

III. Acute Pulmonary Edema

Shalini Reddy, MD
Assistant Dean of Student Programs
University of Chicago Pritzker School of Medicine

Michelle Sweet, MD
Subinternship Director
Rush University Medical College

Learning Objectives:

1) Knowledge:

Subinterns should be able to:

- a) Understand the pathophysiology behind both cardiogenic and noncardiogenic causes
- b) Recognize the etiologies of cardiogenic pulmonary edema including:
 - myocardial ischemia
 - valvular disease (acute aortic insufficiency, mitral regurgitation, mitral stenosis)
 - renovascular hypertension
 - tachycardia
 - other underlying conditions that may precipitate pulmonary edema (fever, sepsis, thyroid disease, anemia)
- c) Recognize the etiologies of noncardiogenic pulmonary edema including:
 - ARDS
 - Re-expansion pulmonary edema
 - High altitude pulmonary edema
 - Neurogenic pulmonary edema
 - Transfusion related acute lung injury (TRALI)
 - Opiate toxicity
 - Salicylate poisoning
 - Reperfusion pulmonary edema
 - Pulmonary embolus
- d) Recognize the clinical symptoms and signs of pulmonary edema
- e) Assess the severity of a patient's condition based on clinical presentation, laboratory and radiographic data (ECG, CXR, ABG)
- f) Identify other conditions that may closely mimic acute pulmonary edema in clinical presentation (PE, pneumonia, ARDS)
- g) Describe indications for emergent treatment regimens in acute pulmonary edema such as:

- Oxygen
 - Diuretics
 - Vasodilators
 - Morphine
 - ACE inhibitors
 - Inotropic agents
- h) Describe the mechanisms of actions of the above medications in the treatment of pulmonary edema
- i) Describe the major indications for intubation and mechanical ventilation
- j) Recognize situations in which it is necessary to seek support from resident emergently.
- k) Recognize indications for transfer to higher care units (e.g. the intensive care unit).

2) Skills.

Subinterns should demonstrate skill in:

- a) Identifying symptoms of acute pulmonary edema
- b) Conducting a history specific for symptoms relating to pulmonary edema and a patient's decompensation from pulmonary edema
- c) Performing an appropriate physical exam including an assessment for hemodynamic stability and impending respiratory failure
- d) Creating a differential diagnosis for acute pulmonary edema based on specific clinical situations
- e) Interpreting laboratory/radiographic studies (ABG, CXR, ECG) to arrive at specific cause for acute pulmonary edema
- f) Developing a management plan for patients in acute pulmonary edema including emergent supportive care and follow-up care (measuring daily weights, urinary input-output)

Case I: Acute Pulmonary Edema

SCENARIO: You are on call for the general medicine team and are cross-covering for a colleague. A nurse from the 5th floor (telemetry) calls you about pt RD, “Dr., I am calling you about Dr. Smith’s patient, Mr. D. He is short of breath.”

1. **Question:** what additional questions would you like to ask the nurse?
2. **Question:** are there any telephone orders you would like to give the nurse?
3. **Question:** What are your thoughts about a differential diagnosis as you proceed to the patient’s room?
4. **Question:** What specific information do you want to look for on exam?

EXAM: On examination he is a middle-aged man who looks older than his stated age, tachypneic and in acute distress. He cannot answer any questions because of his extreme shortness of breath. He is restless and prefers to sit up in bed. BP 90/70, P 120 irreg., RR 28, T 98.5 Oxygen saturation 83%. JVP is elevated 12 cm. Chest: decreased breath sounds and dullness at both bases, with coarse crackles to above the scapula. Cardiac exam: PMI diffuse, laterally and inferiorly displaced, distant heart sounds, S3 gallop, intermittent midsystolic murmur at the apex. Abdominal exam is normal. Extremities are cool with thready pulses and without edema.

5. Question: what should you do next?

ADDITIONAL DATA:

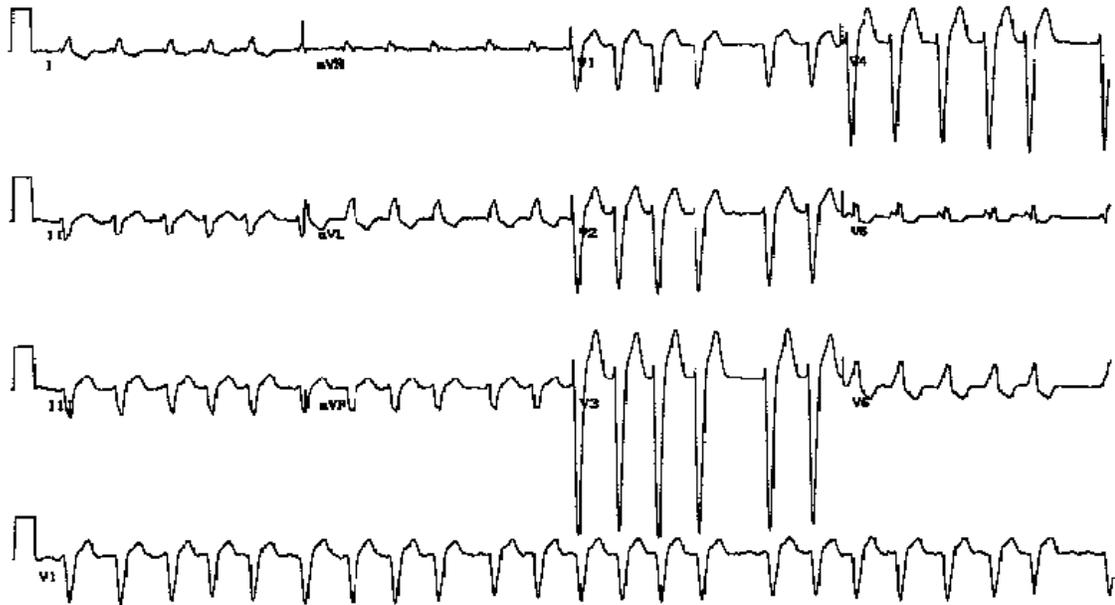
Additional history from your quick chart review:

59 y/o man with ischemic cardiomyopathy (EF 30%) admitted for an acute CHF exacerbation as a result of increased dietary sodium intake. He has been in the hospital for three days and has been receiving IV lasix for diuresis. He has diuresed approximately 2 pounds each day. He received a contrasted CT scan today for the evaluation of abdominal pain. Shortness of breath began 10 minutes ago.

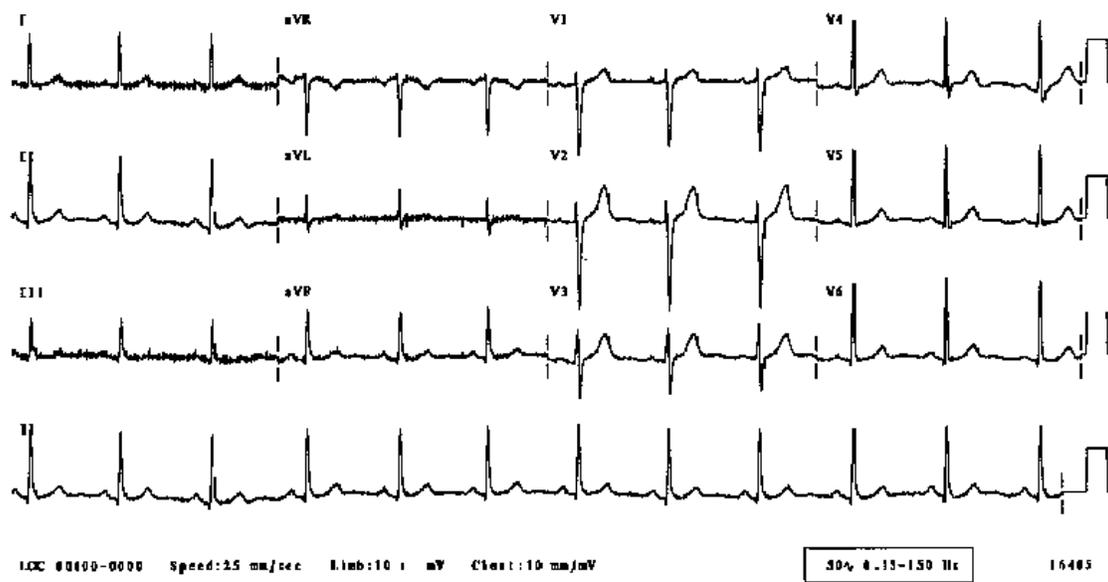
Lab:

**Hct 38 WBC 12.9 75 P/28 L Plt 245 K
Na 129K 3.5 C1 96 HCO₃ 27 BUN 44 Creat 1.4 Glu 116
R.A. ABG pH 7.48 pO₂ 54 pCO₂34 HCO₃ 24**

Current ECG:



EKG from admission:



CXR:



Additional questions:

6. What are possibilities to explain his presentation?
7. Why the narrowed pulse pressure?
8. Interpret the ABG in relation to the clinical findings.
9. What other tests would you order?
10. How would you treat him?

Case II: Acute Pulmonary Edema

SCENARIO: You are on call on the general medical floor and Mr X, your new admission, just arrived on the unit from the emergency department. He is a 65 year old man with a history of alcohol abuse who comes in with a fever and shortness of breath. His symptoms have been present for the past 3 days. He has a cough productive of green sputum and chest pain while coughing. His admission vital signs include: BP 100/74, P 110, RR 28, T 102.4, SpO₂ = 92% on 4L nasal cannula. His pulmonary exam includes rales on left lower lung fields.

Labs:

Hct 33 WBC 18.8 Plt 111 K
Na 131 K 3.5 C1 100 HCO₃ 23 BUN 48 Creat 1.2 Glu 117
AST: 111 ALT: 60 T Bili:1.6

1. Question: What is your differential diagnosis?
2. Question: What other tests would you order?
3. Question: How would you treat Mr X?

FOLLOW UP: You diagnosis Mr X with community acquired pneumonia after finding a left lower lobe infiltrate on his chest x-ray. Overnight Mr X has become more hypoxic. His vital signs this morning include RR36 P 132 BP90/66, T 100.3 SpO₂=92% on 100% nonrebreather mask. His physical exam this morning reveals that he is in obvious respiratory distress. He has crackles bilaterally on lung exam in all lung fields. He is hyperventilating and using his accessory respiratory muscles. He is more lethargic this morning. He has no JVD, no peripheral edema, and his cardiac exam is the same as last night, except he is now more tachycardic. His ABG is pH 7.33 pCO₂ 48 pO₂ 62 HCO₃ 25. His repeat CXR is below.



4. Question: What is the differential diagnosis to explain his decompensation acutely?

5. Question: What tests would you order to confirm a diagnosis?

6. Question: How would you interpret his ABG?

FOLLOW UP: Mr X is transferred to the ICU and subsequently intubated and placed on a ventilator. An echocardiogram is performed and this reveals a normal ejection fraction with no significant wall motion abnormalities, valvular disease, or effusions.

7. Question: What is your most likely diagnosis? Based on what criteria?

8. Question: What are the most common causes of this condition?

9. Question: How would you manage his symptoms?

References

General overviews:

ACC/AHA Guidelines for the Evaluation and Management of Chronic Heart Failure in the Adult: Executive Summary

[HTTP://CIRC.AHAJOURNALS.ORG/CGI/CONTENT/FULL/104/24/2996](http://circ.ahajournals.org/cgi/content/full/104/24/2996)

Sacchetti AD, Harris RH: Acute cardiogenic pulmonary edema. What's the latest in emergency treatment? *Postgrad Med* 1998, 103:145–147

Gandhi SK. Powers JC. Nomeir AM. Fowle K. Kitzman DW. Rankin KM. Little WC. **The pathogenesis of acute pulmonary edema associated with hypertension.**[comment]. [Clinical Trial. Journal Article] *New England Journal of Medicine*. 344(1):17-22, 2001 Jan 4.

Brochard L: Noninvasive ventilation for acute respiratory failure. *JAMA* 2002, 288:932–935. The authors review noninvasive ventilation indications and practical modalities in various types of acute respiratory failure.

Hollenberg SM. Kavinsky CJ. Parrillo JE. Cardiogenic Shock. *Annals of Internal Medicine*. 131 (1): 47-59, 1999 July.

Sharma S. Kumar A. **Septic shock, multiple organ failure, and acute respiratory distress syndrome.** [Review] [112 refs] [Journal Article. Review. Review, Tutorial] *Current Opinion in Pulmonary Medicine*. 9(3):199-209, 2003 May.

Bernard GR, Artigas A, Brigham KL, et al: **The American-European Consensus Conference on ARDS: Definitions, mechanisms, relevant outcomes, and clinical trial coordination.** *Am J Respir Crit Care Med* 149:818–824, 1994.

Diagnosis:

Martin GS. Ely EW. Carroll FE. Bernard GR. **Findings on the portable chest radiograph correlate with fluid balance in critically ill patients.**[comment]. [Clinical Trial. Journal Article. Randomized Controlled Trial] *Chest*. 122(6):2087-95, 2002 Dec.

Duane PG. Colice GL. **Impact of noninvasive studies to distinguish volume overload from ARDS in acutely ill patients with pulmonary edema: analysis of the medical literature from 1966 to 1998.** [Journal Article. Meta-Analysis] *Chest*. 118(6):1709-17, 2000 Dec.

Etiologies:

Kopko PM. Marshall CS. MacKenzie MR. Holland PV. Popovsky MA. **Transfusion-related acute lung injury: report of a clinical look-back investigation.** [Journal Article] *JAMA*. 287(15):1968-71, 2002 Apr 17.

Kirby RR. **Perioperative fluid therapy and postoperative pulmonary edema: cause-effect relationship?[comment].** [Comment. Editorial] *Chest*. 115(5):1224-6, 1999 May. Treatment

British Thoracic Society Standards of Care Committee: Non-invasive ventilation in acute respiratory failure. *Thorax* 2002, 57:192–211. A consensus statement from the British Thoracic Society on the use of noninvasive ventilation in acute respiratory failure.

L'Her E. **Noninvasive mechanical ventilation in acute cardiogenic pulmonary edema.** [Review] [53 refs] [Journal Article. Review. Review, Tutorial] *Current Opinion in Critical Care*. 9(1):67-71, 2003 Feb.

Case II CXR:

Courtesy of Michael B. Gotway, MD, Department of Radiology, University of California, San Francisco. **Mason: Murray & Nadel's Textbook of Respiratory Medicine**, 4th ed. 2005