

Disease of the Pleura

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Academic Half Day 3-28-2023

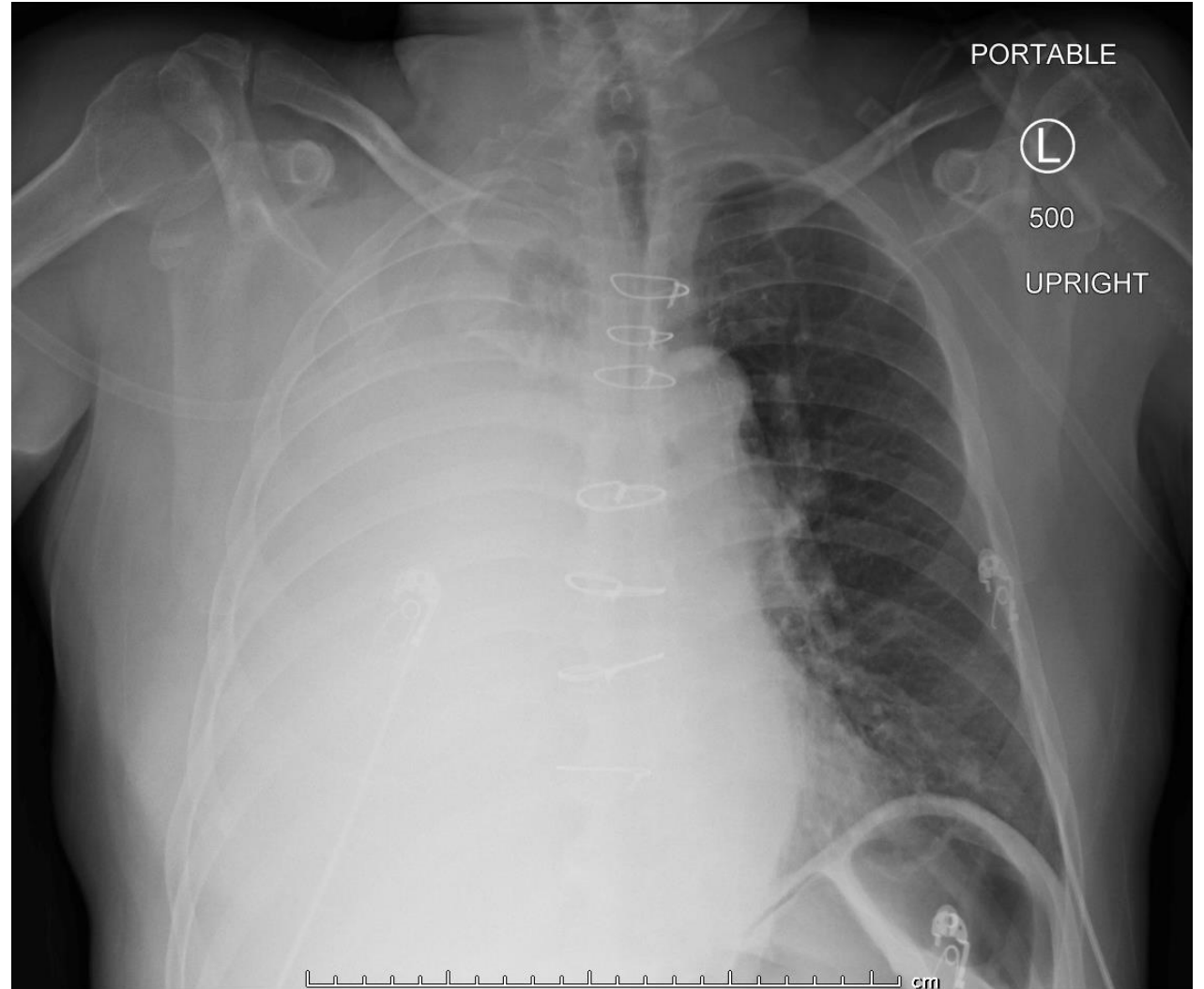


Objectives

- Describe the symptoms and physical exam findings of a pleural effusion.
- Describe the indications for thoracentesis.
- Describe the appropriate tests to order to evaluate pleural fluid according to Light's criteria, 2-test and 3-test rule. Know how to determine if the fluid is transudative or exudative.
- Describe the differential for transudative effusions and describe the evaluation that can help determine when a transudative effusion is falsely exudative (especially after diuretics have been given.)
- Describe the differential for exudative effusions. Know the indications for chest tube drainage of exudative pleural effusions.
- Describe the indications for treatment for a spontaneous pneumothorax.

Case

- 65-year-old man presents with worsening dyspnea.
- Physical exam:
 - Diminished breath sounds on the right side
 - Dullness to percussion right chest
- CXR shows a large R pleural effusion.

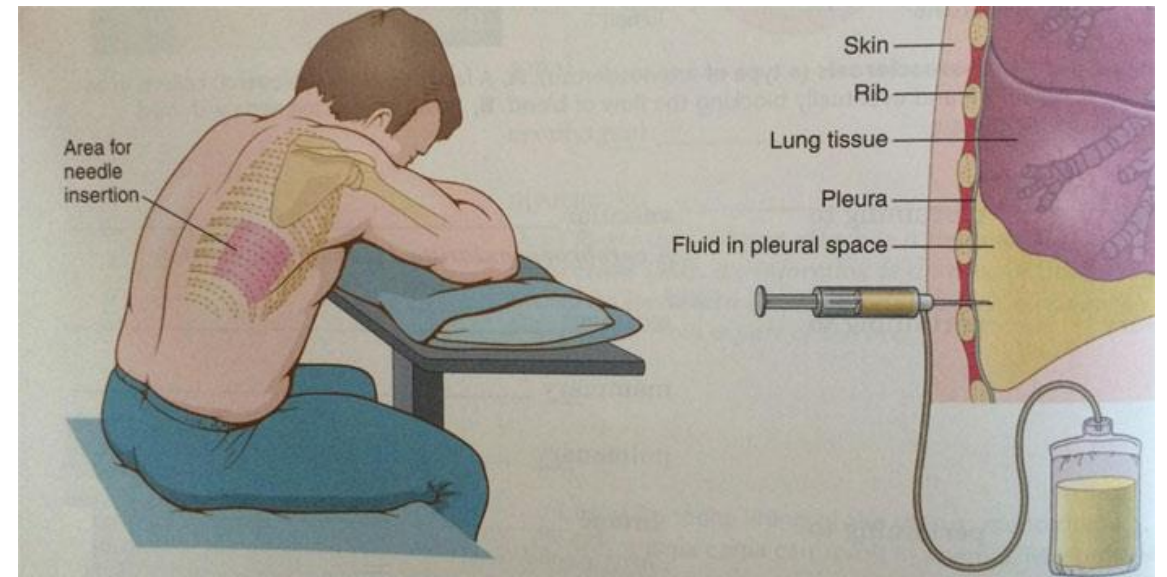
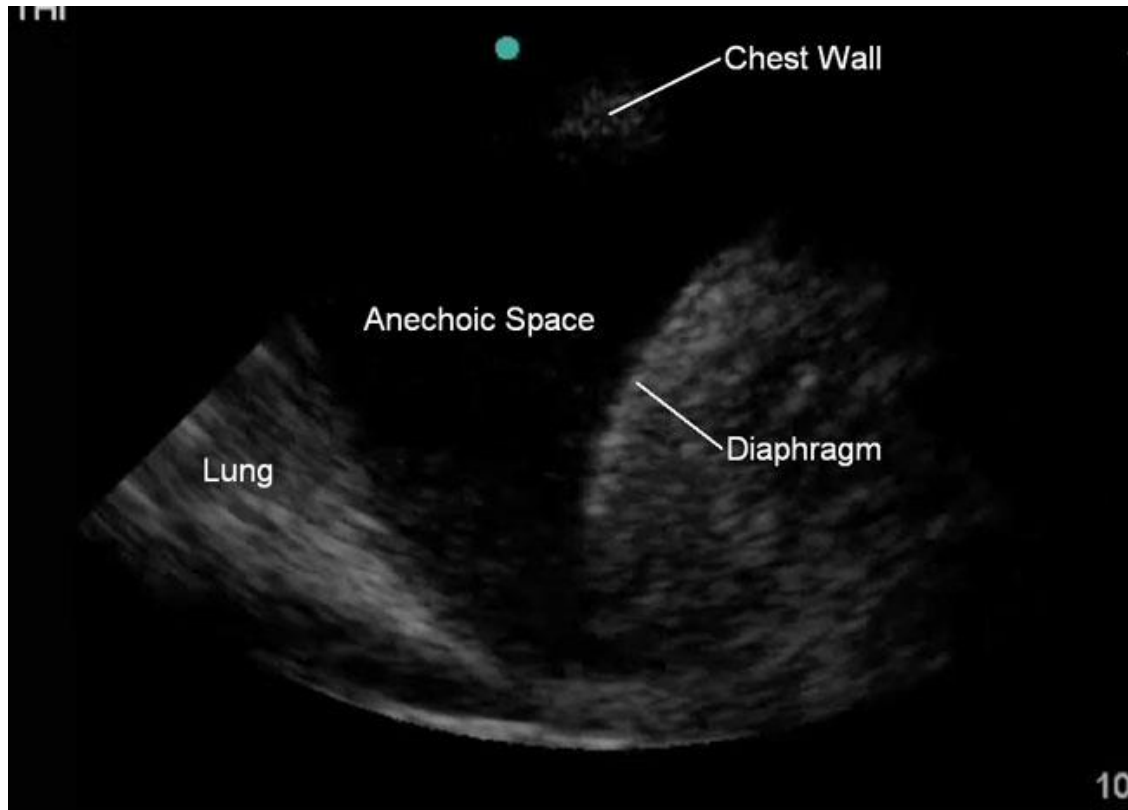


Case

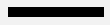
- What is the most appropriate next step in evaluation?
 - a. Chest CT
 - b. Place a surgical chest tube
 - c. VATS
 - d. Ultrasound guided thoracentesis

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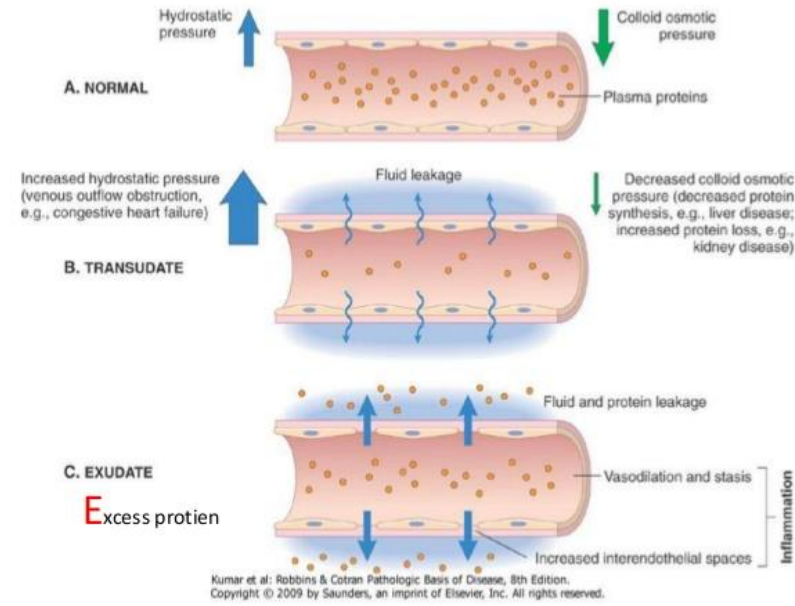
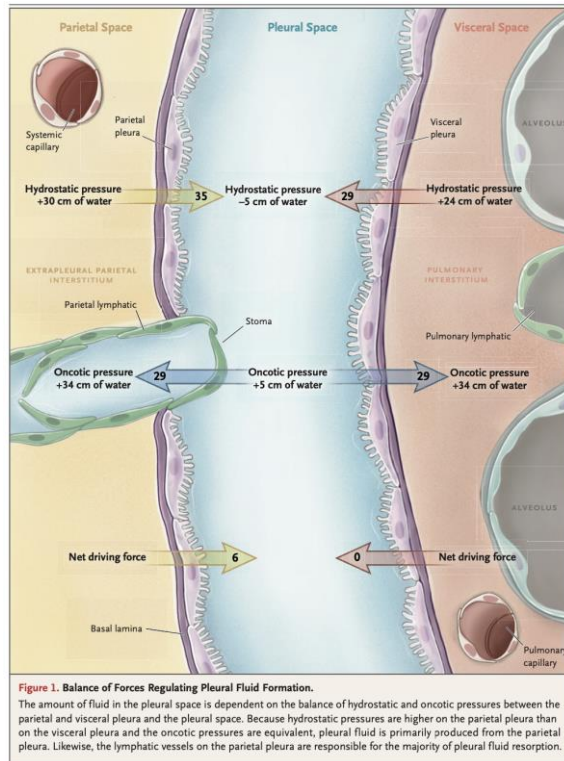


Case



- What tests will you order?

Pathophysiology



Rate of entry of fluid in the pleural space is about 0.01ml/Kg/hr

Mechanisms that may play a role in the formation of pleural effusion

-
- Altered permeability of the pleural membranes (eg, inflammation, malignancy, PE)
 - Reduction in intravascular oncotic pressure
 - Increased capillary permeability or vascular disruption (eg, trauma, malignancy, inflammation, infection, pulmonary infarction, drug hypersensitivity, uremia, pancreatitis)
 - Increased capillary hydrostatic pressure in the systemic and/or pulmonary circulation (CHF, SVC syndrome)
 - Reduction of pressure in the pleural space (ie, due to an inability of the lung to fully expand during inspiration); this is known as "trapped lung"

Mechanisms that may play a role in the formation of pleural effusion

-
- Decreased lymphatic drainage or complete lymphatic vessel blockage, including thoracic duct obstruction or rupture (eg, malignancy, trauma)
 - Increased peritoneal fluid with microperforated extravasation across the diaphragm via lymphatics or microstructural diaphragmatic defects
 - Movement of fluid from pulmonary edema across the visceral pleura
 - Persistent increase in pleural fluid oncotic pressure from an existing pleural effusion, causing further fluid accumulation

Evaluation



- History
- Physical Exam
- Imaging
- Pleural fluid analysis

History

- Severity, duration, and rate of onset of dyspnea, cough, or chest pain
- Presence of constitutional symptoms such as fever or weight loss
- Recent injury or intervention to the chest
- Recent illness
- Recent hospital admissions or operations
- TB exposure
- History of malignancy
- Occupational history
- Medications
- Other histories such as heart failure, hepatic, or renal failure

Physical exam

Table 4. Accuracy of Common Clinical Findings for Diagnosing Pleural Effusion

<i>Finding</i>	<i>Sensitivity (%)</i>	<i>Specificity (%)</i>
Pleural friction rub	5.3	99
Asymmetric chest expansion	74	91
Reduced vocal resonance	76	88
Reduced vocal fremitus	82	86
Auscultatory percussion	30 to 96	84 to 95
Diminished breath sounds	42 to 88	83 to 90
Dullness to percussion	30 to 90	81 to 98
Crackles	56	62

Information from reference 17.

Table 3. Signs and Symptoms that Suggest an Etiology of Pleural Effusion

<i>Signs and symptoms</i>	<i>Suggested etiology</i>
Ascites	Cirrhosis
Distended neck veins	Heart failure, pericarditis
Dyspnea on exertion	Heart failure
Fever	Abdominal abscess, empyema, malignancy, pneumonia, tuberculosis
Hemoptysis	Malignancy, pulmonary embolism, tuberculosis
Hepatosplenomegaly	Malignancy
Lymphadenopathy	Malignancy
Orthopnea	Heart failure, pericarditis
Peripheral edema	Heart failure
S3 gallop	Heart failure
Unilateral lower extremity swelling	Pulmonary embolism
Weight loss	Malignancy, tuberculosis

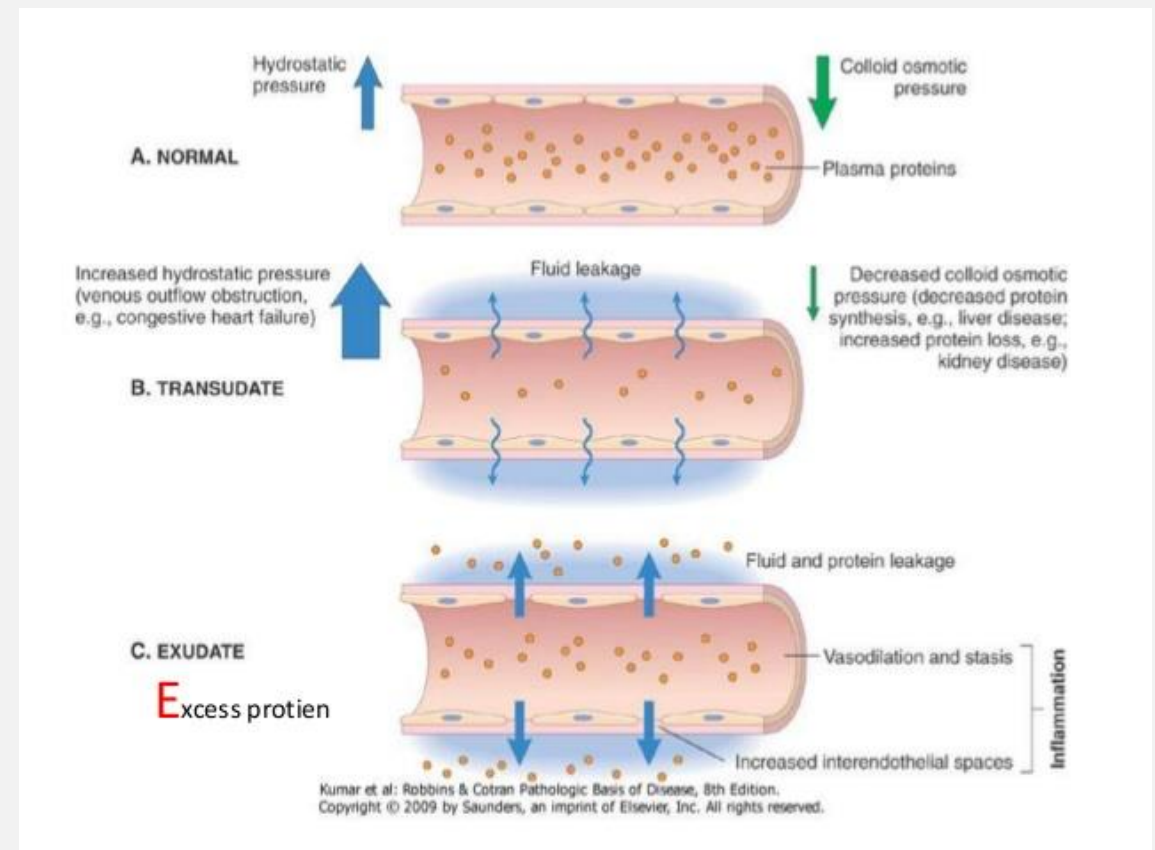
Information from references 1 through 10, and 13.

Imaging

-
- CXR:
 - PA film – 200ml of fluid can be seen
 - Lateral decubitus – 50 ml
 - Chest CT
 - Can show small effusion not seen on CXR
 - Ultrasound
 - More sensitive in detecting septation

Thoracentesis

- Determining transudate vs exudate helps with diagnosing etiology
- Gross appearance of fluid
- Lights criteria
- 2 test and 3 test rule



Transudative effusions

Congestive heart failure

Cirrhosis

Nephrotic syndrome

Glomerulonephritis

Peritoneal dialysis

Hypoalbuminemia (typical serum albumin, <1.5 mg/dl)

Atelectasis

Superior vena cava obstruction

Trapped lung

Sarcoidosis

Myxedema

Cerebrospinal fluid leak or ventriculopleural shunt

Urinothorax

Pulmonary arterial hypertension

Pulmonary embolism

Pericardial disease

Extravascular migration of central venous catheter

Exudative effusions

Infectious: bacterial, viral, tuberculosis-related, fungal, parasitic

Neoplastic: metastatic disease (e.g., lung cancer, breast cancer, lymphoma, myeloma, ovarian cancer, pancreatic cancer, cholangiocarcinoma), mesothelioma, primary body-cavity lymphoma

Paramalignant effusions: reactive pleuritis due to underlying lung cancer, airway obstruction or atelectasis, radiation-induced pleuritis

Reactive: reactive pleuritis due to underlying pneumonia (i.e., parapneumonic)

Embolic disease: pulmonary embolism

Abdominal disease: pancreatitis, cholecystitis, hepatic or splenic abscess, esophageal perforation after esophageal varix sclerotherapy

Cardiac or pericardial injury, including myocardial infarction (after coronary-artery bypass, cardiac surgery, or cardiac ablation procedures), pulmonary-vein stenosis

Gynecologic: ovarian hyperstimulation, Meigs' syndrome, endometriosis, postpartum complications

Collagen vascular disease: rheumatoid arthritis, systemic lupus erythematosus, Sjögren's syndrome, familial Mediterranean fever, eosinophilic granulomatosis, granulomatosis with polyangiitis

Medications: nitrofurantoin, dantrolene, methysergide, dasatinib, amiodarone, interleukin-2, procarbazine, methotrexate, clozapine, phenytoin, β -blockers, ergot drugs

Hemothorax

Chylothorax (most commonly seen after trauma or in patients with lymphoma)

Sarcoidosis

Lymphoplasmacytic lymphoma

Cholesterol effusions (commonly seen in tuberculosis, rheumatoid effusions, and any other chronic pleural effusion)

Miscellaneous: benign asbestos pleural effusion, yellow nail syndrome, uremia, drowning, amyloidosis, electrical burns, iatrogenic effusion, capillary leak syndromes, extramedullary hematopoiesis

Light's criteria

- If any of these is met the fluid is an exudate:
 - Pleural fluid protein divided by serum protein is greater than 0.5.
 - Pleural fluid LDH divided by serum LDH is greater than 0.6.
 - Pleural fluid LDH is greater than two-thirds the upper limit of normal for the serum LDH.
- If none of these criteria is met, the patient has a transudative pleural effusion

The 2 and 3 test rules

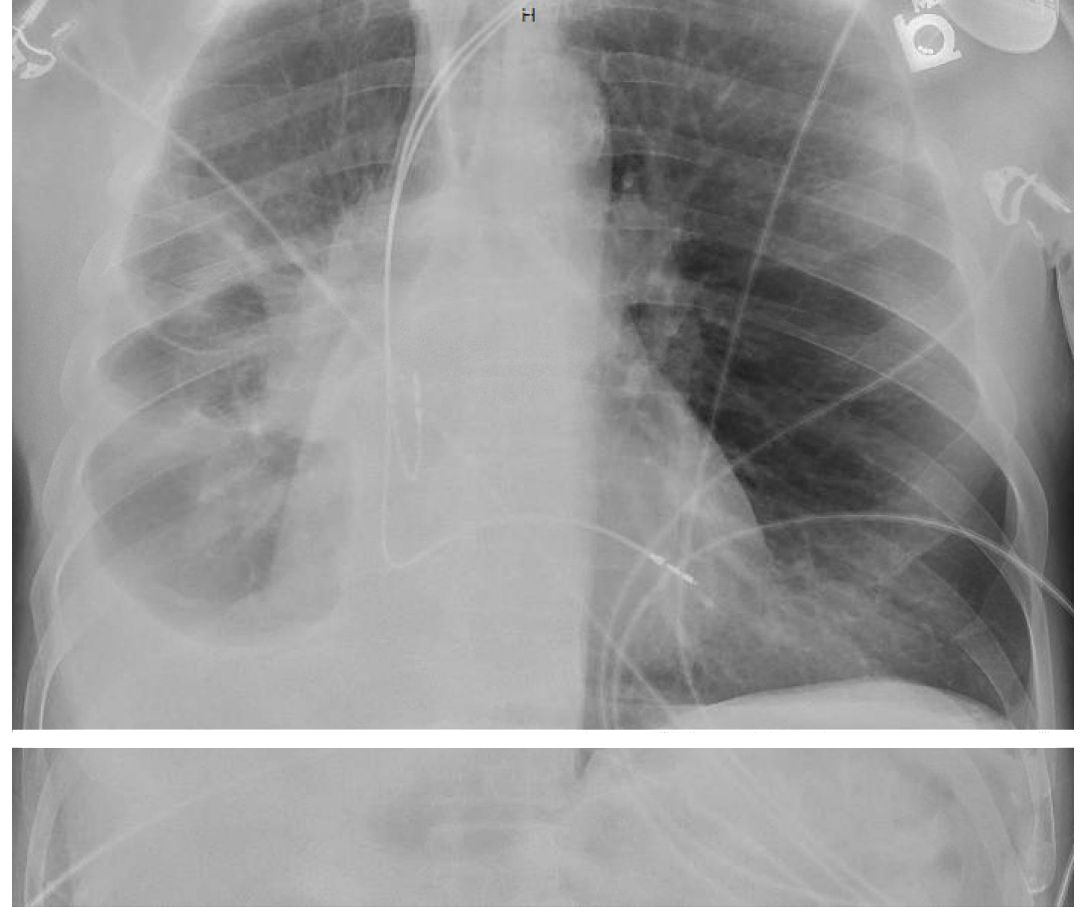
- Two-test rule
 - Pleural fluid cholesterol greater than 45 mg/dL
 - Pleural fluid LDH greater than 0.45 times the upper limit of the laboratory's normal serum LDH
- Three-test rule
 - Pleural fluid protein greater than 2.9 g/dL (29 g/L)
 - Pleural fluid cholesterol greater than 45 mg/dL (1.165 mmol/L)
 - Pleural fluid LDH greater than 0.45 times the upper limit of the laboratory's normal serum LDH
- If any one criterion is met the fluid is an exudate
- Similar accuracy to Light's criteria but doesn't require a blood draw

Patients on diuretics

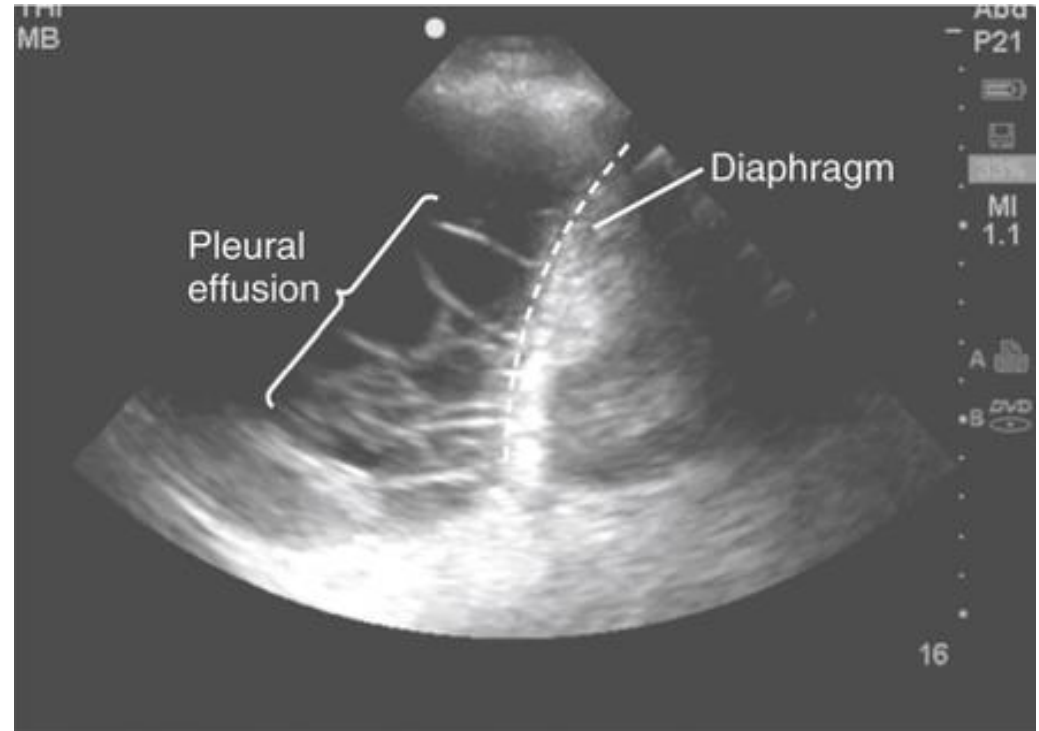
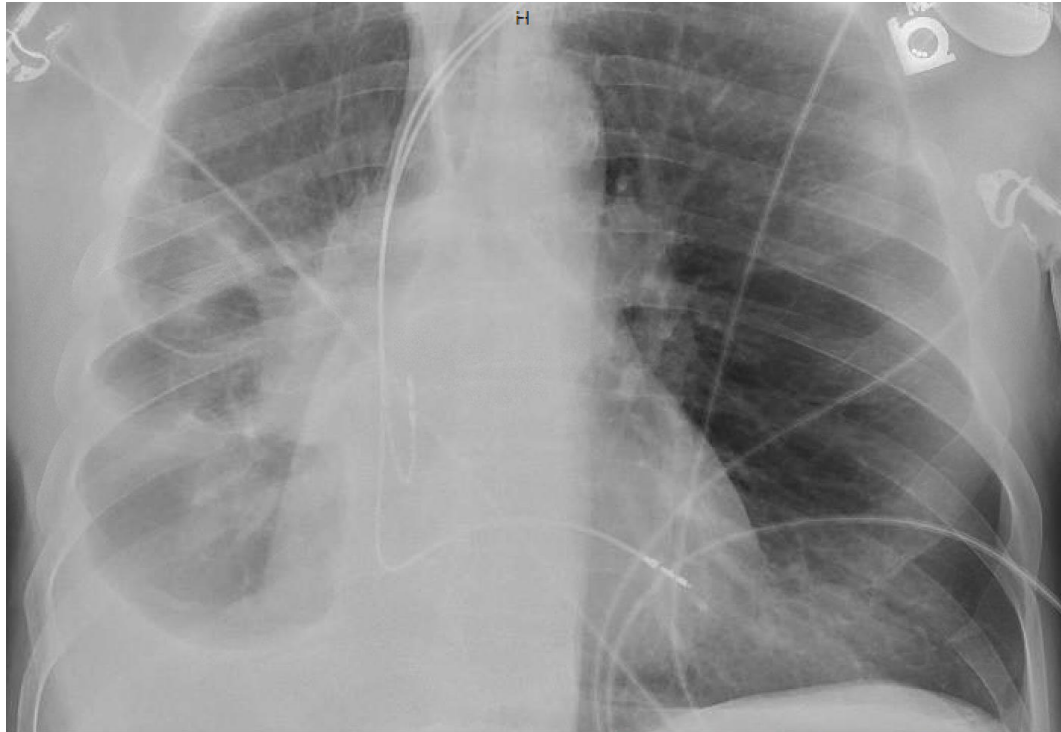
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- Light's criteria can falsely make it look like exudate.
 - Alternative criteria:
 - Serum – fluid albumin gradient > 1.2 g/dl – transudate
 - Serum – fluid protein gradient > 3.1 g/dl - transudate

Case

- 70-year-old man presented with a 5day H/O fever, productive cough and shortness of breath.
- Exam: T: 102, HR 95, RR 30, BP 100/40
- Lungs: Diminished breath sounds right base, dullness to percussion
- CV: Tachycardia
- Abdomen: Normal



Case



Pleural fluid analysis

-
- Cloudy fluid
 - pH: 7.1
 - Protein: 3.5g/dl
 - LDH: 195
 - Cell count: predominate neutrophils
 - No malignant cells

Case

-
- Likely diagnosis
 - a) CHF
 - b) Empyema
 - c) Lung cancer
 - d) Chest trauma

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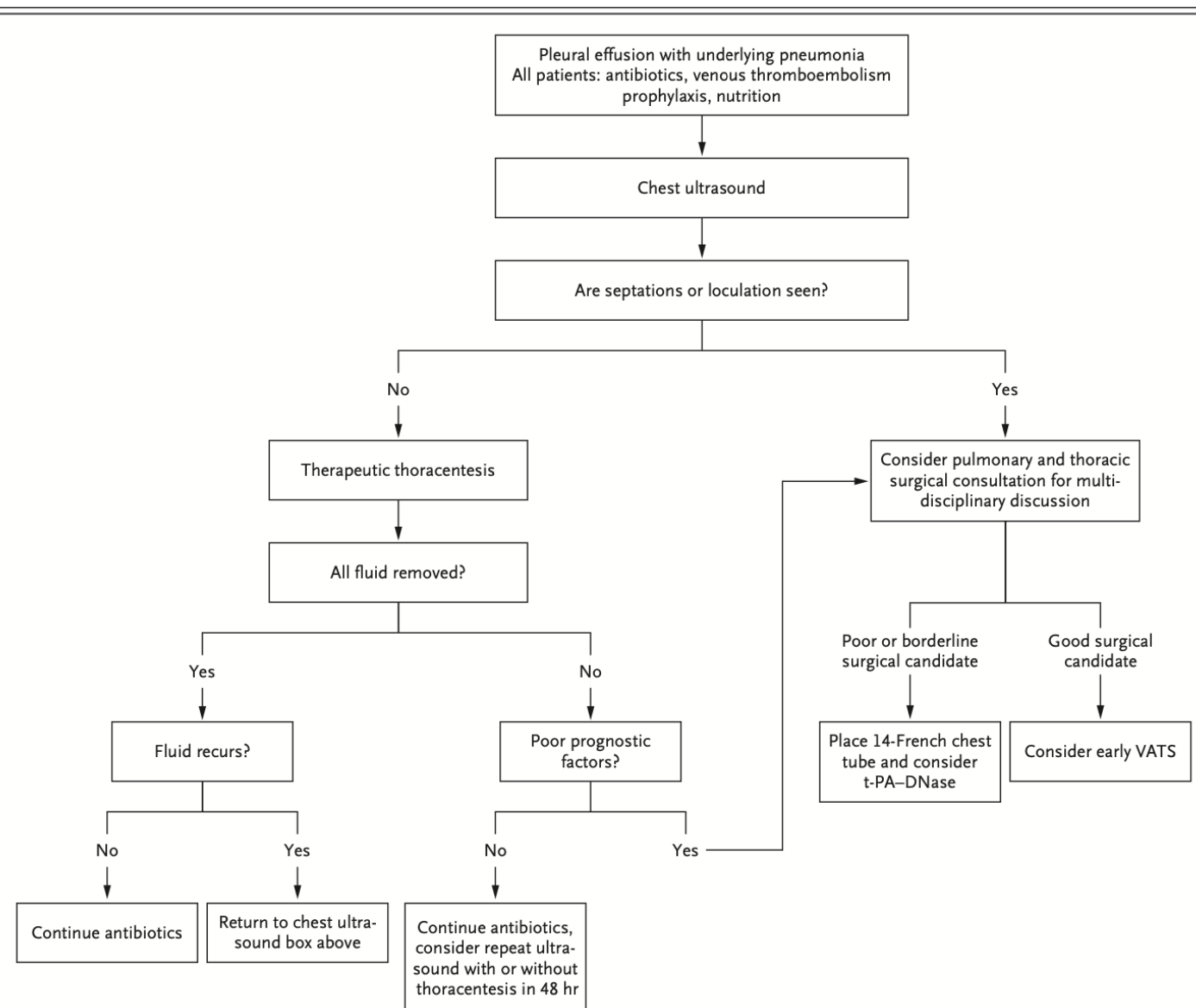
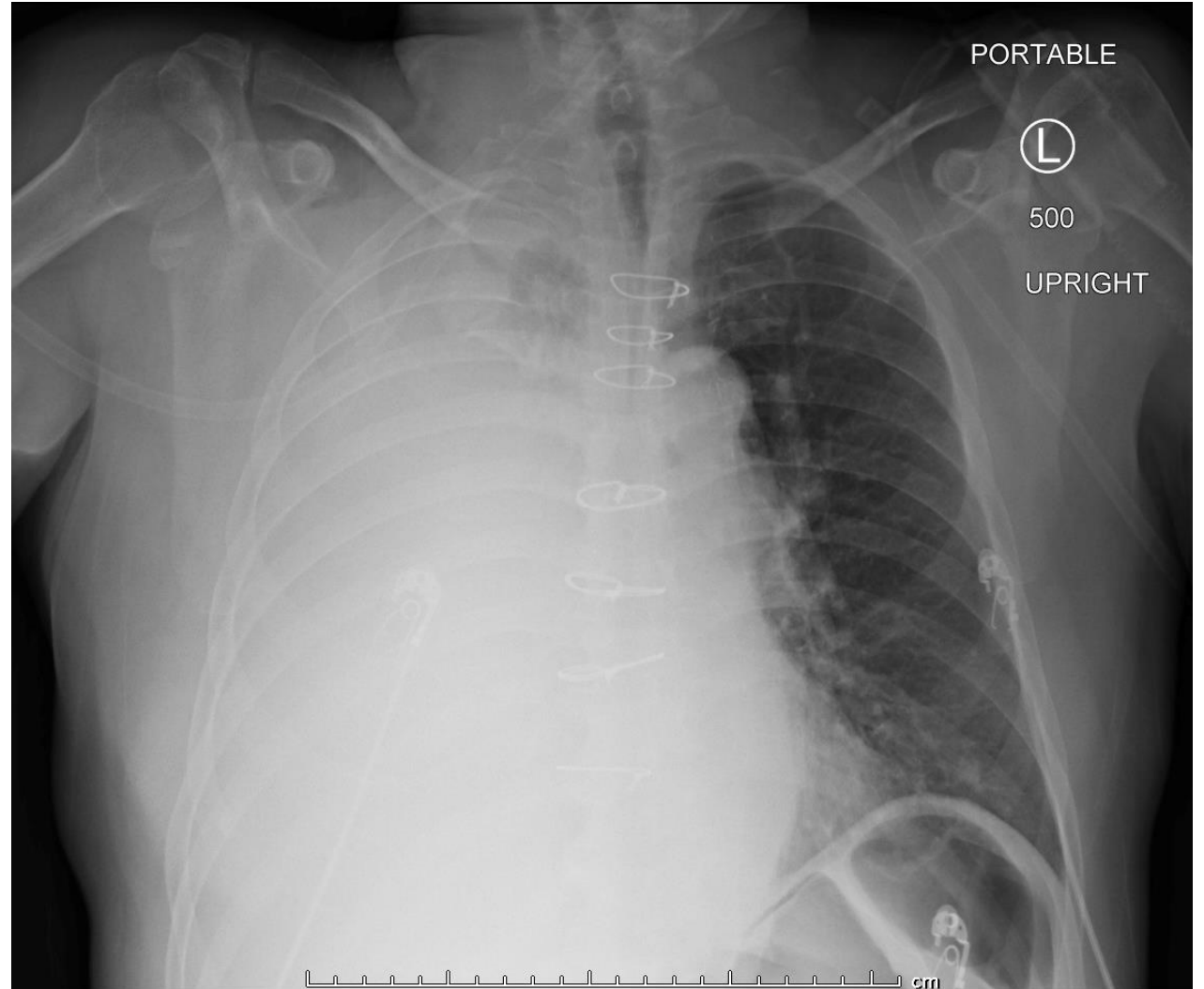


Figure 2. Management of Parapneumonic Effusions.

Poor prognostic factors after incomplete removal of fluid by means of therapeutic thoracentesis include pus in the pleural space, positive Gram's stain or culture, pleural fluid glucose level less than 40 mg per deciliter, pleural fluid pH lower than 7.15, and pleural fluid lactate dehydrogenase level more than 3 times the upper limit of the normal range for serum.^{1,53} A decision regarding surgery depends on the patient's clinical status and ability to undergo surgery, as well as on local resources and the availability of a skilled surgeon. The figure is modified from Davies et al.⁴⁴ The abbreviation t-PA denotes tissue plasminogen activator, and VATS video-assisted thoracoscopic surgery.

Case

- 65-year-old man presents with worsening dyspnea.
- Recent diagnosis of lung ca.
- Physical exam:
 - Diminished breath sounds on the right side
 - Dullness to percussion right chest
- CXR shows a large R pleural effusion.



Pleural fluid analysis

-
- Straw colored clear fluid
 - pH: 7.3
 - Protein: 4g/dl
 - LDH: 450
 - Gm stain: No organisms
 - AFB: No organisms
 - + malignant cells

Case

-
- How much fluid would you remove?
 - a. 15 ml
 - b. 150 ml
 - c. 1500 ml
 - d. As much as possible

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-
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AMERICAN THORACIC SOCIETY DOCUMENTS

Management of Malignant Pleural Effusions An Official ATS/STS/STR Clinical Practice Guideline

David J. Feller-Kopman*, Chakravarthy B. Reddy*, Malcolm M. DeCamp, Rebecca L. Diekemper, Michael K. Gould, Travis Henry, Narayan P. Iyer, Y. C. Gary Lee, Sandra Z. Lewis, Nick A. Maskell, Najib M. Rahman, Daniel H. Serman, Momen M. Wahidi, and Alex A. Balekian; on behalf of the American Thoracic Society, Society of Thoracic Surgeons, and Society of Thoracic Radiology

THIS OFFICIAL CLINICAL PRACTICE GUIDELINE WAS APPROVED BY THE AMERICAN THORACIC SOCIETY OCTOBER 2018, THE SOCIETY OF THORACIC SURGEONS JUNE 2018, AND THE SOCIETY OF THORACIC RADIOLOGY JULY 2018

PICO 3:

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- Should the Management of Patients with Symptomatic Known or Suspected MPE Be Guided by Large-Volume Thoracentesis and Pleural Manometry?

Thoracentesis volume

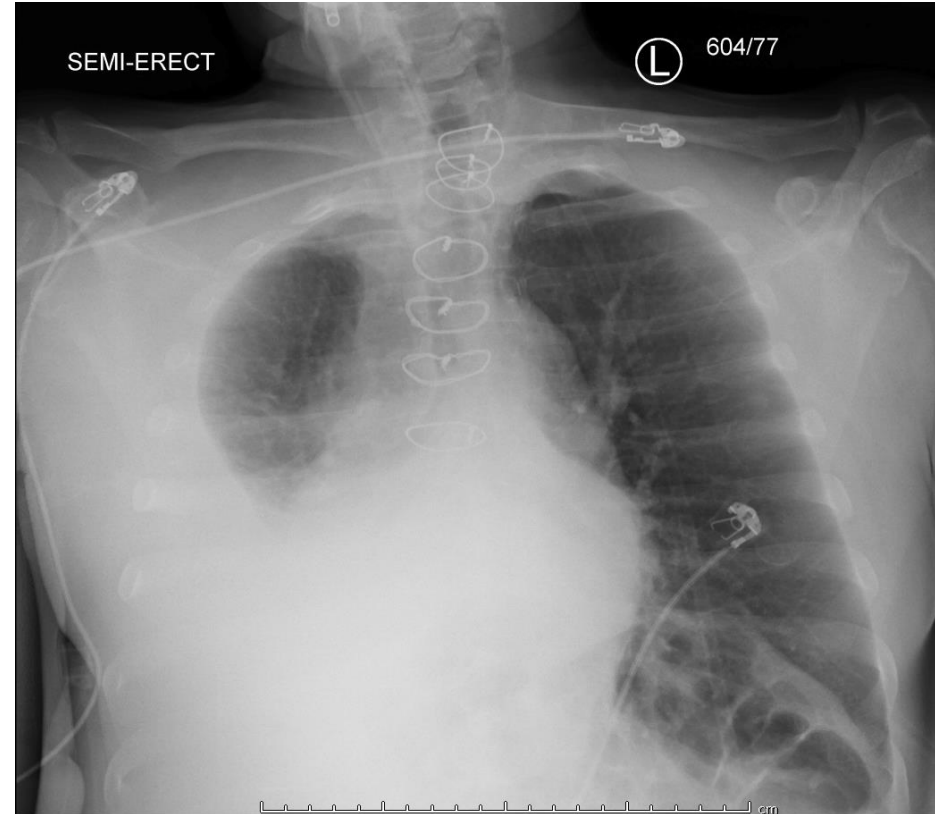
- Performing a therapeutic drainage before a definitive pleural intervention in patients with MPE can serve the following:
 - relief of dyspnea if that is secondary to the effusion
 - confirming symptomatic improvement after fluid drainage
 - identifying the presence of non-expandable lung
 - assess rate of reaccumulation. Ost et al found that up to 60% of patients will require another procedure within 9 days of the initial tap. Chest 2018;153: 438–452.
- If symptoms are not relieved – other causes of dyspnea should be evaluated.
- Non-expandable lung occurs in at least 30% of patients with MPEs.

PICO 3: Should the Management of Patients with Symptomatic Known or Suspected MPE Be Guided by Large-Volume Thoracentesis and Pleural Manometry?

- Recommendation. In patients with symptomatic MPE, we suggest large-volume thoracentesis if it is uncertain whether the patient's symptoms are related to the effusion and/or if the lung is expandable (the latter if pleurodesis is contemplated) to assess lung expansion.

Case

- 65-year-old man with recent diagnosis of adenocarcinoma of the lung presents with dyspnea.
- New finding on CXR.
- Plan to proceed with ultrasound guided thoracentesis.
- Thoracentesis performed – 2L of fluid removed.
- Significant but not full re-expansion.
- Symptoms improved.
- Cytology – malignant cells present.
- Next Step?



Goals of Treatment

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- Relieve dyspnea
 - Minimize morbidity and risk of mortality
 - Maximize independence
 - Minimize hospitalization time
 - Minimize need for recurrent visits

Management Options

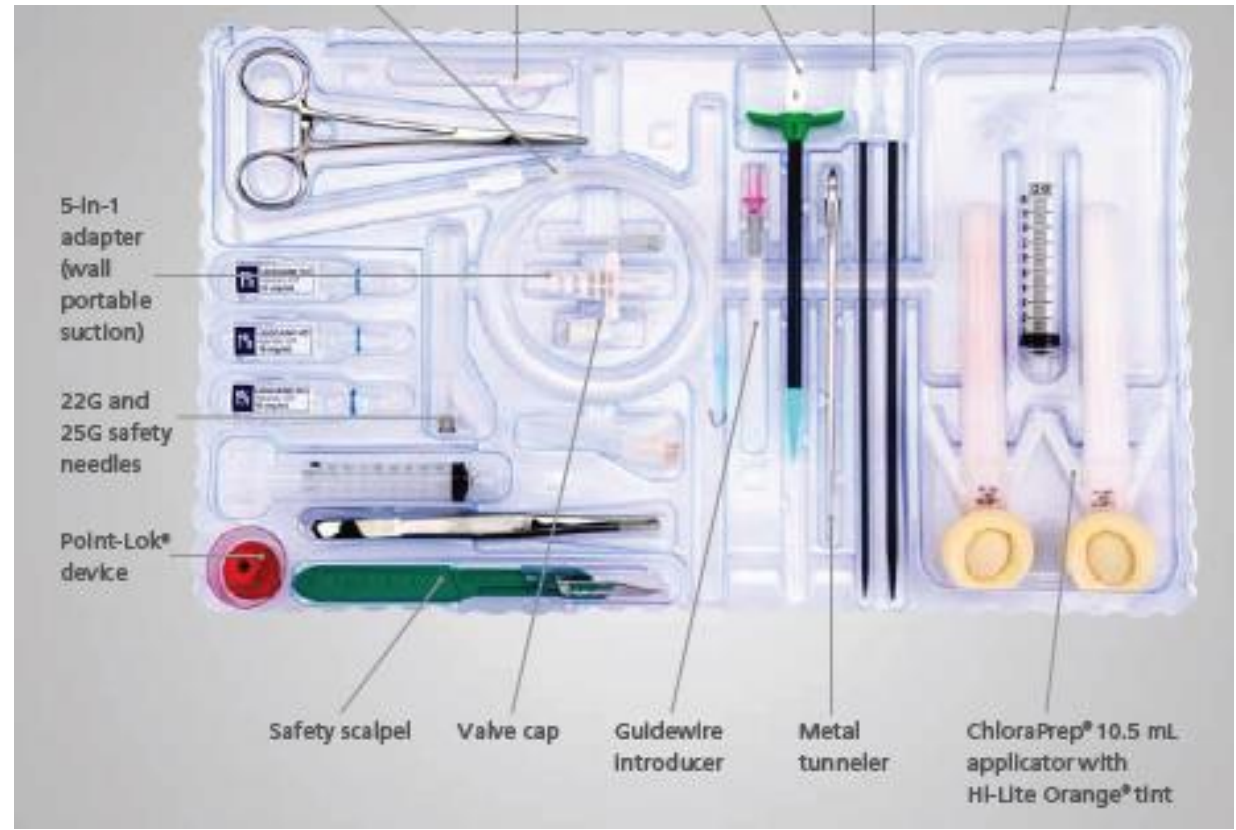
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- Chemotherapy (Breast, Small cell Lung ca)
 - Radiation Therapy (mediastinal XRT in Lymphoma)
 - Repeated Thoracentesis
 - Chest tube drainage and talc pleurodesis
 - Medical / Surgical Thoracoscopy and talc poudrage
 - Pleurectomy/ Decortication
 - Indwelling Pleural catheters

Pleurodesis

-
- Who should get pleurodesis?
 - Respiratory symptoms due to MPE (Relief with thoracentesis)
 - Complete re-expansion of lung after thoracentesis
 - Life expectancy more than 1-3 months

How to achieve pleurodesis?

-
- Modality
 - Chest tube + sclerosant
 - Pleuroscopy + sclerosant
 - VATS
 - Tunneled pleural catheter



Indwelling Pleural Catheter

What is an
indwelling
pleural
catheter?

- Fenestrated, 66 cm silicone tunneled catheter with a
- Polyester cuff and proprietary valve
- Placed with local anesthetic with or without mild sedation



PICO 4: In Patients with Symptomatic MPE with Known or Suspected Expandable Lung and No Prior Definitive Therapy, Should IPCs or Chemical Pleurodesis Be Used as First-Line Definitive Pleural Intervention for Management of Dyspnea?

-
- Recommendation. In patients with MPE with known (or likely) suspected expandable lung and no prior definitive therapy, and whose symptoms are attributable to the effusion, we suggest that either IPCs or chemical pleurodesis be used as first-line definitive intervention for management of dyspnea

PICO 6: In Patients with Symptomatic MPE with Nonexpandable Lung, Failed Pleurodesis, or Loculated Effusion, Should an IPC or Chemical Pleurodesis Be Used?

-
- Recommendation. In patients with symptomatic MPEs with nonexpandable lung, failed pleurodesis, or loculated effusion, we suggest the use of IPCs over chemical pleurodesis

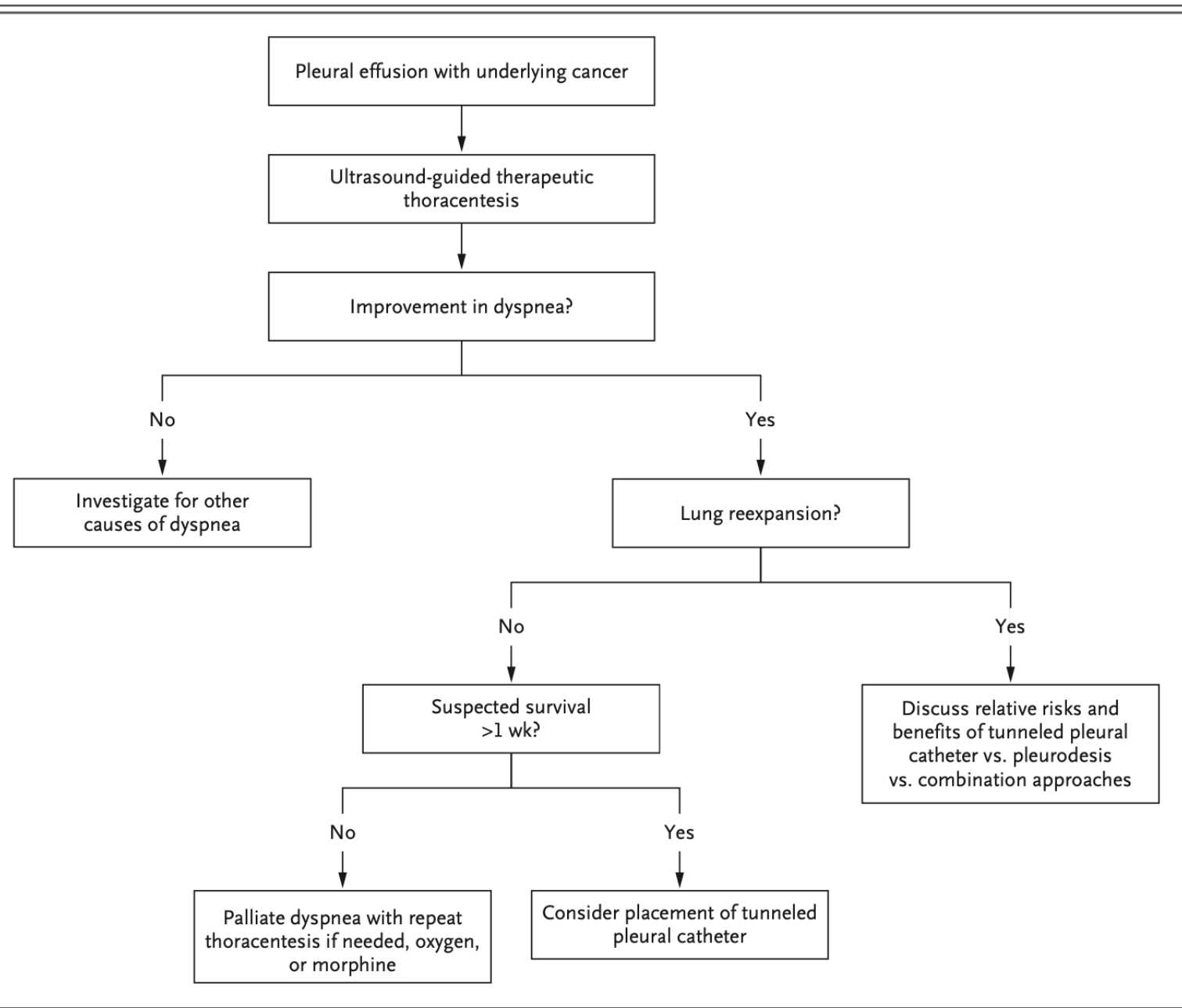
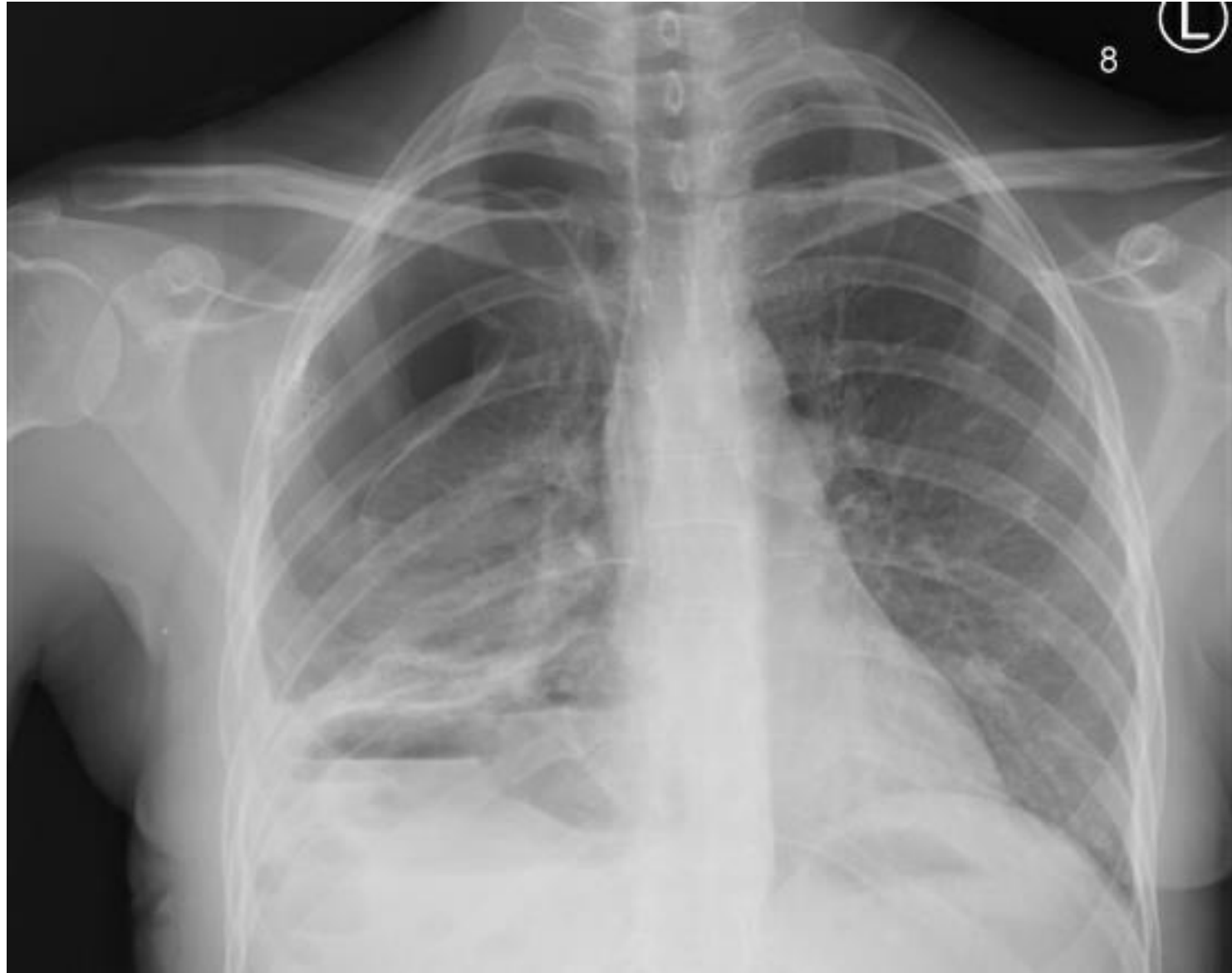


Figure 3. Management of Malignant Pleural Effusions.

The figure is modified from Roberts et al.⁶³

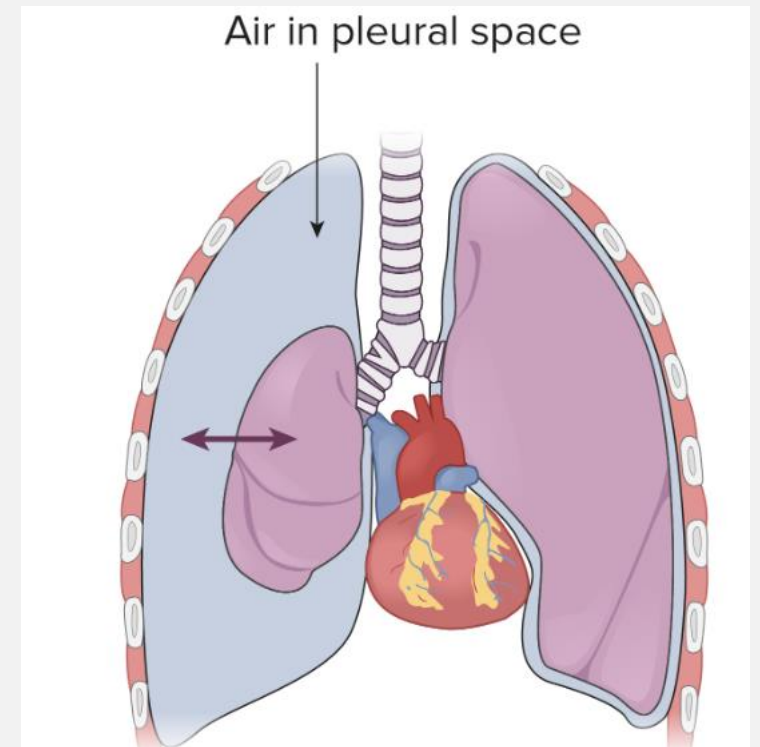
Case

-
- 40-year-old patient
 - Presented with sudden onset of right sided chest pain and dyspnea
 - H/O lung biopsy 2 days ago
 - Exam
 - Reduced breath sounds on the right
 - What test would you order?

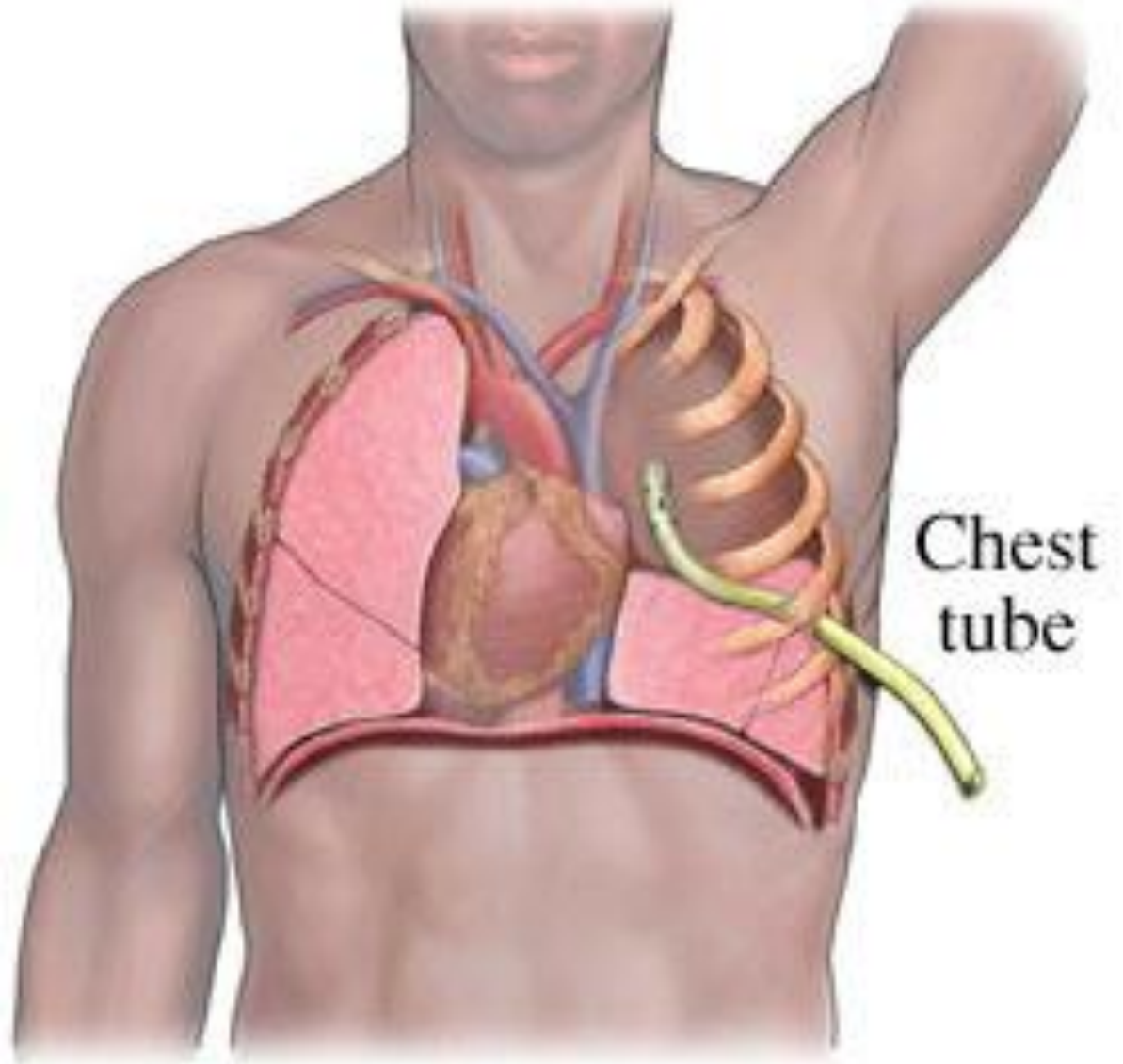


Pneumothorax

-
- Management depends on size and hemodynamics
 - Large pneumothorax:
 - ACCP – 3cm from the apex
 - BTS – intrapleural distance 2cm at the level of the hilum
 - Treatment
 - Aspiration
 - Chest tube
 - Pleurodesis



Chest tube



Chest tube management

-
- Indications for insertion:
 - Pneumothorax
 - Pleural effusion

Chest tube management

-
- Indications for insertion:
 - Pneumothorax
 - Presence or absence of air leak
 - Air leak signifies Broncho-pleural fistula
 - Our plan is to progress from suction to water seal to removal
 - May need to clamp tube before removal
 - Small bore tube is recommended

Chest tube management

- Pneumothorax
 - Lung usually expands and airleak stops in 3 days
 - Airleak > 5 days – persistent signifying bronchopleural or bronchoalveolar fistula
 - Options:
 - Blood patch
 - Thoracoscopy
 - Endobronchial valves
 - Pleurodesis

Chest tube management

-
- Likelihood of recurrence of spontaneous pneumothorax
 - > 50%
 - Reduced to 25% following pleurodesis (talc, doxycycline)
 - Thoracoscopy (bleb resection, etc) + pleurodesis (chemical or mechanical) – recurrence 5%

Chest tube management

- Indications for insertion:
- Pleural effusion
 - Note daily fluid collection and nature of fluid
 - May need thrombolytics for empyema
 - Persistent fluid may necessitate an indwelling catheter
 - If fluid production decreases to $< 200\text{ml}$ we can consider removal of chest tube.

Questions?

