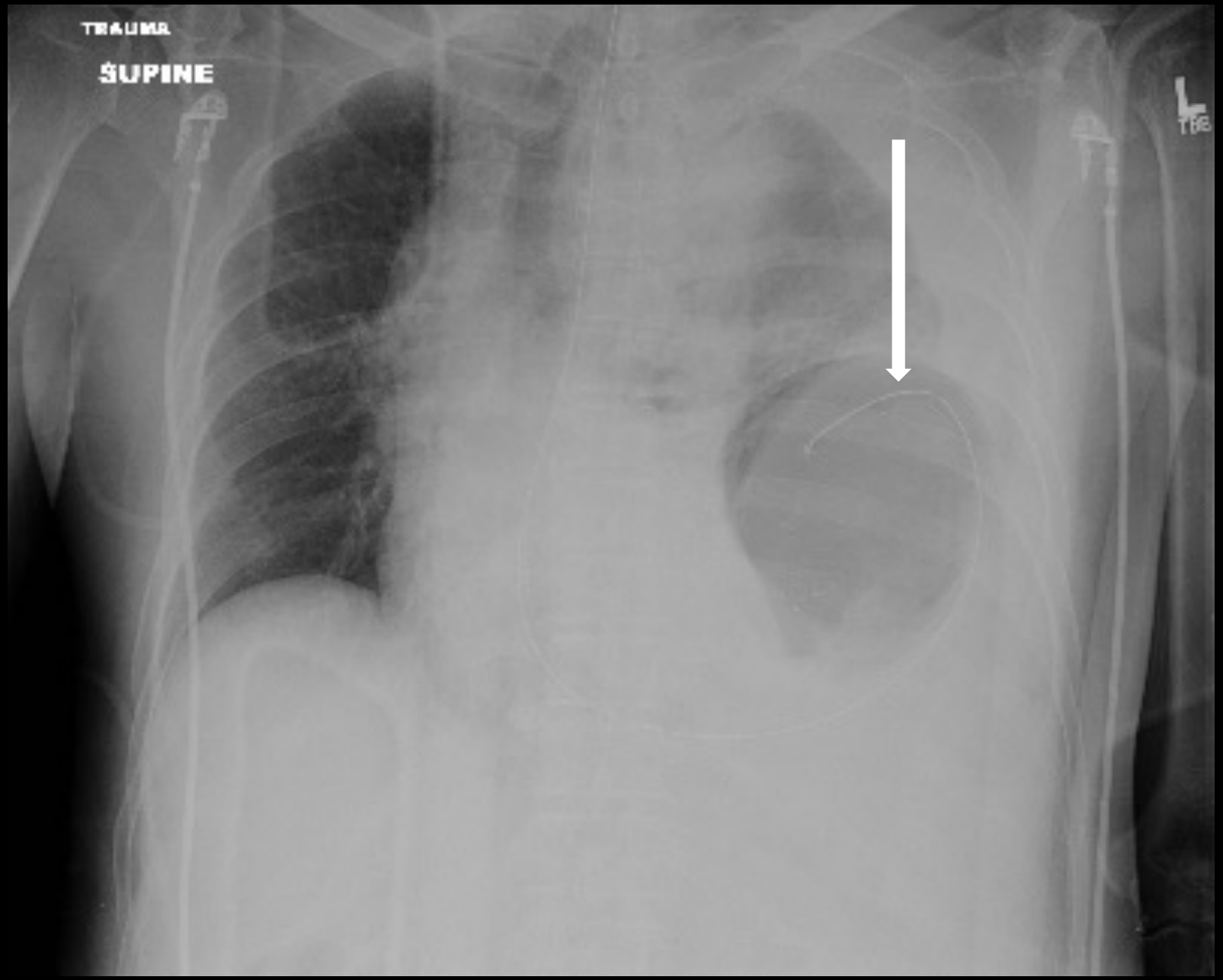
Traumatic Aortic Disruption

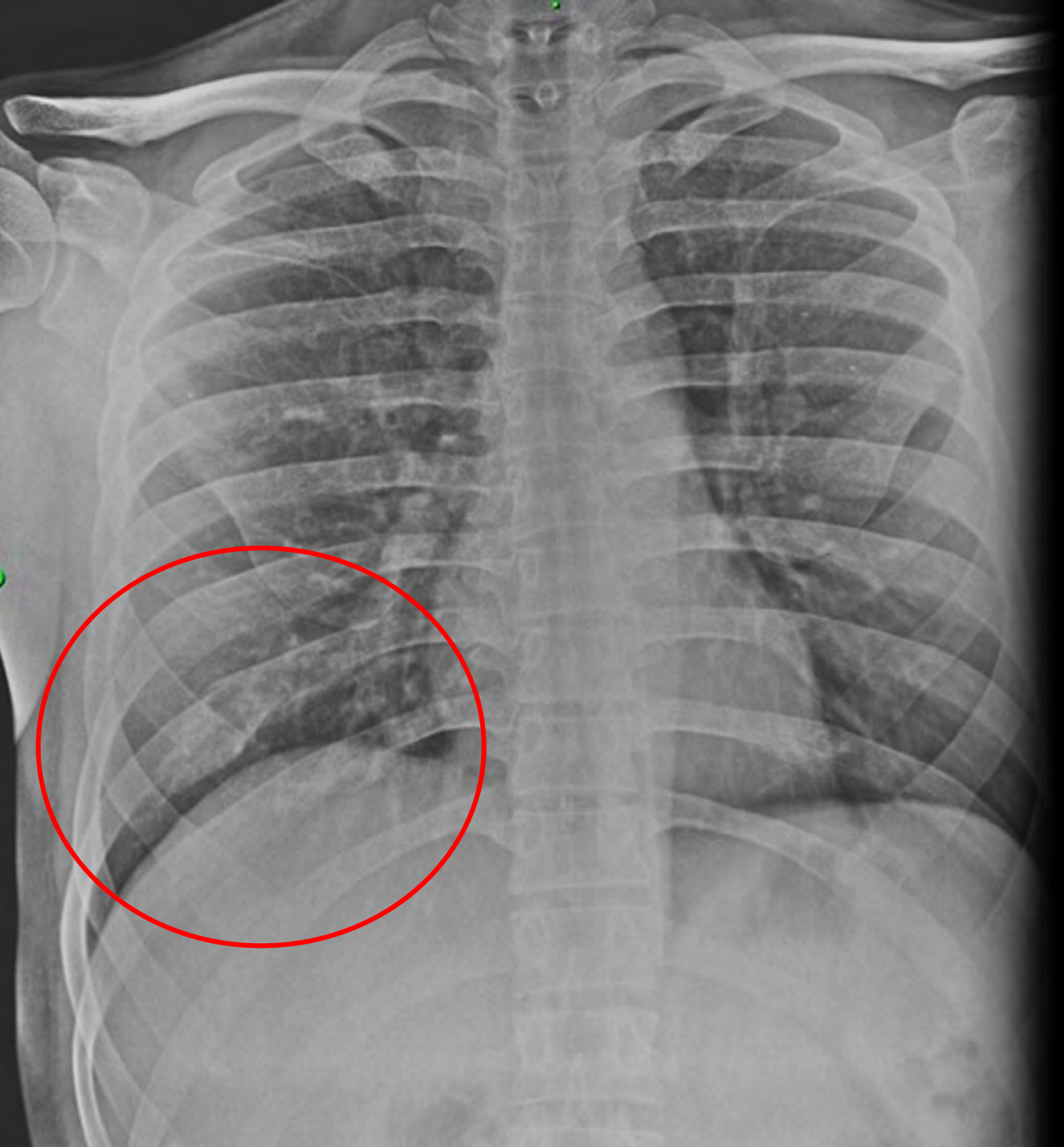
Treatment

- Heart rate and blood pressure control
  - HR < 80, MAP goal 60-70 mmHg
- Pain relief
- Open repair
- Endovascular repair
  - Most common
  - Excellent short-term outcomes

Blunt Diaphragmatic Injury

- Usually result from high-speed MVC or severe blow to abdomen
- Initial chest x-ray may be normal.
- Suggestive findings:
  - Abnormal nasogastric tube placement
  - Ipsilateral hemidiaphragm elevation
  - Abdominal visceral herniation


TRAUMA
SUPINE



Rib Fractures

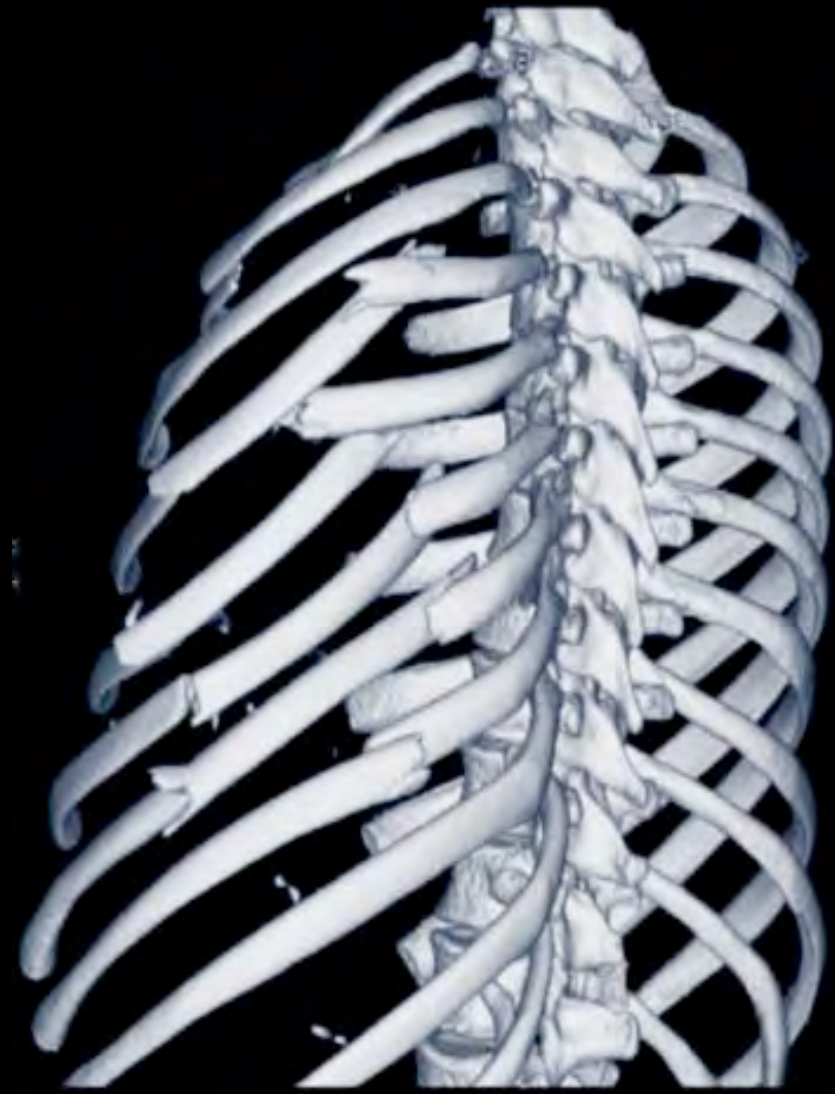
- 1st & 2nd rib fracture
  - High impact trauma
  - Suspect neck or great vessel injury
- 4th-9th rib fracture
  - Most common site of fractures
  - Suspect lung injury
- 9th-11th rib fracture
  - Suspect hepatosplenic injury

Sarkar, S. Rib fracture. Case study, Radiopaedia.org. (accessed on 13 Jan 2022) https://doi.org/10.53347/rID-48302

SHORT

Clinical Challenges

- Mechanical factors
- Rib fracture motion
- Prolonged pain
- Contracture of fractured segments
- Thoracic volume loss
- Persistent pain



Rib Fractures

Triad

- Inspiratory pain
- Shallow respirations
- Retained secretions

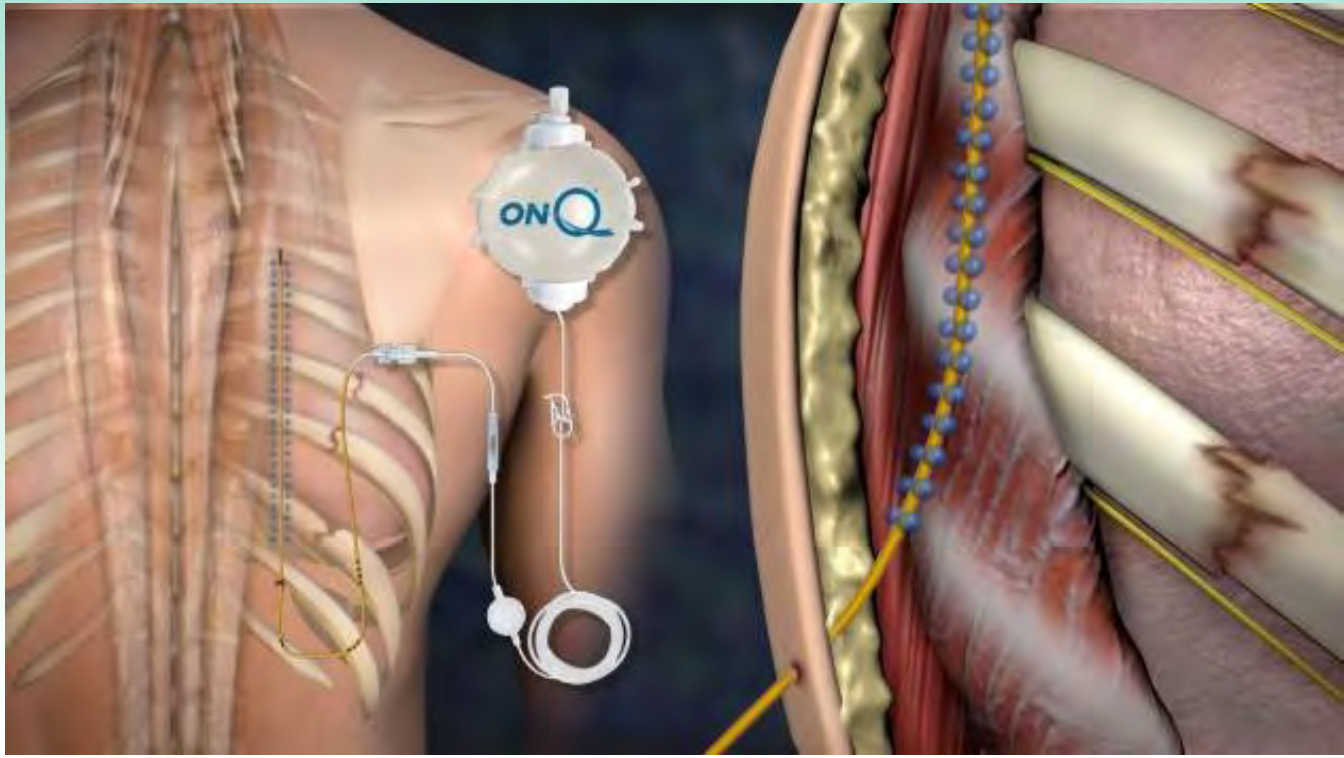
Goal of Therapy

- Pain control
- Adequate pulmonary function
- Avoid potential complications

Pain Management

Options

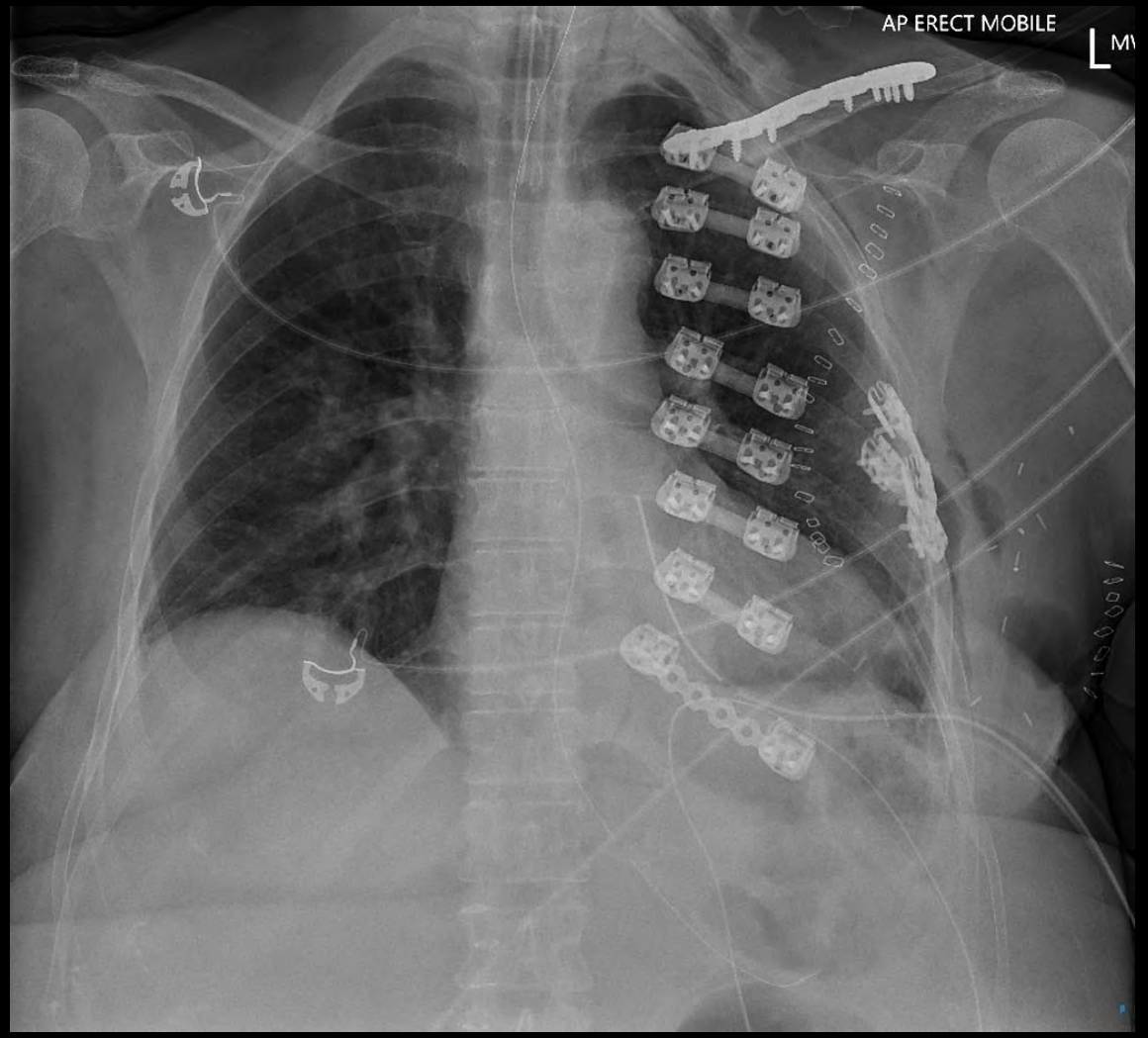
- Multi Modal Analgesia
  - Oral acetaminophen, NSAIDS
  - Oral Opioids
  - Pharm D or pain management consult
- Regional analgesia
- Operative fixation



Otto, 2016

Operative Fixation

- Reduction in pain
- Ability to reconstruct chest wall
- Restore thoracic volume
- Decreased ventilator days
- Decreased hospital LOS
- Decreased neuralgia



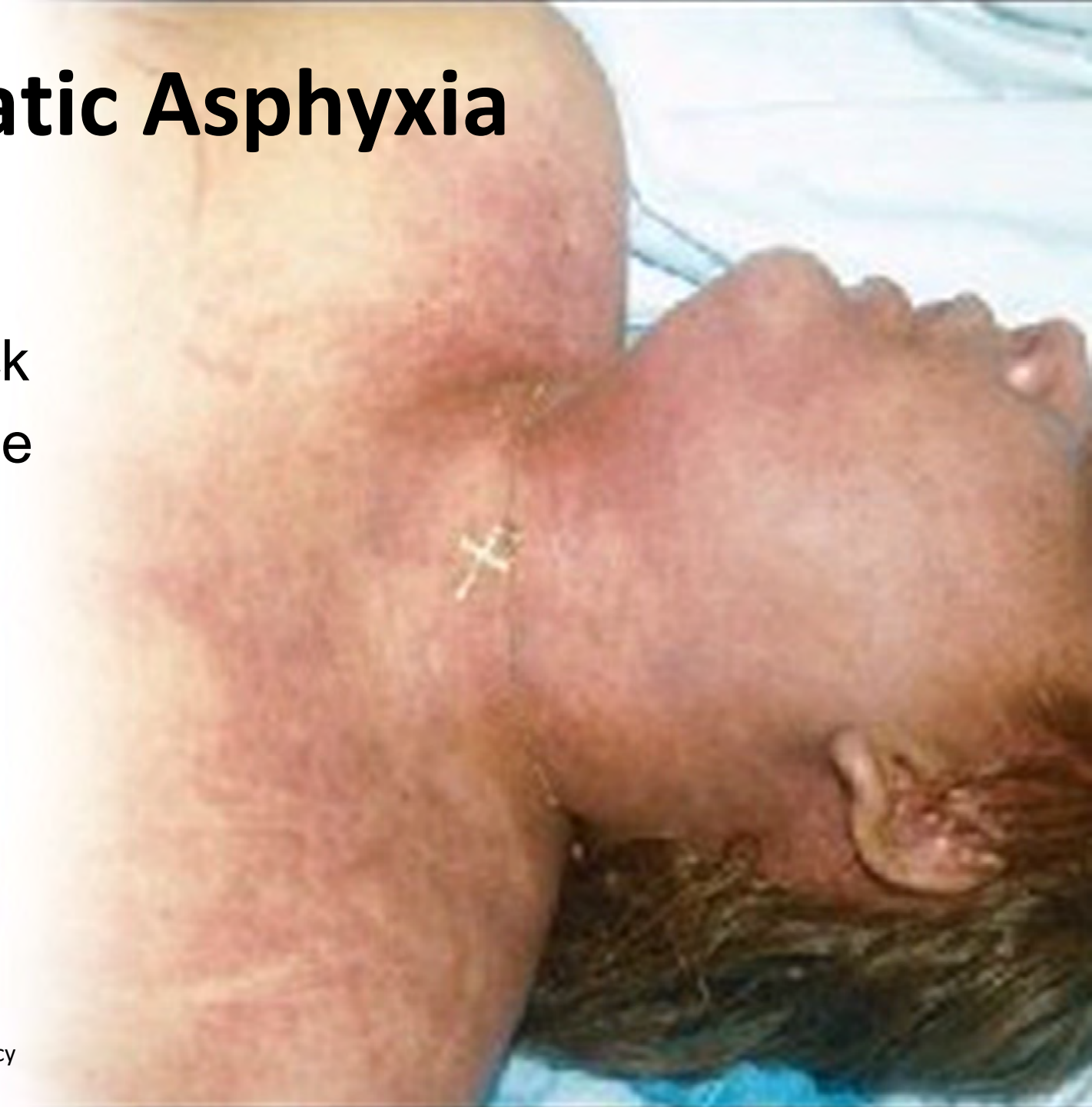
Hacking, 2022

Subcutaneous Emphysema

- Airway injury
- Facial swelling
- Pneumothorax
- Blast injury

Traumatic Asphyxia

- Crushing force to chest
- Cyanosis of head and neck
- Subconjuctival hemorrhage
- Hemotypanum
- Associated injuries



https://slidetodoc.com/by-dr-gholamreza-masoumi-assistant-professor-of-emergency

Scapula and Clavicle Fractures

Scapula

- Uncommon
- Clinical signs
  - Pain
  - Edema
  - Crepitus
- Management
  - Analgesia
  - Immobilization followed by PT

Clavicle

- Common
- Clinical signs
  - Tenderness
  - Crepitus
  - Deformity
- Management
  - Shoulder immobilizer
  - ORIF

Sternal Fracture

Clinical Manifestations

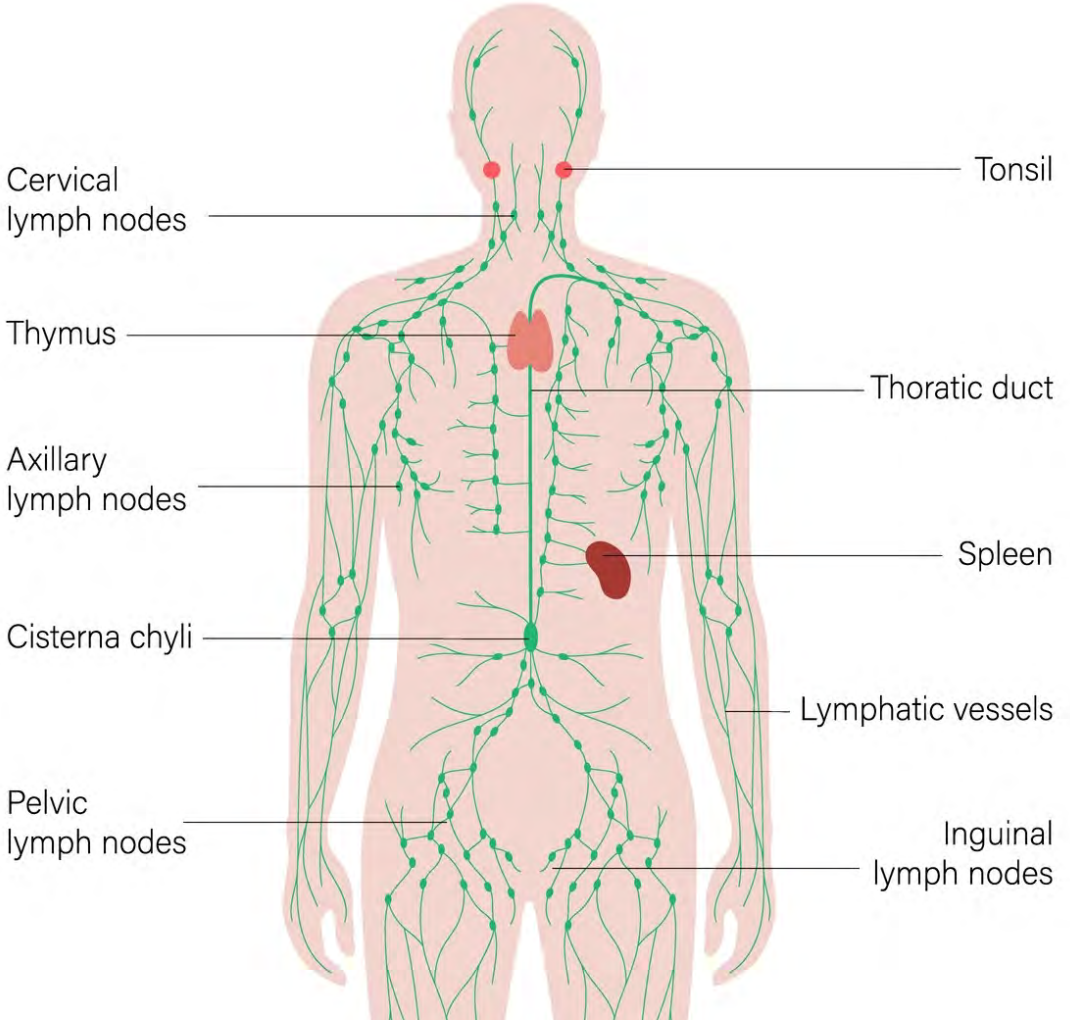
- Anterior chest pain
- Tenderness
- Palpable deformity
- Unstable fracture may result in flail chest
- ECG changes

Management

- Cardiac monitoring
- Serial ECG to rule out myocardial insult
- Echocardiogram
- Pain Control

Thoracic Duct Injury

- Uncommon
- Milky white fluid (*Chyle)
  - May be clear if patient NPO
- Chylothorax
- Continued chest tube drainage coupled with nutritional support usually results in spontaneous closure in <1 month



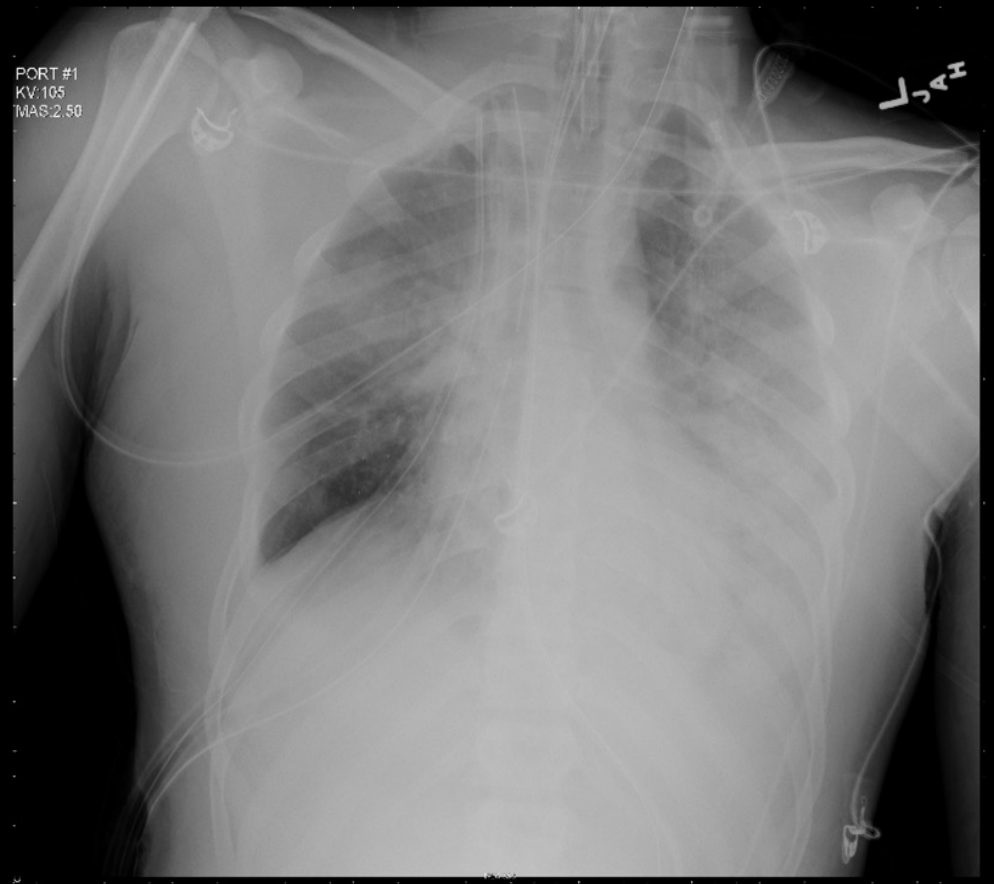
Secondary Thoracic Trauma Complications

- Respiratory Failure
  - ALI
  - ARDS
- Pneumonia
- Empyema
- Persistent Air Leak
- Pneumatocele
- Air Embolism

Acute Lung Injury (ALI)
Acute Respiratory Distress Syndrome (ARDS)

ALI/ARDS

- Acute onset of diffuse bilateral pulmonary infiltrates
- Vasculature and alveolar endothelium injured
- No evidence of hydrostatic pulmonary edema
- Severe Hypoxemia
- Treatment includes ventilatory strategies



ALI vs ARDS

- **P/F ratio ALI**
  - $PaO_2:FiO_2$ 200-300

- **P/F ratio ARDS**
  - $PaO_2:FiO_2 \leq 200$

Pneumonia

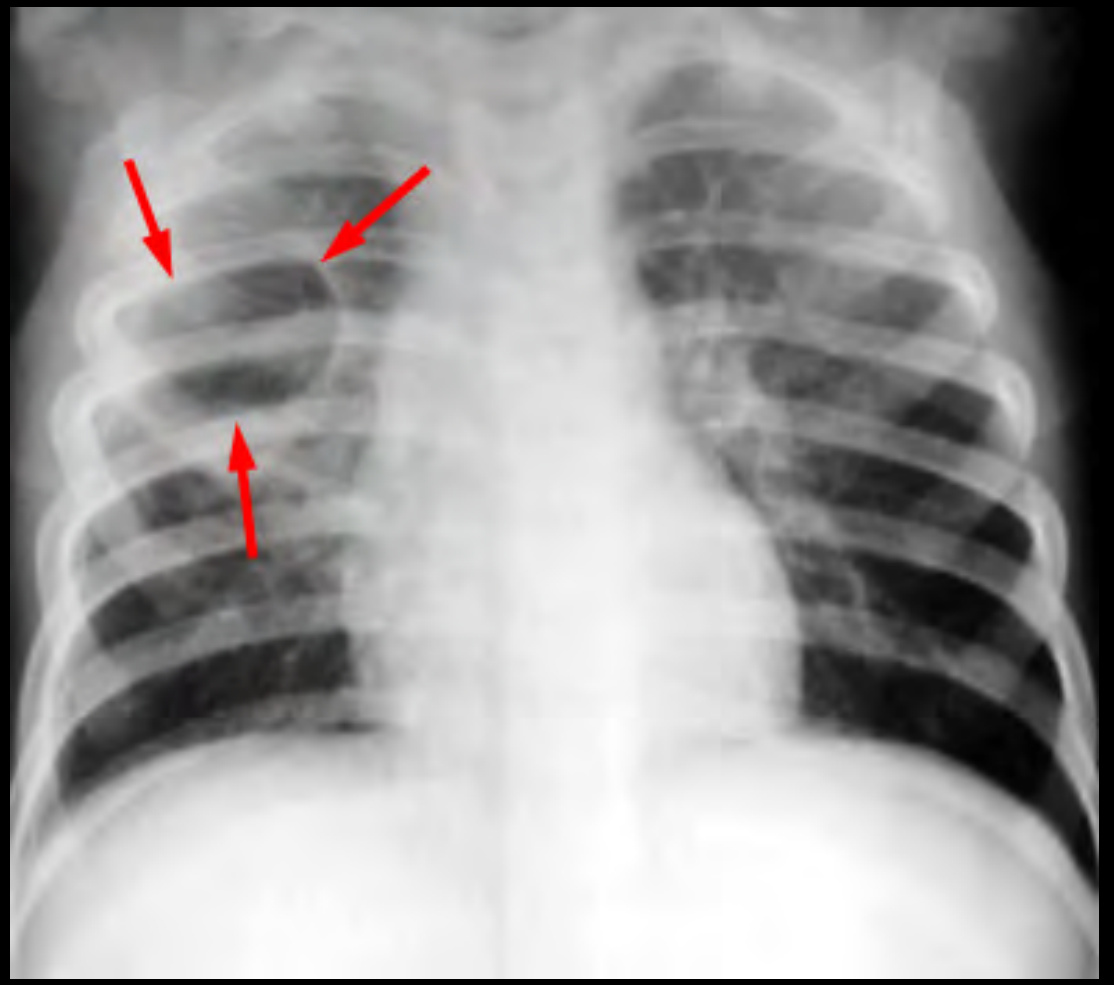
- Trauma patient susceptible particularly if they are intubated
- VAP partially iatrogenic
- Especially common in patients with ARDS
- Multiple pathogens associated with VAP
- Indiscriminate use of antibiotics
- Optimal treatment is prevention to include:
  - Hand hygiene, gowning, gloving
  - Endotracheal hygiene per protocol
  - Minimizing duration time of intubation
  - Consideration of NIPPV vs intubation

Empyema

- Risk of development remains high.
- Etiology includes inadequately drained pleural space, direct contamination from the penetrating injury or secondary infection such as a clotted HTX or diaphragm disruption.
- Suspect in chest trauma with an unexplained fever, leukocytosis or respiratory failure
- Early CT Scan if suspected
- Pathogen identification

Pneumatocele

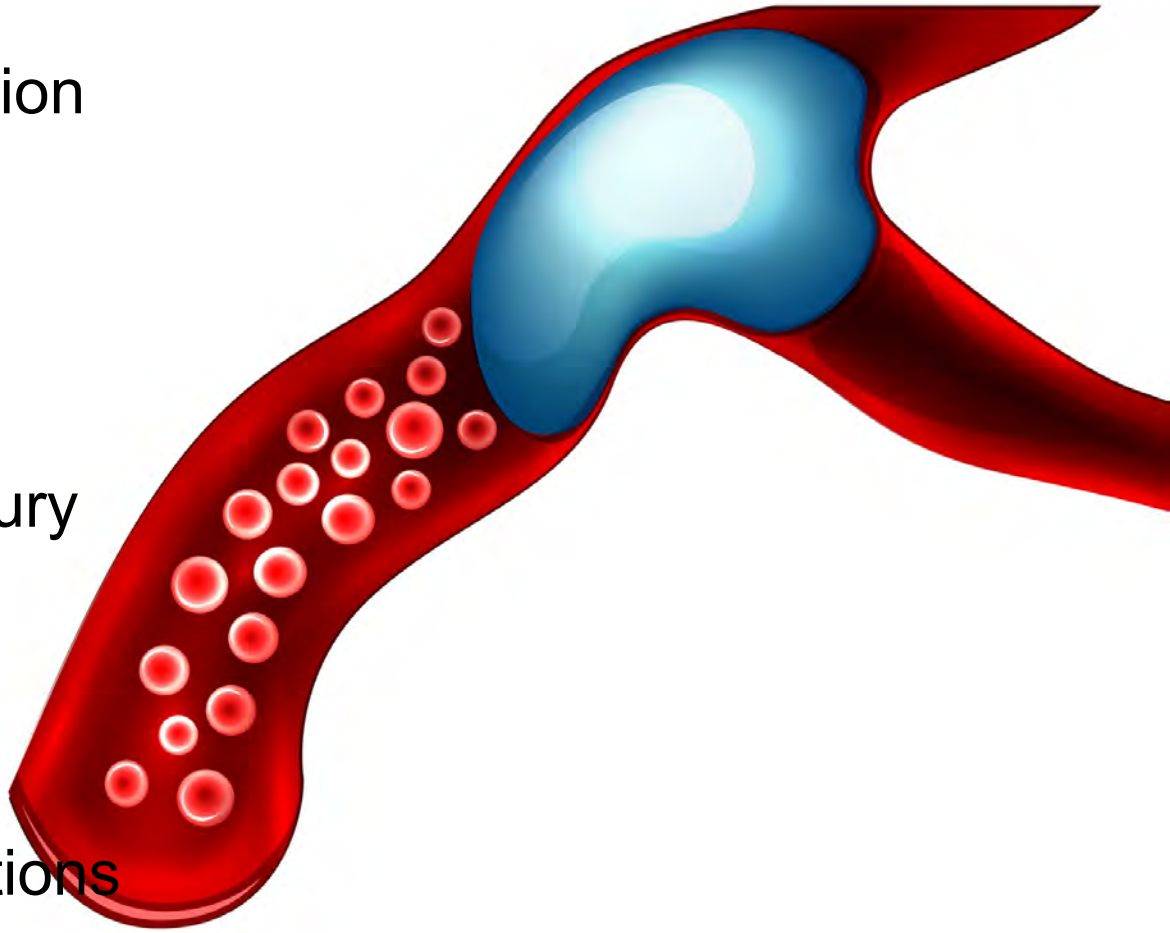
- Air collection in lung parenchyma
- Usually develops during mechanical ventilation
- Usually resolves following weaning from ventilator
- May need CT guided drainage



Air Embolism

Etiology

- Patient with large HTX requiring intubation with positive pressure
- Iatrogenic from central venous access procedures
- Fistula between pulmonary vein & bronchiole due to a penetrating lung injury results in systemic air embolism



Symptoms

- Sudden cardiac or cerebral dysfunction
- Air in retinal vessels and arterial aspirations
- Hemoptysis
- Seizures

Air Embolism

Treatment

- Immediately place patient in Trendelenburg position
- Rotate patient to left lateral decubitus position
- Airway management
- Immediate thoracotomy and clamping of hilum to avoid propagation of air embolus before repair of injury
- Aspiration of air from cardiac chambers, aortic root and/or right coronary artery
- Cardiac massage

Summary

- Identify and treat life-threatening injuries during primary survey.
- Maintain high level of suspicion for other injuries.
- Recognize potential complications.
- Describe treatment modalities.
- Pain management is integral to positive outcomes.

Thoracic Trauma

1. Which injuries are considered life-threatening, requiring immediate intervention?
    a. Tension pneumothorax and pericardial tamponade
    b. Cardiac contusion and rib fractures
    c. Clavicle fracture and pulmonary contusion
    d. Pneumomediastinum and subcutaneous emphysema

2. What is an early sign of tension pneumothorax?
    a. Tracheal deviation
    b. Respiratory distress
    c. Increased cardiac output
    d. Epistaxis

3. What is the immediate management of tension pneumothorax?
    a. Chest tube placement in 7th intercostal space
    b. Place a three-sided dressing over chest tube site
    c. Needle decompression in the 4^{th} or 5^{th} intercostal space mid-axillary line
    d. ED thoracotomy

4. Flail chest is defined as:
    a. Multiple rib fractures with subsequent subcutaneous emphysema
    b. Chyle in the pleural space
    c. Excess fluid in pericardium
    d. Two or more ribs fractured at two or more points, and subsequent paradoxical motion

5. Which patient would benefit most from an emergent thoracotomy?
    a. 48 year-old patient with gunshot wound to the back who lost vital signs upon arrival to the ED
    b. 12 year-old patient with traumatic asphyxia with CPR in progress for past 15 minutes prior to arrival to the ED
    c. 16 year-old patient with significant trauma to head, GCS 4 on scene, intubated and CPR for past 5 minutes by prehospital providers
    d. 19 year-old patient with stab wound to chest who is dropped at Triage by friends, with fixed and dilated pupils

6. A nasogastric tube was inserted in a trauma patient. A follow-up chest radiograph shows abdominal contents in the chest cavity. The nurse should be suspicious of:
    a. Diaphragmatic rupture
    b. Chylothorax
    c. Pleural effusion
    d. Tension pneumothorax

7. What is the most appropriate immediate nursing intervention for a patient who has pulled out their chest tube?

a. Restrain patient and place bed in Trendelenburg position.
b. Cover site with a dressing and contact the physician
c. Apply oxygen per face mask and order chest x-ray
d. Monitor for air leaks and report subcutaneous emphysema

8. What is the goal of treatment in patients with rib fractures?

a. Maintain pulmonary function and relieve pain
b. Monitoring supplemental oxygen
c. Application of sequential stockings
d. Administering cough suppressant medication

9. What is the most common medical intervention required for patients with thoracic trauma?

a. Chest tube insertion
b. Thoracotomy
c. VATS (video-assisted thoracoscopic surgery)
d. Pericardiocentesis

10. Three days post motor vehicle crash, a patient was started on a regular diet. The nurse noticed the patient's chest tube drainage changed from serous-sanguineous to milky white. The physician orders for the fluid to be sent for triglyceride and chylomicron levels. The nurse suspects the patient may have:

a. Thoracic duct injury with chylothorax
b. Pulmonary contusion with empyema
c. Retained hemothorax with interstitial bleeding
d. Persistent air leak with pneumatocele

Thoracic Trauma

1. Which injuries are considered life-threatening, requiring immediate intervention?
    a. Tension pneumothorax and pericardial tamponade
    b. Cardiac contusion and rib fractures
    c. Clavicle fracture and pulmonary contusion
    d. Pneumomediastinum and subcutaneous emphysema

2. What is an early sign of tension pneumothorax?
    a. Tracheal deviation
    b. Respiratory distress
    c. Increased cardiac output
    d. Epistaxis

3. What is the immediate management of tension pneumothorax
    a. Chest tube placement in 7th intercostal space
    b. Place a three-sided dressing over chest tube site
    c. Needle decompression in the 4^{th} or 5^{th} intercostal space mid-axillary line
    d. ED thoracotomy

4. Flail chest is defined as:
    a. Multiple rib fractures with subsequent subcutaneous emphysema
    b. Chyle in the pleural space
    c. Excess fluid in pericardium
    d. Two or more ribs fractured at two or more points, and subsequent paradoxical motion

5. Which patient would benefit most from an emergent thoracotomy?
    a. 48 year-old patient with gunshot wound to the back who lost vital signs upon arrival to the ED
    b. 12 year-old patient with traumatic asphyxia with CPR in progress for past 15 minutes prior to arrival to the ED
    c. 16 year-old patient with significant trauma to head, GCS 4 on scene, intubated and CPR for past 5 minutes by prehospital providers
    d. 19 year-old patient with stab wound to chest who is dropped at Triage by friends, with fixed and dilated pupils

6. A nasogastric tube was inserted in a trauma patient. A follow-up chest radiograph shows abdominal contents in the chest cavity. The nurse should be suspicious of:
    a. Diaphragmatic rupture
    b. Chylothorax
    c. Pleural effusion
    d. Tension pneumothorax

7. What is the most appropriate immediate nursing intervention for a patient who has pulled out their chest tube?

a. Restrain patient and place bed in Trendelenburg position.
b. Cover site with a dressing and contact the physician
c. Apply oxygen per face mask and order chest x-ray
d. Monitor for air leaks and report subcutaneous emphysema

8. What is the goal of treatment in patients with rib fractures?

a. Maintain pulmonary function and relieve pain
b. Monitoring supplemental oxygen
c. Application of sequential stockings
d. Administering cough suppressant medication

9. What is the most common medical intervention required for patients with thoracic trauma?

a. Chest tube insertion
b. Thoracotomy
c. VATS (video-assisted thoracoscopic surgery)
d. Pericardiocentesis

10. Three days post motor vehicle crash, a patient was started on a regular diet. The nurse noticed the patient's chest tube drainage changed from serous-sanguineous to milky white. The physician orders for the fluid to be sent for triglyceride and chylomicron levels. The nurse suspects the patient may have:

a. Thoracic duct injury with chylothorax
b. Pulmonary contusion with empyema
c. Retained hemothorax with interstitial bleeding
d. Persistent air leak with pneumatocele

References

Thoracic Trauma

5th Edition

Altinok, T., Can, A. (2014). Management of tracheobronchial injuries. *The Eurasian Journal of Medicine, 46*(3), 209-215. https://pubmed.ncbi.nlm.nih.gov/25610327/

American College of Surgeons Committee on Trauma. (2018). Advanced trauma life support, ATLS student course manual, 10th ed. Chicago, IL: American College of Surgeons.

Barbero, C., Ricci, D., Boffini, M., Rinaldi, M. (2018). Traumatic heart and great vessels injuries. *Journal of Thoracic Disease, (11)(Suppl 2), 192-195.* *https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6389557/*

Chaudhry, R., Bordoni, B. (2021). *Anatomy, thorax, lungs.* StatPearls. https://www.ncbi.nlm.nih.gov/books/NBK470197/

Edgecombe, L., Sigmon, D., Galuska, M., Angus, L. (2021). Thoracic trauma. StatPearls. https://www.ncbi.nlm.nih.gov/books/NBK534843/

Emergency Nurses Association (2020). *Trauma nursing core course, 8th ed.* Jones & Bartlett Learning.

Feliciano, D. V., Mattox, K. L., & Moore, E. E. (Eds.). (2017). *Trauma, 8th ed.* New York, NY: McGraw-Hill Education.

Kim, M., & Moore, J. E. (2020). Chest Trauma: Current Recommendations for Rib Fractures, Pneumothorax, and Other Injuries. Current anesthesiology reports, 10(1), 61–68. https://doi.org/10.1007/s40140-020-00374-w

Hacking, C. Extensive rib plating for flail segment. Case study, Radiopaedia.org. (accessed on 27 Jan 2022) https://doi.org/10.53347/rID-84918

Kuo, K. (2021). *Rib fracture.* StatPearls. https://www.ncbi.nlm.nih.gov/books/NBK541020/

Lee, J, Cho, JS, Hoseok, I and Kim, YD. (2017). Delayed right chylothorax after left blunt chest trauma: A case report. *Journal of Medical Case Reports*, 11(98), 1250-1252. https://jmedicalcasereports.biomedcentral.com/articles/10.1186/s13256-017-1250-2

Llahi, M., St Lucia, K., Llahi, T. (2021). Anatomy, thorax, thoracic duct. *StatPearls.* StatPearls Publishing. https://www.ncbi.nlm.nih.gov/books/NBK513227/

Mahabadi, N., Goizueta, A., Bordoni, B. (2021). *Anatomy, thorax, lung pleura, and mediastinum.* StatPearls. https://www.ncbi.nlm.nih.gov/books/NBK519048/Darling, D. (2011). *Internet Encyclopedia of Science.* Retrieved from http://www.daviddarling.info/encyclopedia/D/diaphragm.html

McKendy, K. M., Lee, L. F., Boulva, K., Deckelbaum, D. L., Mulder, D. S., Razek, T. S., & Grushka, J. R. (2017). Epidural analgesia for traumatic rib fractures is associated with worse outcomes: a matched analysis. The Journal of surgical research, 214, 117–123. https://doi.org/10.1016/j.jss.2017.02.057

MedlinePlus. (2021, May 30). *Diaphragm and lungs.* *https://medlineplus.gov/ency/imagepages/19380.htm*

Ota, K., Fumimota, S., Lida, R., Kataoka, T., Ota, K., Taniguchi, K., Hanaoka, N., Takasu, A. (2018). Massive hemothorax due to two bleeding sources with minor injury mechanism: a case report. *Journal of Medical Case Reports, 12,* 291. https://doi.org/10.1186/s13256-018-1813-x

Otto, M., (2016) A better way to relieve rib fracture pain in the ICU. Retrieved from https://www.mdedge.com/chestphysician/article/106185/geriatrics/better-way-relieve-rib-fracture-pain-icu

Stoddard, N., Heil, J., Lowery, D. (2021, July 31). *Anatomy, thorax, mediastinum.* StatPearls. https://www.ncbi.nlm.nih.gov/books/NBK539819/

Stoppler, M. (2021, March 29). *Medical definition of jugular vein.* Medicine Net. https://www.medicinenet.com/jugular_vein/definition.htm

William, A., Bigham, C., Marchbank, A. (2020). Anaesthetic and surgical management of rib fractures. BJA Education,20(10), 332-340. https://www.bjaed.org/article/S2058-5349(20)30081-0/fulltext#relatedArticles