Case 7: Nausea and Vomiting

- **Chief complaint**
  - 32-year-old female presents with nausea, vomiting, and abdominal pain
  - EMS Report (if requested): Pt presenting from home with stomach cramps and vomiting since last night. She thinks she has the stomach flu.

- **Vital signs**
  - **HR: 122** BP: 142/90 **RR: 24** Sat: 99% on RA T: 36.9°C Wt: 75 kg

- **Patient appearance**
  - Patient appears uncomfortable, grabbing upper stomach and cringing

- **Primary survey**
  - Airway: speaking normally
  - **Breathing:** mild tachypnea, clear lungs
  - Circulation: warm skin, 2+ distal pulses
  - Disability: PERRL, opens eyes spontaneously, answers questions appropriately, moves all extremities spontaneously (GCS 15), distal sensation intact

- **Action**
  - Place patient on the monitor
  - Oxygen by NC (optional)
  - Two large bore peripheral IV lines (draw rainbow top)
  - 1 L IVF bolus
  - POC glucose (85, if ordered)
  - Order stat ECG (**Figure 7.1-** sinus tachycardia, occasional PVCs)
  - Order stat portable CXR

- **History**
  - Source: Patient
  - HPI: a 32-year-old female presents with nausea and vomiting. After eating out at a restaurant last night, she developed cramping and diffuse abdominal pain associated with nausea and vomiting. She had 3 episodes of nonbloody, nonbilious emesis overnight followed by a single episode of blood streak emesis this morning. She notes the abdominal pain is now more severe, localized in the upper abdomen and lower chest, and radiates to the back and shoulders. This pain is unchanged with position or exertion. She denies any history of recent trauma, cough, shortness of breath, fever, chills, urinary symptoms, or vaginal discharge.

- PMHx: negative
- PSHx: none
- Allergies: none
- Meds: none
- Social: denies alcohol, smoking, or drugs, sexually active with one partner, no hx of STIs
- FHx: non-contributory
- Code Status: full code

- **Physical Exam**
  - **General:** awake and alert, appears uncomfortable due to pain
  - HEENT: normal
  - Neck: normal
  - Chest: nontender, no crepitus
  - **Heart:** tachycardic, otherwise normal
  - **Lungs**: tachypneic, decreased breath sounds at bilateral bases
  - **Abdomen:** soft, nondistended, tenderness to palpation in epigastric area, no rebound or guarding
  - Rectal: normal
  - Pelvic: normal
  - Extremities: normal
  - Back: normal
  - Neuro: normal
  - Skin: normal
  - Lymph: normal

- **Instructor Prompt:** learners should discuss differential diagnosis

- **Action**
  - Order Labs
    - CBC, BMP, LFT, lipase, PT/INR, PTT, type and screen, urinalysis, serum hCG
    - Consider lactate, alcohol level, salicylate, acetaminophen, UDS, troponin, d-dimer
  - Order Imaging
    - CXR (if not already ordered)
    - Consider CT abdomen/pelvis with IV contrast
  - Order Meds
    - 1 L IVF bolus (if not already given, may consider 2nd liter)
    - IV analgesia (consider opioid medication)
    - IV antiemetic (ondansetron 4 mg IV)
  - Consider POCUS Thoracic/Lung
    - **Figure 7.2 A**: Anterior R & L chest wall (B-mode), normal lung sliding, no PTX
    - **Figure 7.2 B**: Anterior R & L chest wall (M-mode), seashore sign, no PTX
    - **Video 7.3**: Anterior R & L chest wall (B-Mode), normal lung sliding, no PTX

- **Response/Results**
  - Patient reevaluation and repeat vitals:
    - Patient has worsening pain after another episode of vomiting, now diffusely across chest (give additional IV opioids)
    - Reexamination of patient reveals palpable crepitus in bilateral upper chest and neck
    - Vitals after IVF bolus and pain med: HR: **128** **BP: 110/74** **RR 35** Sat: 99% (Prompt: give additional IVF bolus)
    - Vitals if IVF bolus and pain med not given: HR: **140** **BP: 97/52** **RR 35** Sat: 99% (Prompt: give IVF bolus)
  - **Case 7 Lab Results** (sig for WBC 14.9, CO_2 20)
  - Additional Lab Results: **lactate 5.2**, **lipase 200**, serum hCG negative, all other labs negative
  - CXR (**Figure 7.4:** normal)

- **Instructor Prompt:** given the change in patient's status and new exam findings, discuss an updated differential diagnosis and what further interventions and studies are required

- **Action**
  - Oxygen by NC or NRB (if not already done)
  - Order stat repeat portable CXR
  - Consider repeat ECG

- **Response/Results**
  - Patient reevaluation:
    - Pain is still present but improved
    - Vitals after additional IVF bolus, pain meds, and supplemental oxygen: HR: **120** BP: 116/78 **RR 32** Sat: 100% on NC or NRB
  - Repeat CXR (**Figure 7.5**: subcutaneous emphysema in neck and pneumomediastinum)
  - Repeat ECG (verbal report: unchanged, with sinus tachycardia, occasional PVCs)

- **Action**
  - Make patient NPO
  - Order Meds
    - Additional IV fluids for a total of at least 30 mL/kg
    - Additional IV opioids prn
    - IV antibiotics (piperacillin/tazobactam, meropenem, or cefepime/metronidazole and vancomycin)
    - IV PPI (pantoprazole 40-80 mg IV bolus)
  - Order additional Imaging
    - CT neck and chest with IV contrast
    - Consider contrast esophagram [water-soluble contrast]

    - Consult GI and CT surgery: express concern for esophageal perforation and need for procedural or operative intervention
        - Both consultants state they will come to evaluate the patient after the additional imaging tests are performed. The learner should advocate for emergent evaluation based on the clinical presentation and CXR findings.

- **Response/Results**
    - CT neck and chest with IV contrast (**Figure 7.6**: left sided pneumothorax, moderate bilateral pleural effusions, pneumomediastinum)
    - CT abdomen and pelvis, if ordered (verbal report: no acute findings)
    - Contrast esophagram (**Figure 7.7:** contrast extravasation from the esophagus just proximal to the gastroesophageal junction)
    - Place left sided chest tube
    - Discuss case with GI and CT surgery consultants
        - GI defers to CT surgery
        - CT surgery recommendations include keeping the patient NPO, continued resuscitation with IVF, broad-spectrum antibiotics, chest tube and admission to ICU with plans for surgical repair.
    - Update patient of presumed diagnosis and plan
    - Admit patient to ICU

- **Diagnosis**
    - Primary Diagnosis: Boerhaave syndrome
    - Secondary Diagnoses: pneumothorax, mediastinitis

- **Critical actions**
    - IVF bolus
    - Treat symptoms (antiemetic, pain control)
    - Stat CXR
    - Early broad-spectrum IV antibiotics
    - Consultations with GI and CT surgery for emergent intervention
    - Admission to ICU

- **Instructor Guide**
    - This is a case of Boerhaave syndrome or esophageal rupture in a patient presenting with forceful vomiting in the setting of severe gastroenteritis. The patient presented with tachycardia, tachypnea, and epigastric pain with decreased breath sounds at bilateral bases, which should signal to learners to broaden differential beyond uncomplicated gastroenteritis to include cardiopulmonary pathology. Important early actions include recognition of abnormal vital signs, prompt resuscitation with IVF, and supportive care with antiemetics and adequate pain management. Reevaluation and reexamination of this patient is essential in this case and will reveal worsening pain, minimal improvement in vital signs, and crepitus. If the patient is not reevaluated, the nurse will alert learners

of increasing heart rate, tachypnea, hypoxia, hypotension and altered mental status. After finding crepitus, important actions include stat repeat CXR, initiation of broad-spectrum antibiotics, and CT imaging. POCUS, although not required, may be useful in this case to identify the development of pneumothorax and pleural effusions.
    - If time allows, consider difficult consultants and delaying the CT scan and CT reads. After the repeat CXR, the surgical consultant can be reluctant to see the patient with "gastroenteritis" prior to obtaining the CT scan. There can also be a delay with the CT scan due to high ED volume. Learners should point to their exam, CXR, and lab findings as reasons to have high suspicion for Boerhaave syndrome and push the consultants to see the patient as soon as possible. The patient should be dispositioned to the ICU with possible surgical intervention.

- **Case Teaching Points**
    - The differential for nausea, vomiting and epigastric pain should include gastroenteritis, viral infection (such as COVID-19, influenza), peptic ulcer disease, pancreatitis, biliary tract disease, SBO, gastroparesis, ACS, dissection, pulmonary embolism, pneumonia, pneumothorax, hepatitis, and Boerhaave syndrome.
    - Although this patient likely has a viral infection, epigastric pain and in this case tachypnea and tachycardia should direct learners to include cardiopulmonary etiologies in their differential. Given abrupt onset of symptoms, pneumonia and URI are less likely causes for the patient's symptoms. ACS is unlikely given the patient's age and lack of risk factors, and the patient is unlikely to have a PE in the setting of a negative d-dimer. SBO and gastroparesis are also less likely without any medical history.

- **What is Boerhaave syndrome?**
    - Boerhaave syndrome is a type of esophageal rupture caused by the rapid increase in intraesophageal pressure countered by the opposing negative intrathoracic pressure that then leads to spontaneous perforation. This can occur with deep inspirations between forceful vomiting.
        - Makes up 15% of esophageal ruptures
        - Lack of serosal layer makes the esophagus prone to rupture
        - Most common location is the left posterior aspect of the distal esophagus, 2–3 cm proximal to the gastroesophageal junction
        - Other causes of esophageal rupture include: ingestions (FB or caustic), neoplasm, infection, blunt or penetrating trauma, instrumentation

- **In which clinical presentations should esophageal rupture be high on the differential?**
    - High index of suspicion is essential
        - 1/3 of patients have an atypical presentation although most common presenting symptom is chest pain
        - Be cognizant of tunnel vision and anchoring on common diagnoses
    - Medical history: esophageal cancer, infection, recent endoscopic procedure, penetrating trauma, foreign body or caustic ingestion

- Physical exam:
  - Uncomfortable, ill-appearing
  - VS abnormalities: tachycardia and tachypnea
  - Subcutaneous air
  - Unilateral diminished breath sounds
- Mackler's triad: vomiting, chest pain and subcutaneous emphysema
- Pitfalls
  - Mediastinal emphysema requires time to develop
  - Initial severe chest pain may occur with rupture and initial extravasation of contents, but then improves when sealed off
  - If there are no clinical improvement of symptoms after initial resuscitation, step back and reassess
  - Unstable vitals are followed by respiratory distress and shock

- **What are the imaging modalities to help diagnose esophageal perforation?**
  - Thoracic POCUS: evaluate for effusion
  - CXR: mediastinal widening, pneumomediastinum, subcutaneous air
  - Contrast esophagram: extravasation of water-soluble contrast
  - CT scan: with IV contrast
    - If using PO contrast, use water-soluble contrast PO
    - Barium is caustic to the mediastinum and worsens injury, if leaked into the mediastinum due to full thickness tear/rupture

- **How is esophageal perforation managed in the ED?**
  - ABCs
    - Airway
    - Breathing: consider pneumothorax (perform POCUS)
      - Consider chest tube for pneumothorax or hemothorax
    - Circulation: at risk for distributive shock as bacteria disseminate into bloodstream through mediastinal space
      - IVF, vasopressors as needed hypotension
      - Early broad-spectrum antibiotics
        - Gram positive, gram negative, pseudomonas, and anaerobic coverage
          - Piperacillin/tazobactam
          - or Meropenem
          - or Cefepime + Metronidazole
        - MRSA coverage
          - Add vancomycin
        - Consider addition of caspofungin and fluconazole if immunocompromised
      - Antiemetics to prevent volume depletion and further esophageal tear and extravasation of gastric contents

            - Adequate pain control (increased pain can increase esophageal pressure)
            - Adequate sedation if patient is intubated
            - Initiate proton pump inhibitor
    - Surgical consultation for primary repair
        - Surgical management via VATS or open thoracotomy likely with pleural or mediastinal contamination
    - GI consultation, especially if iatrogenic or early diagnosis without widespread contamination for possible repair with stent and IR for chest tube and fluid drainage.
    - Admission to ICU

- **What is the mortality associated with Boerhaave syndrome?**
    - Boerhaave syndrome has a high mortality due to extravasation of gastric contents, digestive enzymes and bacteria into the mediastinal space. This can lead to:
        - Mediastinitis, pleural empyema, pneumothorax (secondary to rupture of the parietal pleura)
        - Septic shock and multi-organ failure
    - High mortality rate if untreated (>90%) and remains high even in those with surgical intervention (40%); however is better with early treatment
    - A patient who is nontoxic appearing on arrival still needs ICU admission due to high mortality and risk for subsequent complications

- **POCUS Pearls** (time-permitting)
    - POCUS is more sensitive for detecting PTX than CXR and can be performed more rapidly at the bedside than a CXR.
    - To assess for PTX, scan the anterior chest wall with the linear probe while the patient is supine. Air will collect in the least dependent portion of the chest.
    - In B-mode (Basic mode), lung sliding or any comet tail artifact at the pleural line rules out PTX in the rib space you are evaluating.
    - In M-mode (Motion mode), the “seashore sign” indicates movement of the lung below the pleural line and rules out PTX in the rib space you are evaluating. The “stratosphere” or “barcode” sign (uniform linear appearance across the top and bottom of the image) is pathognomonic for PTX.

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    - CXRs from Radiopaedia: https://radiopaedia.org/cases/normal-cxr-and-lateral?lang=us, https://radiopaedia.org/cases/pneumomediastinum-18?lang=us
    - CT courtesy of Dr. Nicole Prendergast
    - XR esophagram courtesy of Dr. Nicole Prendergast
    - POCUS images courtesy of: Northwestern Emergency Medicine POCUS Image Bank AND Emory Emergency Medicine POCUS Archive

Case 7 Lab Results

Basic Metabolic Panel:

Na	139 mEq/L
K	3.5 mEq/L
Cl	97 mEq/L
CO_2	20 mEq/L
BUN	20 mg/dL
Cr	1.2 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	200 U/L
Albumin	4.0 g/dL

Complete Blood Count:

WBC	14.9 x 10^3/uL
Hb	14.1 g/dL
Hct	42.5%
Plt	285 x 10^3/uL

Coagulation Panel:

PT	13.1 sec
INR	1.0
PTT	28 sec

Urinalysis:

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

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Figure 7.1- ECG

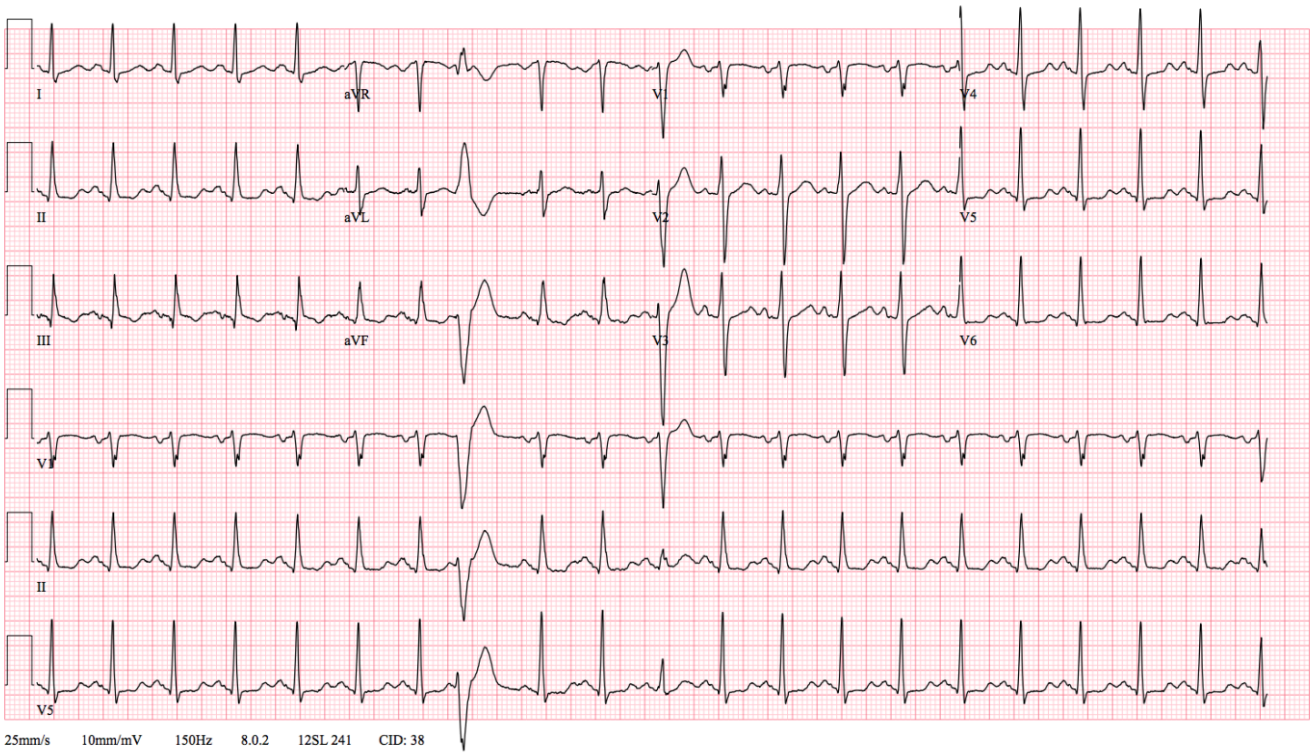

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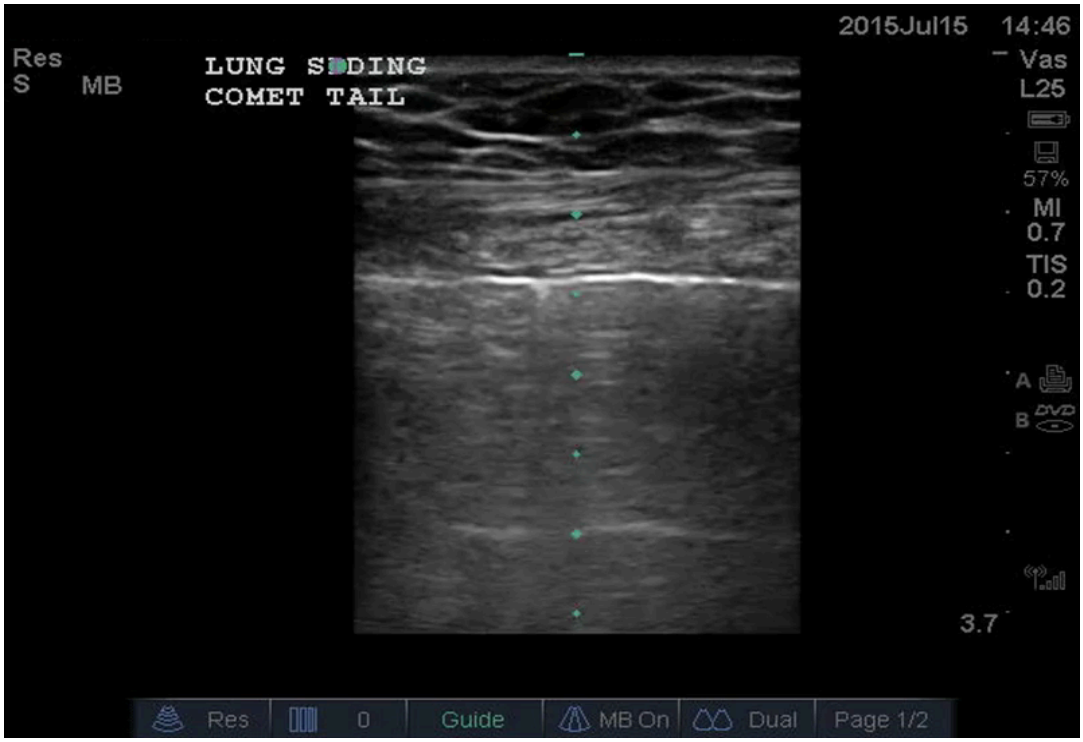
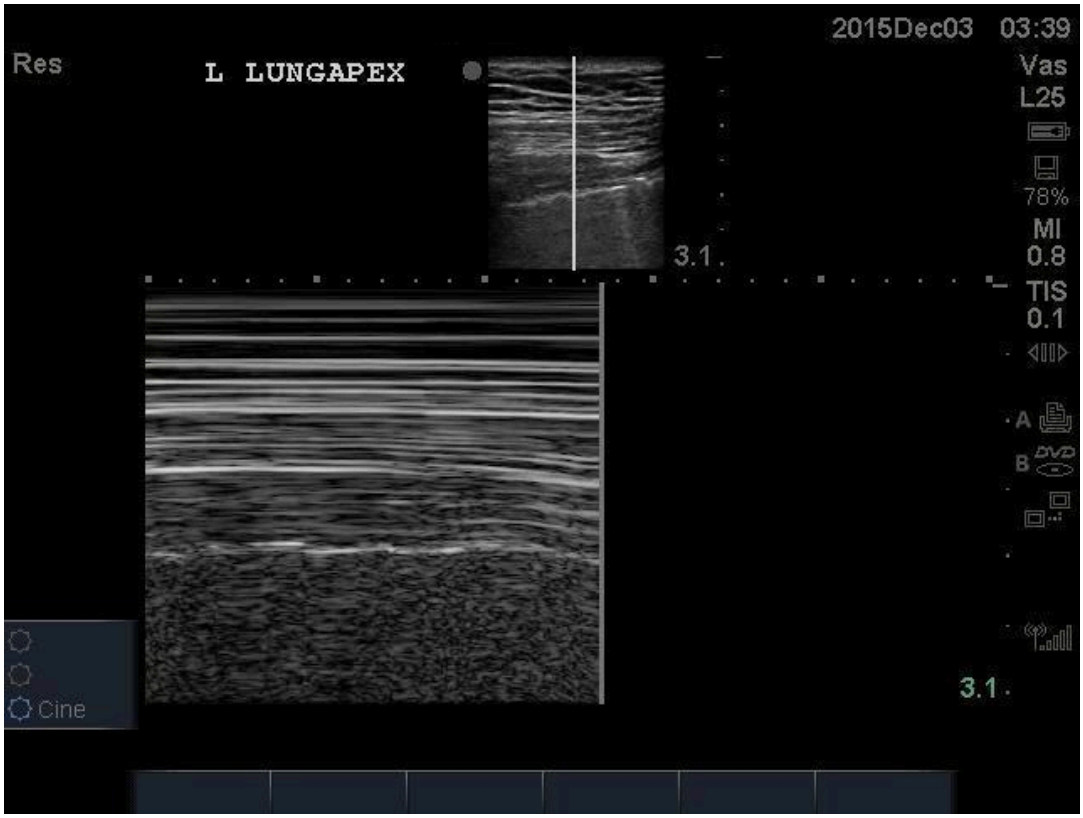
Figure 7.2- Thoracic POCUS (R&L) [(A) B-mode and (B) M-Mode]

A.



B.



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Video 7.3- Thoracic POCUS (R&L) [B-mode]

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Figure 7.4- CXR

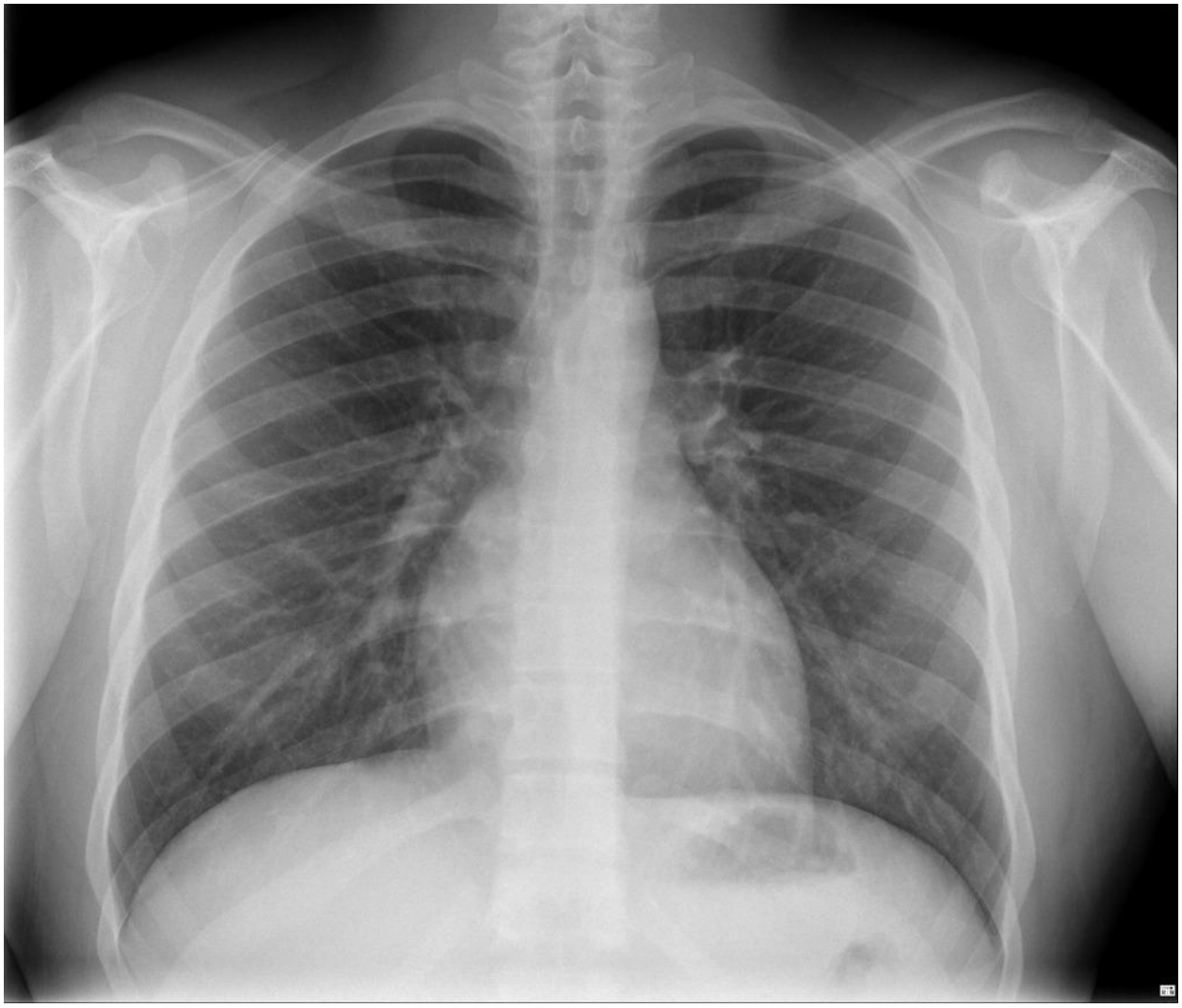

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Figure 7.5- Repeat CXR

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Figure 7.6- CT neck and chest with IV contrast

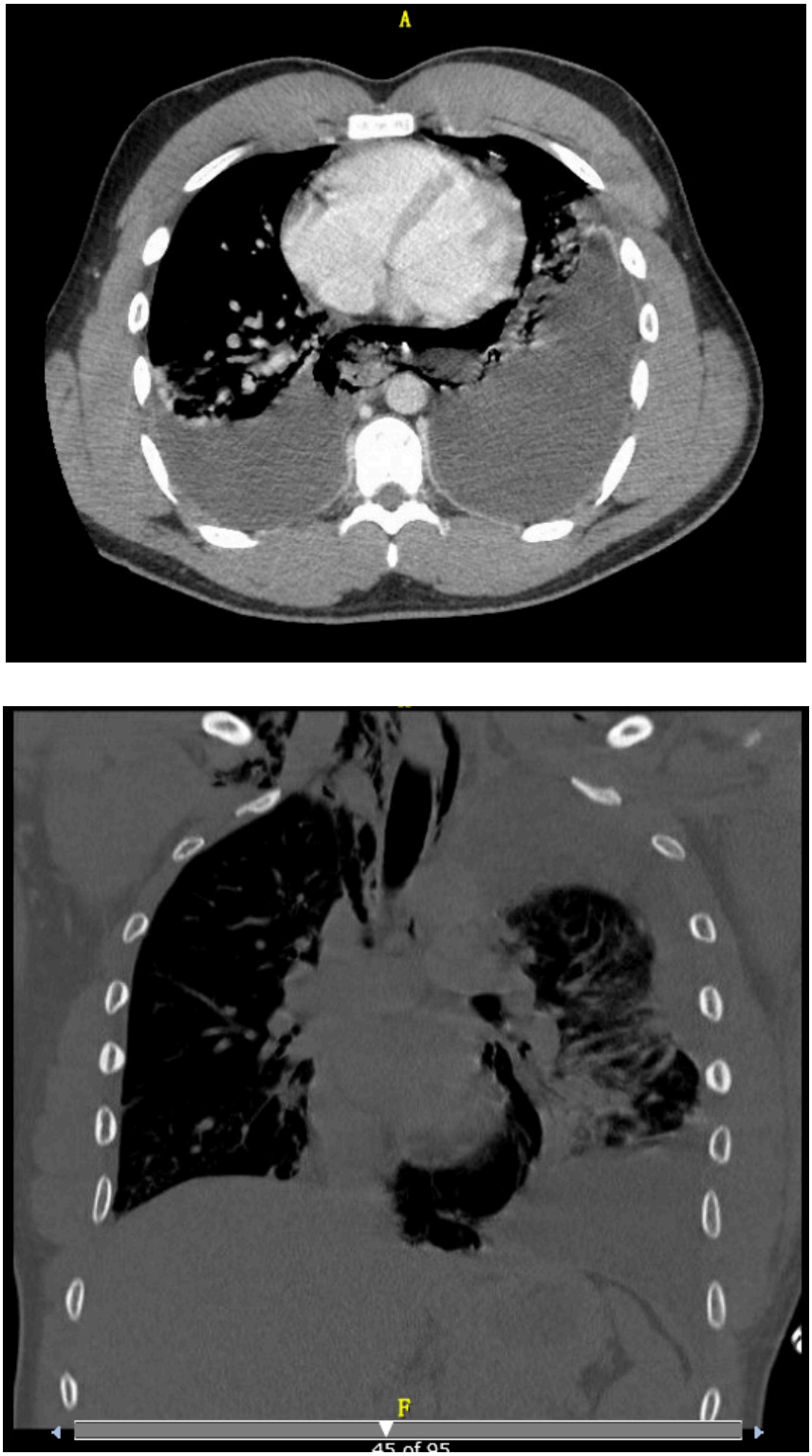

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Figure 7.7- Contrast Esophagram

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