Case 90: Stab Wound to Chest

- **Chief complaint**
  - 29-year-old male presents with shortness of breath and stab wound to the chest
  - EMS Report (if requested): EMS was called to the scene of a large party, with the patient complaining of being stabbed in the chest with a broken liquor bottle
  - Time permitting: consider early discussion of preparation prior to patient arrival

- **Vital signs**
  - **HR: 118 BP: 75/38 RR: 30 Sat: 89% on RA** T: 37°C Wt: 100 kg

- **Patient appearance**
  - Patient appears in respiratory distress, repeatedly yelling "I can't breathe"

- **Primary survey**
  - Airway: speaking in three or four word phrases at a time
  - Breathing: moderate respiratory distress, diminished breath sounds to right chest, trachea deviated to left

- **Action**
  - Place patient on the monitor
  - Oxygen by NRB
  - Two large bore peripheral IV lines (draw rainbow top)
  - 1 L IVF bolus
  - Consider immediate R needle thoracostomy (describe procedure)
  - POCUS thoracic US to confirm pneumothorax
    - Figure 90.2- (A) R anterior chest wall, M-Mode showing stratosphere sign consistent with pneumothorax, (B) L anterior chest wall, M-Mode showing seashore sign consistent with normal lung, no pneumothorax
    - Figure 90.3 Video- Normal lung sliding on L, no lung sliding on R; consistent with pneumothorax
    - If asked, cardiac windows are normal
  - Briefly explain the situation to patient, may consider IV analgesia or anxiolytic prior to procedure (fentanyl, pain dose Ketamine or similar)
  - Decompression of pneumothorax
    - May consider R needle thoracostomy (describe procedure) first, must be quickly followed by
    - R tube thoracostomy (describe procedure, including appropriate analgesia with subQ lidocaine)

- Rush of air upon entry, hemothorax (500cc initial output, IF asked)

- **Instructor Prompt:**
  - Discuss clinical presentation and thoracic US findings to identify a differential for immediate life threat(s)
  - Discuss order of operations for stabilization during the primary survey
  - Patient reevaluation and repeat vitals:
    - Vitals after decompression of pneumothorax: HR: 95 BP: 115/78
    - Vitals if decompression not performed: **HR: 136 BP: 60/palp** (Prompt: decompress the pneumothorax)

- **Primary survey (continued)**
  - Circulation: warm, dry, 2+ pulses in all extremities, no active signs of bleeding
  - Disability: PERRL, eyes open spontaneously, answers questions appropriately, moving all extremities equally and spontaneously (GCS 15), sensation intact throughout
  - Exposure: remove clothing, full body skin exam including log-roll with spinal precautions reveals stab wound to R anterior chest above the nipple line, no other injuries evident

- **History**
  - Source: Patient, EMS
  - HPI: a 29-year-old male presents with shortness of breath and stab wound to the right chest. Patient states he was with his friends at a large party when a fight broke out. He was subsequently stabbed in the chest with a broken liquor bottle by an unknown assailant who subsequently fled the scene. Unknown last tetanus vaccination [must ask].
  - PMHx: negative
  - PSHx: none
  - Allergies: none
  - Meds: none
  - Social: social alcohol, including four beers tonight; denies smoking, or drugs
  - FHx: non-contributory
  - Code Status: full code

- **Secondary Survey** (s/p needle or tube decompression)
  - General: awake and alert, well-appearing, no acute distress
  - HEENT: normal
  - **Neck:** (must ask specifics) trachea midline, no JVD
  - **Chest/lungs:** (must ask specifics) symmetric bilateral breath sounds with equal chest wall expansion
    - 3 cm linear wound to right chest directly superior to the nipple, no crepitus or bony tenderness
    - Needle decompression only: R lung with slightly diminished breath sounds, L lung with normal breath sounds, no wheezing or crackles

        - Chest tube placed: chest tube in right 4th intercostal space at mid-axillary line, 500cc noted as initial output, symmetric breath sounds bilaterally, no wheezing or crackles
    - Heart**:** normal
    - Lungs: normal
    - Abdomen: normal
    - Rectal: normal
    - Extremities: normal
    - Back: normal
    - Neuro: normal
    - **Skin:** normal, with no other injuries except chest wall stab wound
    - Lymph: normal

- **Instructor Prompt:** learners should discuss differential diagnosis per location of stab wound

- **Action**
    - Order Labs
        - CBC, BMP, LFT, PT/INR, PTT, type and cross two units
    - Order Imaging
        - Stat portable CXR
        - CT chest or C/A/P with IV contrast [patient must be stabilized first]
    - Order Meds
        - Pain control (4-8 mg IV morphine or similar)
        - Tetanus IM
        - Prophylactic antibiotics s/p chest tube placement (cefazolin 2 g IV)
    - POCUS: FAST exam for penetrating trauma
        - **Figure 90.1**- RUQ, LUQ, pelvic and subxiphoid cardiac views negative for free fluid
    - Consult Surgery/Trauma: express concern for tension pneumothorax s/p decompression, hemothorax and need for admission

- **Response/Results**
    - **Case 90 Lab Results** (normal
    - CXR (**Figure 90.4**): R tube thoracostomy in place, small R pneumothorax

- **Action**
    - Update patient with presumed diagnosis and plan
    - Admit patient to Trauma

- **Diagnosis**
    - Primary Diagnosis: Tension pneumothorax
    - Secondary Diagnosis: Penetrating trauma to the chest, hemothorax

- **Critical actions**
    - Recognition of tension pneumothorax prior to CXR
    - Emergent decompression of tension pneumothorax via tube thoracostomy, or needle decompression followed by tube thoracostomy
    - POCUS eFAST exam
    - Confirmation of tube thoracostomy with CXR
    - Trauma surgery consult and admission

- **Instructor Guide**
    - This is a case of tension pneumothorax in a patient who sustained a stab wound to the chest. The patient presents hemodynamically unstable, with tachycardia, hypotension, tachypnea, and hypoxia with diminished breath sounds, respiratory distress, and tracheal deviation, consistent with tension pneumothorax. Important early actions include recognizing the clinical signs of tension pneumothorax (with or without POCUS guidance) and decompression with emergent needle decompression followed by chest tube placement. Any delay, including requesting a CXR prior to needle decompression or chest tube, can lead to clinical decompensation and cardiac arrest. After chest tube placement, the patient should be examined and worked-up for any other injuries. The patient should ultimately be admitted to Trauma.

- **Case Teaching Points**
    - The differential for shortness of breath after a stab wound to the chest should include (tension) pneumothorax, hemothorax, cardiac tamponade, lung laceration with associated hemorrhage, tracheo-bronchial injury, and aortic injury. Bedside ultrasound can quickly guide evaluation, especially for a hemodynamically unstable patient who should not be taken to a CT scanner. Depending on the location of the stab wound, intra-abdominal and diaphragmatic injury should also be considered.

- **What is the pathophysiology of tension pneumothorax?**
    - Tension pneumothorax occurs when there is a chest injury that acts as a one-way valve. The valve presents free movement of air with the chest and surrounding environment, effectively causing progressive accumulation of air within the chest. This leads to an increase in the intrapleural pressure.
    - In this manner, when the patient inspires, air enters the defect. However, when the patient expires, the air cannot exit. This causes progressive increase in intrapleural pressure.
    - The rising intrapleural pressure causes a shift of mediastinal contents away from the lung with tension pneumothorax. This causes compression of the vena cava and distortion of the cavoatrial junction, causing decreased diastolic filling of the heart and decreased cardiac output, or obstructive shock.
    - These physiologic changes cause rapid clinical deterioration including hypoxia, shock, and cardiac arrest if not treated expeditiously.

- **How does tension pneumothorax typically present?**
    - The classic triad of tension pneumothorax includes hypotension, distended neck veins, and diminished or absent breath sounds on the side of pneumothorax. However, all three of these elements need not be present for tension pneumothorax to occur.
    - Additional signs of tension pneumothorax include:
        - Tracheal deviation away from the side of tension pneumothorax
        - Hypoperfusion (i.e. altered mental status)
        - Hypoxia
        - Tachycardia
        - Cool extremities (i.e. obstructive shock)
    - Although tension pneumothorax is most commonly found in patients with penetrating trauma to the chest, any pneumothorax can exhibit tension physiology. For instance, a ruptured bleb or other spontaneous pneumothorax can become a tension pneumothorax. Additionally, patients with a small (non-tension) pneumothorax on positive-pressure ventilation can progress to a tension pneumothorax.

- **How is tension pneumothorax managed?**
    - If tension pneumothorax is suspected, a chest tube should be immediately placed. If needed or if there are any suspected delays to placing a chest tube, needle decompression should be performed.
    - For needle decompression, use a 14-gauge needle (for adults) and insert:
        - At the 2nd intercostal space just above the rib (so as to avoid the neurovascular bundle inferior to the rib) at the midclavicular line, or
        - At the 4th-5th intercostal space just above the rib at the anterior axillary line
    - Diagnostic imaging, such as chest x-ray or CT, should not be used to confirm tension pneumothorax. Any delay in treatment of tension pneumothorax can lead to complete hemodynamic collapse and cardiac arrest.
    - If there is any diagnostic uncertainty regarding the diagnosis of tension pneumothorax, bedside ultrasound can be used to evaluate for lung sliding and barcode sign.

- **In patients with hemothorax, what are indications for OR Thoracotomy?**
    - Persistent unstable vitals
    - Initial chest tube output >1.5L (20cc/kg) OR
    - Chest tube output >200/hr over 3-4hr (3cc/kg) OR persistent bleeding >7cc/kg/hr
    - Persistent air leak

- **POCUS Pearls**
    - POCUS is more sensitive than CXR in assessing for pneumothorax and especially helpful in the acutely ill patient when there isn't enough time for a CXR.
    - In cases of isolated penetrating trauma, the E-FAST exam can be abbreviated to focus on clinically relevant portions of the exam based on the location of injury. This can prevent delay in performing other critical interventions for the patient.

- To assess for a PTX, scan the anterior chest wall of a supine patient in the same location you would perform a needle decompression- air will collect in this least dependent portion of the chest first.
- Lung sliding or any comet tail artifact originating from the pleural line rules out PTX on B-mode and the “seashore sign” rules out PTX on M-mode (left lung images in this case).
- The “stratosphere sign” or “barcode sign” on M-Mode is highly suggestive of PTX
- Pitfalls:
  - Subcutaneous gas: traumatic injuries may cause air to collect in the soft tissues obscuring your ability to visualize the underlying pleura.
  - Be aware of false positives (lack of lung sliding when there is no pneumothorax): COPD, atelectasis, mainstem intubation, a patient who is not breathing, or pleural adhesions, all of which can mimic pneumothorax. Always evaluate ultrasound findings within the appropriate clinical context.

- **Attributions**
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    - Image References
      - XR from EMdocs (http://www.emdocs.net)
      - POCUS images courtesy of: Emory Emergency Medicine POCUS Archive

Case 90 Lab Results

Basic Metabolic Panel:

Na	138 mEq/L
K	4.0 mEq/L
Cl	104 mEq/L
CO_2	24 mEq/L
BUN	15 mg/dL
Cr	0.9 mg/dL
Gluc	86 mg/dL

Liver Function Panel:

AST	32 U/L
ALT	14 U/L
Alk Phos	90 U/L
T bili	1.1 mg/dL
D bili	0.3 mg/dL
Lipase	40 U/L
Albumin	4.0 g/dL

Complete Blood Count:

WBC	8.2 x 10^3/uL
Hb	14.1 g/dL
Hct	42.5%
Plt	285 x 10^3/uL

Urinalysis:

SG	1.018
pH	6.8
Prot	Neg
Gluc	Neg
Ketones	Neg
Bili	Neg
Blood	Neg
LE	Neg
Nitrite	Neg
Color	Yellow

Coagulation Panel:

PT	13.1 sec
INR	1.0
PTT	28 sec

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Figure 90.1- POCUS FAST exam

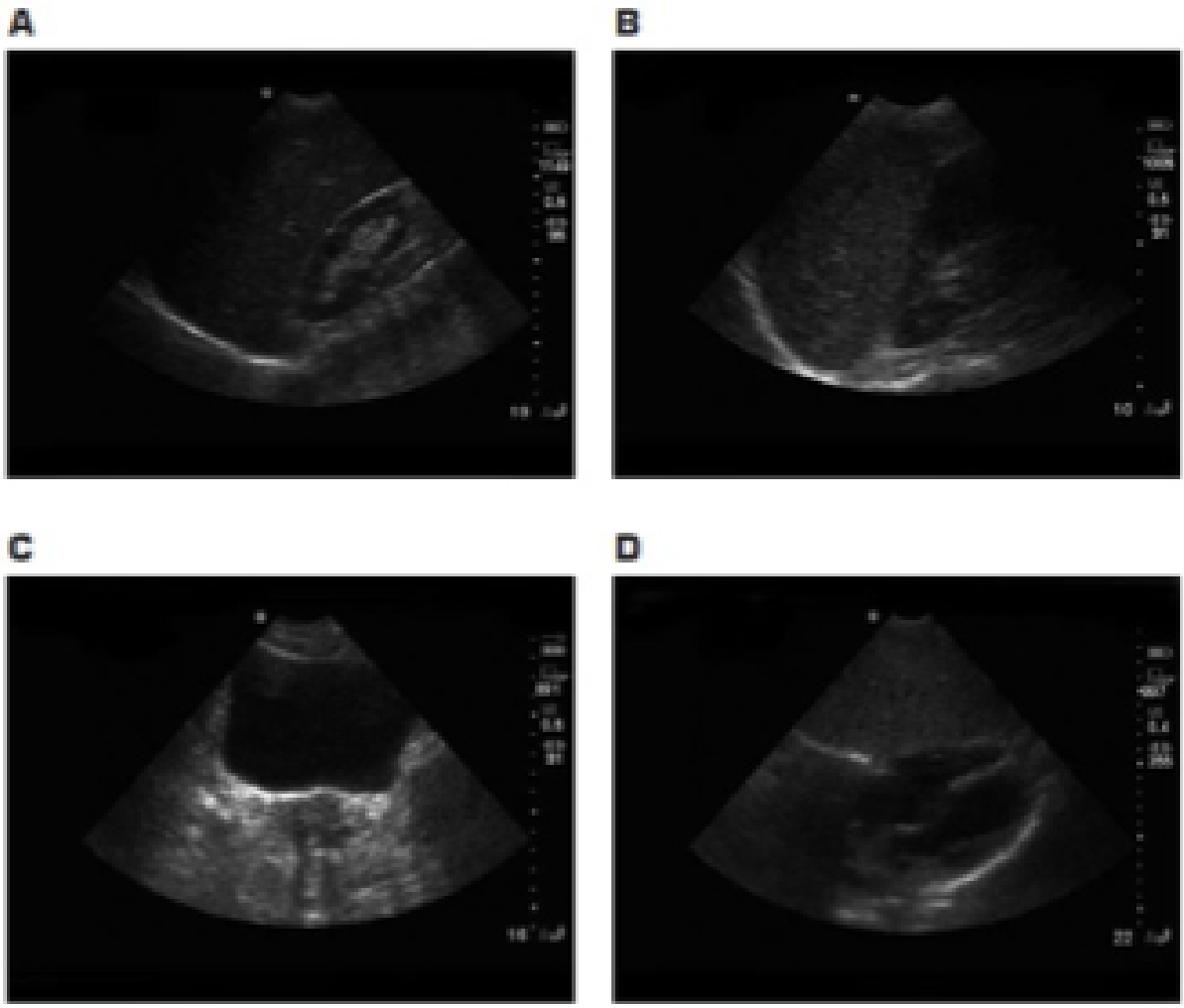

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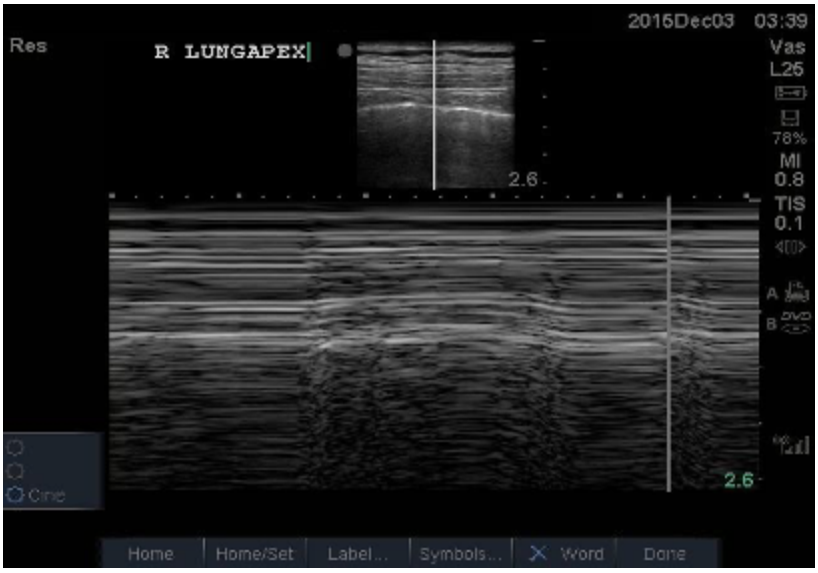
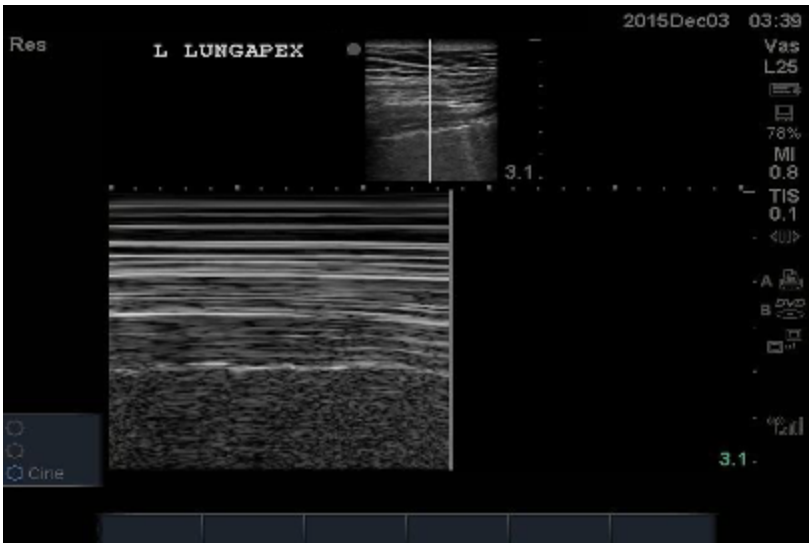
Figure 90.2- POCUS eFAST Thoracic Views

(A) Right Lung



(B) Left Lung



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Video 90.3- POCUS eFAST Thoracic Views

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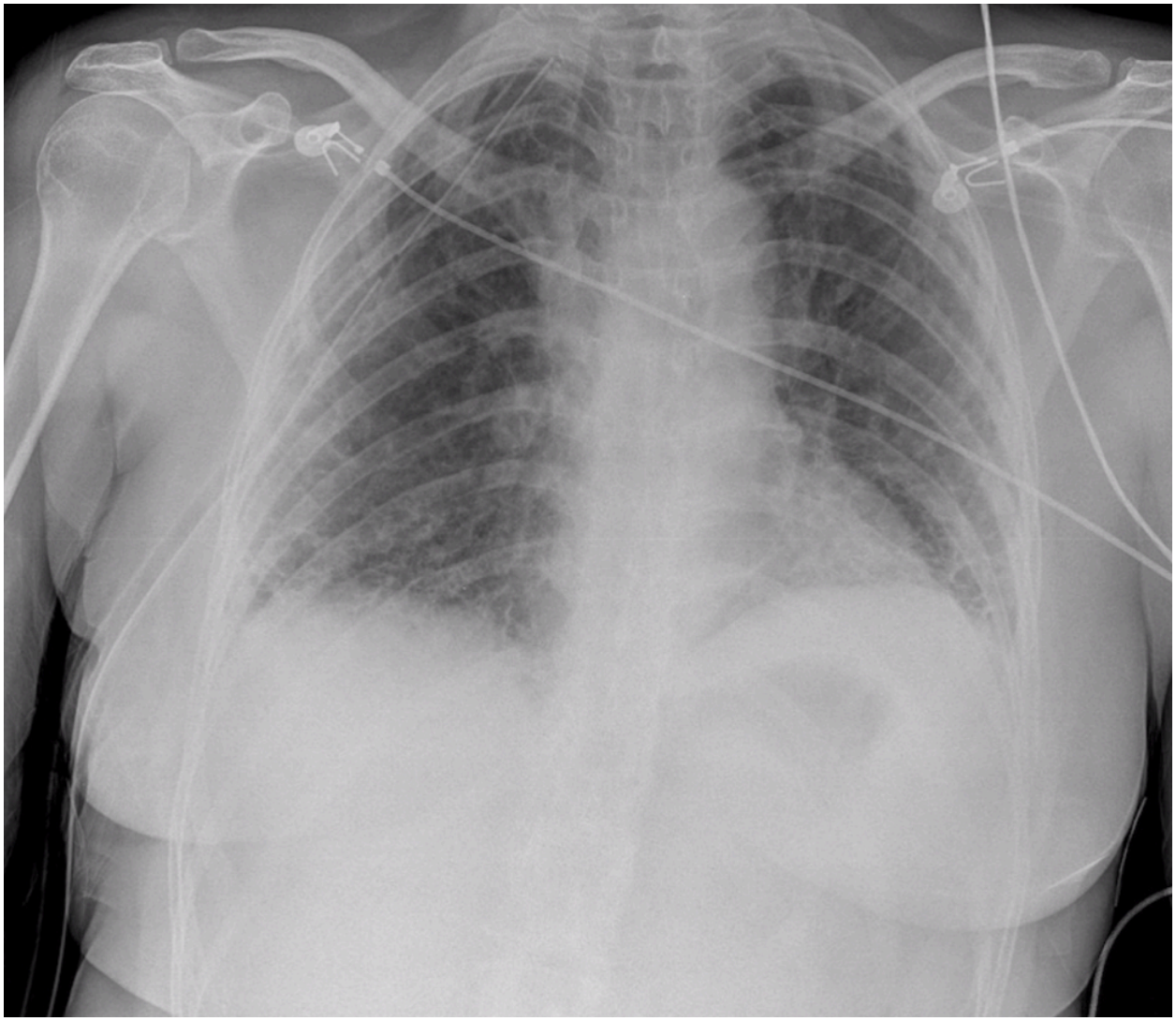
Figure 90.4- CXR



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