PLEURAL COLLECTIONS: EFFUSION VS. EMPYEMA

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OVERVIEW

- Patient presentation
- Pleural anatomy
- Types of pleural space collections
- Pleural effusions: Transudates vs. Exudates
- Empyema: Causes and Organisms
- Radiologic findings of pleural effusion
- Radiologic findings of empyema
- Management of pleural effusions vs. empyema
- Patient case: Empyema Necessitans
OUR PATIENT: INTRODUCTION

- 46yoM presenting with shortness of breath, cough for the past 1 week. Began to experience shoulder and L upper chest wall tenderness and malaise for the past 3 days.
- Temperature of 100, WBC: 14.7
RADIOLOGIC DIFFERENTIAL DIAGNOSIS FOR OUR PATIENT:

- Pleural effusion*
- Empyema*
- Pneumonia
- Atelectasis
- Lobar collapse
- Lung abscess

• Processes involving the pleural space

Courtesy of Dr. Karen Lee
Before we continue to examine our patient’s images in more details, let us review the anatomy of the pleural space, types of pleural space collections, and radiologic modalities/findings for the evaluation of pleural effusions and empyema.
PLEURAL SPACE ANATOMY (1)

Adapted from Charalampidis et al. 2015
- Visceral pleura supplied by the bronchial arteries, empty into pulmonary veins
- Parietal pleura supplied by intercostal arteries, empty into intercostal veins
- Lymphatics drain the small outflow of fluid from capillary beds into pleural space to maintain minimal pleural space
TYPES OF PLEURAL COLLECTIONS

- Any disease entity that disrupts the balance of pleural space fluid inflow and outflow can result in pleural collections

- Exudative and transudative fluid = effusion
- Pus = empyema
- Blood = hemothorax
- Chyle = chylothorax
- Urine = urinothorax
PLEURAL EFFUSION: TRANSUDATE

- Increased hydrostatic pressures OR decreased oncotic pressures

COMMON CAUSES

- Congestive heart failure
- Cirrhosis
- Hypoalbuminemia
- Nephrotic syndrome
PLEURAL EFFUSION: EXUDATE

- Increased pleural permeability, inflammation, or lymphatic obstruction
- If associated with pneumonia, termed parapneumonic effusion

COMMON CAUSES

- Malignancy (primary or metastasis)
- Pneumonia
- Pulmonary embolism
- Trauma
- Autoimmune diseases
PLEURAL EFFUSION: LIGHT’S CRITERIA

Exudate if:

- Pleural fluid: serum protein ratio > 0.5
- Pleural fluid-to-serum lactate dehydrogenase (LDH) ratio > 0.6
- Pleural fluid LDH > 2/3 of upper normal limit for serum
Now that we have reviewed the basics of pleural anatomy and pathophysiology, let us examine the radiologic modalities and features of pleural effusions versus empyema.
PLEURAL EFFUSION: IMAGING MODALITIES

- **Plain film**
  - Upright: able to detect 200-250mL of fluid
  - Lateral decubitus: more sensitive, able to detect 50-75mL of fluid
  - Supine: discouraged, masks fluid

- **CT**
  - Good for identifying etiology

- **Ultrasound**
  - For smaller effusions (5mL) or to guide thoracentesis
PLEURAL EFFUSION: RADIOLOGIC FINDINGS

Plain film:

- Homogenous opacity
- Blunting of costophrenic angles
- Meniscus sign
- Dependent portions – if not, suggests loculated
- Silhouette sign
- Mediastinal shift to contralateral side
- If subpulmonic effusion: lateralization of peak of hemidiaphragm
PLEURAL EFFUSION: RADIOLOGIC FINDINGS

Plain film – Upright and Lateral

Meniscus sign (black arrows)
Silhouette sign (*) of left heart border
Homogenous opacity (*)

Mediastinal shift to contralateral side (*)

Images from Adler and Blok, 2015
https://clinicalgate.com/thoracentesis-2/
PLEURAL EFFUSION: RADIOLOGIC FINDINGS

Subpulmonic effusion: Fluid trapped between lung base and diaphragm

Lateralization of peak of hemidiaphragm(*)
Apparent diaphragm elevation (*)
Flattening of diaphragm (---)

Approximate location of actual diaphragm (---)

Mereu et al. 2011
http://dx.doi.org/10.1594/ecr2011/C-1950
PLEURAL EFFUSION: RADIOLOGIC FINDINGS

Plain film - Supine

Diffuse haziness (*)
Supine view masks fluid

PLEURAL EFFUSION: RADIOLOGIC FINDINGS

Plain film – Lateral Decubitus

- Arrows: layering of fluid in the most dependent position
- Useful for detecting loculation and revealing underlying lung previously covered in upright view

CT of our presenting patient

Crescentic shaped in dependent region (*)

Linear delineation suggest pleural process as opposed to intraparenchymal (*)

Adler and Blok, 2015
https://clinicalgate.com/thoracentesis-2/

Courtesy of Dr. Karen Lee
PLEURAL EFFUSION RADIOLOGIC FINDINGS

Ultrasound

EMPYEMA: OVERVIEW

- Pus accumulation in the pleural space

CAUSES:

1. From within thorax: pneumonia, septic pulmonary infarcts, infection of pleural effusion, ruptured oesophagus, pericarditis
2. From without: penetrating wound or surgery
3. From below: subphrenic or liver abscess
4. From remote sources: septicaemia
5. From above: cervical or facial infections (rare)

Spicer 2008
EMPYEMA: ORGANISMS

- Streptococcus pneumoniae
- Staphylococcus aureus
- Anaerobes
- Enteric gram-negative rods
- Mycobacterium tuberculosis
EMPYEMA: IMAGING MODALITIES

- Plain film
- CT
- Ultrasound
EMPYEMA: RADIOLOGIC FINDINGS

Plain film

Empyema
- Loculated, nondependent areas
- Obtuse angle with chest wall
- Asymmetry
- Lenticular shape

Pleural Effusion
- Dependent areas
- Acute angle
- Can be bilateral
- Crescentic/meniscus sign
EMPYEMA: RADIOLOGIC FINDINGS

Plain film

Arrows: loculated (in fissures as in the case of B), biconvex/lens-shaped densities

EMPHYSEMA: RADIOLOGIC FINDINGS

CT

Empyema
- Enhancement and thickening of pleura: “split-pleura” sign
- Lenticular

Pleural Effusion
- Absence of thickened or enhanced margin
- Crescentic, dependent position
EMPYEMA: RADIOLOGIC FINDINGS

CT: Companion Patient 1

Thickened and enhancing pleura: “split-pleura” sign (*)
Lenticular shaped (*)
EMPYEMA: RADIOLOGIC FINDINGS

Ultrasound

Arrowhead: septations within pleural cavity

Image adapted from Chen et al. 2000
PLEURAL EFFUSION & EMPYEMA

MANAGEMENT OPTIONS

Pleural effusion
- Diagnostic thoracentesis
- Therapeutic thoracentesis
- Treat underlying cause

Empyema
- Drainage + antimicrobials
- Tube thoracostomy ± fibrinolytics
- VATS (Video-assisted thoracoscopic surgery)
PLEURAL EFFUSION & EMPYEMA

Thorascopic view during VATS management of empyema

Wait et al. 2007
Now that we have learned about the radiologic modalities and features of pleural effusion and empyema, let us examine the images of our patient.
OUR PATIENT: EXAMINATION OF IMAGES

Images courtesy of Dr. Karen Lee
Meniscus sign (*) of pleural effusion, homogenous in density, and with silhouetting of L heart border (*)

Lens-shaped density in non-dependent region (*) suggesting loculation or intraparenchymal process
 OUR PATIENT: EXAMINATION OF IMAGES

CT to further characterize findings and elucidate etiology:

Lens-shaped collection (*) with thickened, enhancing pleura (*), with locules of air (*), extending into L anterior chest wall (*).

Partial view of crescentic shaped (*) pleural effusion
OUR PATIENT: EMPYEMA NECESSITANS

Empyema Necessitans

- Extension of empyema past parietal pleura to adjacent soft tissue
- Uncommon, complication of untreated empyema
- Typical causes: Mycobacterium tuberculosis, Actinomyces israelii

Our Patient

- Heavy growth of MSSA
- VATS decortication
- Subpectoral abscess incision and drainage
- PICC line placement for IV nafcillin
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REFERENCES (1)


ACKNOWLEDGEMENTS

• Dr. Karen Lee
• Dr. Paul Spirn
• Dr. Gillian Lieberman