

RADY 401 Case Presentation
One-sided Haziness:
Characterizing the Effusion

Max Rerkpattanapipat, 5/14/24

Focused patient history and workup

HPI:

75 year-old man with medical history of debilitating rheumatoid arthritis, hypertension, and former smoker presents to ED with **1-week history of progressively worsening shortness of breath. Reports cough, congestion, and weakness.** Denies fevers, wheezing, chest pain, edema, vomiting, diarrhea.

Social History – Lives alone. Sedentary lifestyle, mainly walking from bed to chair. Requires home health nursing.

Objective

Physical Exam – 97.2 F, HR 91, RR 18, BP 135/65, **SPO2 96% on 5L O2 (baseline is room air)**

Chronically ill-appearing and frail. Lethargic with intermittent dyspnea. Normal rate, regular rhythm. **Decreased breath sounds** in right-upper, middle, and lower fields. **Hand joint deformities.** Remainder of exam unremarkable.

Labs – **WBC 18.9, Platelet 907,000**

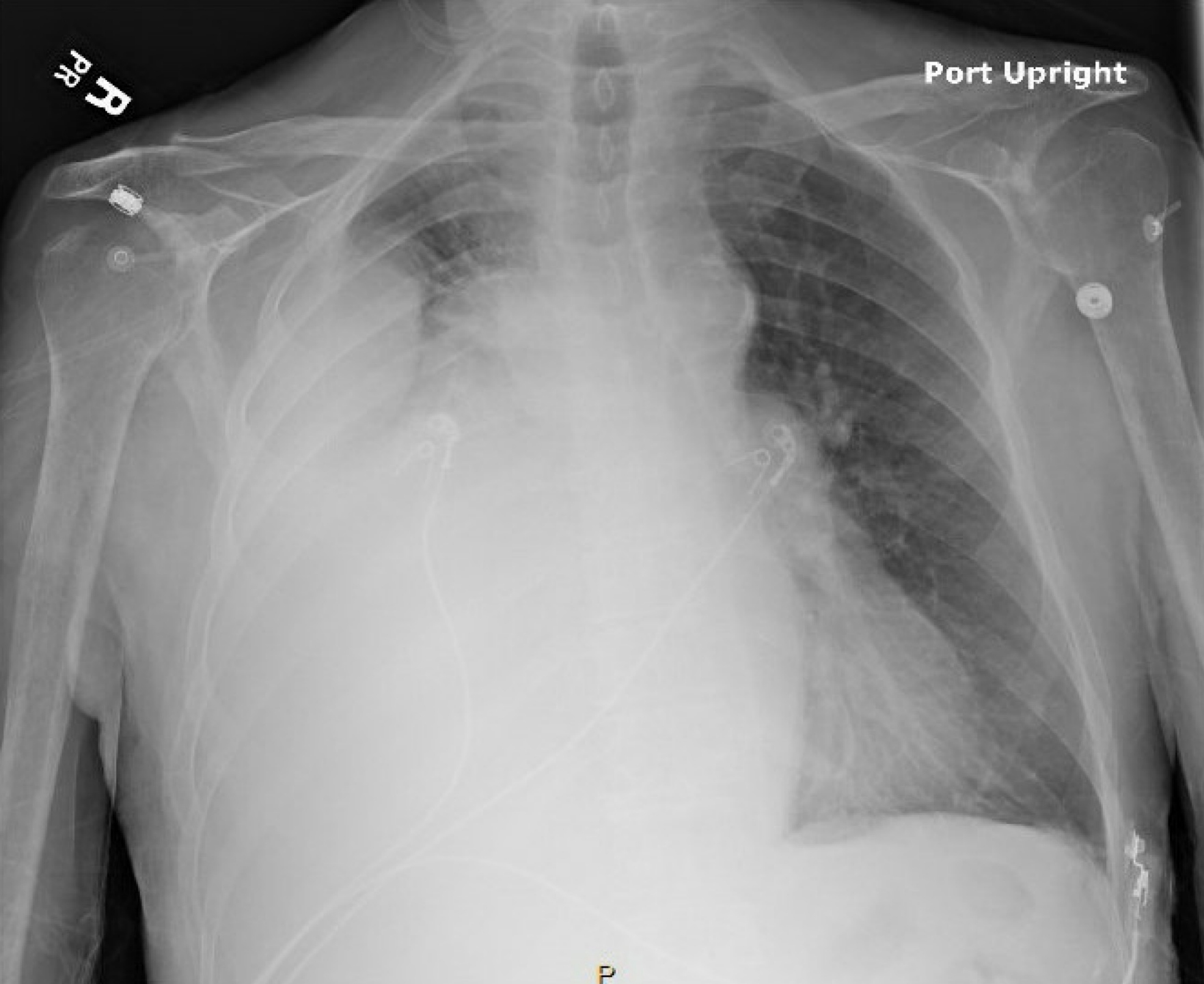
Neutrophils 91.1%, Lymphocytes 4.1%, blood gas pH 7.48, pCO2 33 (40 - 60 mmHg)

Other Work-up:

Initial CXR and Chest CT

List of imaging studies

1. Chest x-ray, Hospital Day 0
2. CT Chest with Contrast, Hospital Day 0
3. Ultrasound Thorax, Hospital Day 1
4. Chest x-ray, Hospital Day 12



Chest X-ray, Hospital Day 0

Modality:

-Chest plain film

Key findings:

- Right hemithorax with nearly complete white out
- Right-sided opacification with reduced lung markings
- Potential presence of right-to-left shift of mediastinal structures

DDx:

Pleural effusion

- exudative vs. transudative
- loculated vs. parapneumonic

Consolidated pneumonia

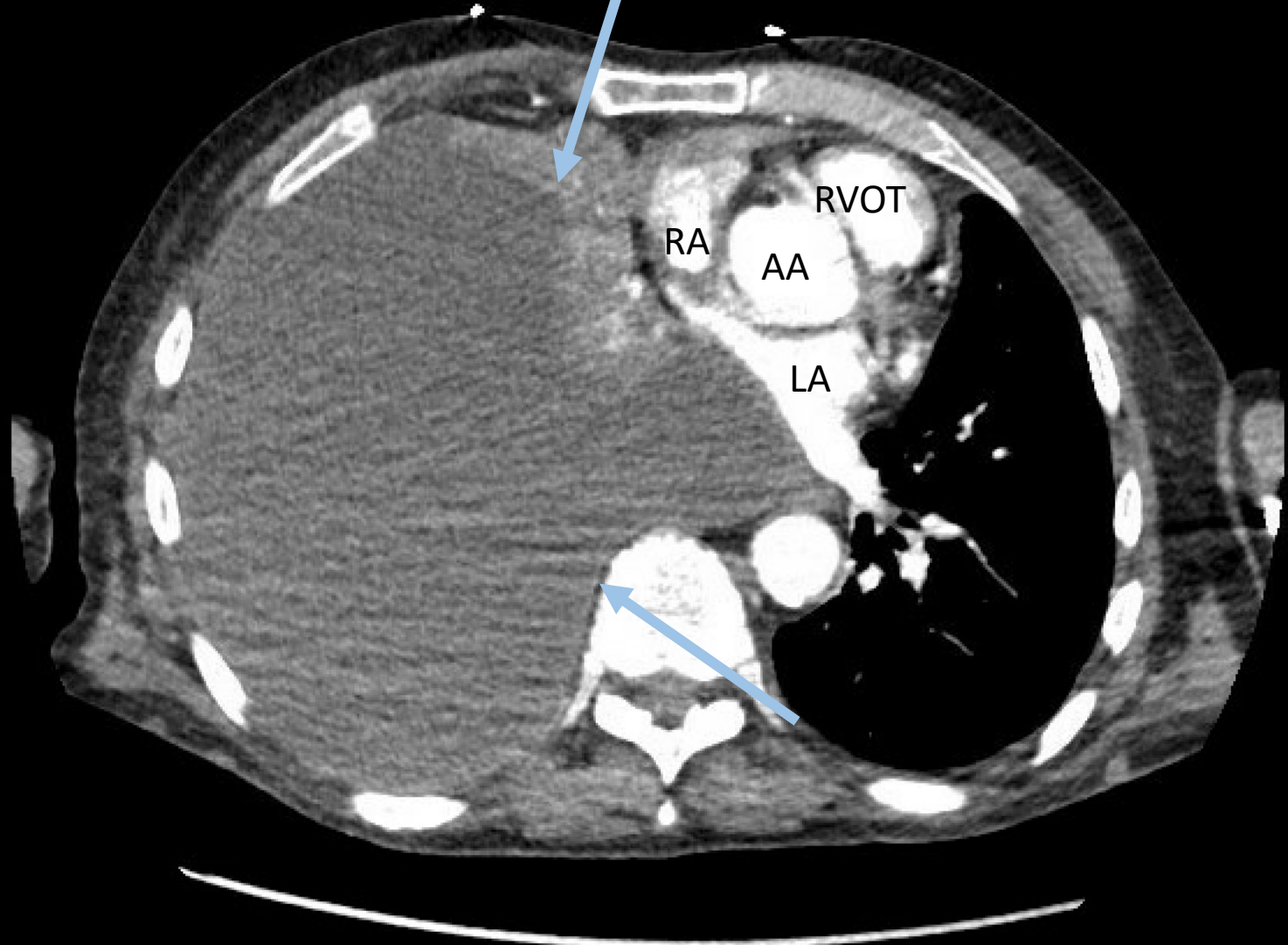
Pulmonary abscess

Mass

Next step?



Split pleura sign



CT Chest, Hospital Day 0

Modality:

CT chest with contrast, axial view

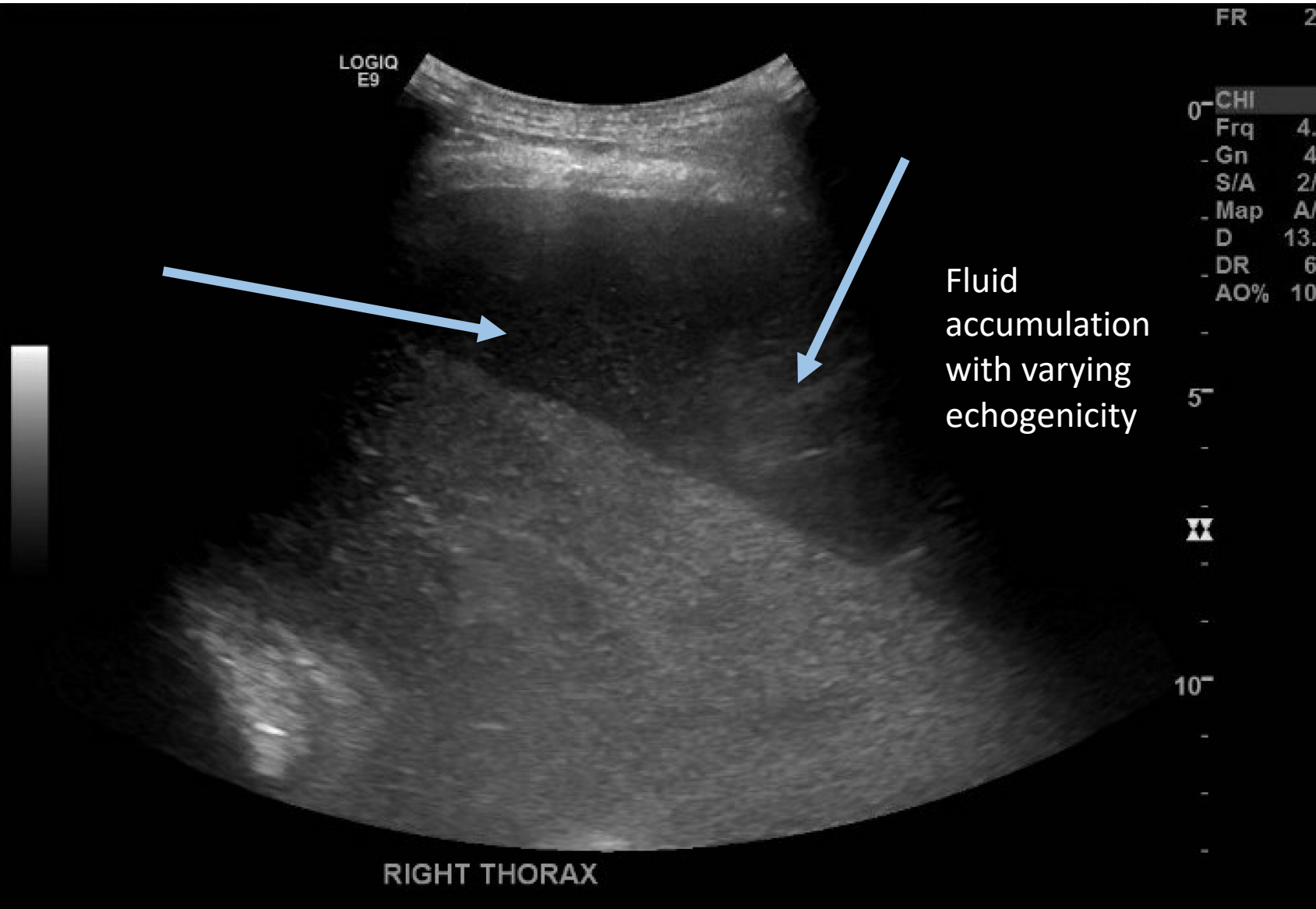
Key findings:

- Large right pleural effusion with collapse of right lung lobes
- Some preservation of right upper lobe aeration on superior cross-section
- Right-to-left shift of mediastinal structures
- “Split pleura” sign suggesting empyema

DDx:

- Empyema
- Parapneumonic effusion
- Pulmonary abscess

Next step?



Ultrasound Posterior Thorax, Hospital Day 1

Modality:

Right US-guided thoracentesis

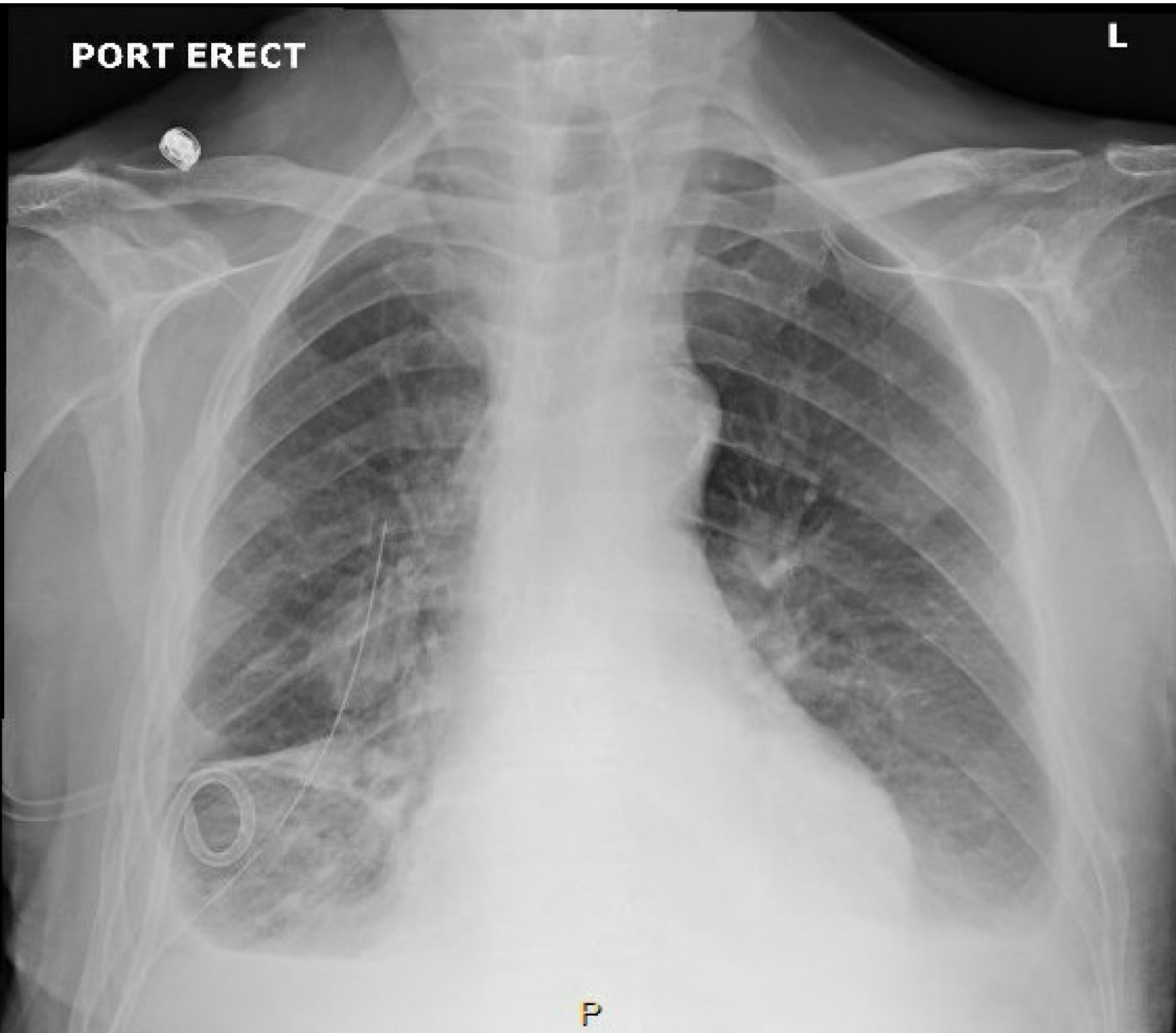
Key findings:

- Loss of sliding pleural stripes
- Fluid within the pleural space that is not uniformly anechoic with varying echogenicity
- Thoracentesis revealed: Yellow opaque purulent fluid, confirmed exudative

Suspected Diagnosis:

Community acquired pneumonia leading to parapneumonic effusion that progressed to empyema

Next step?



Chest X-ray, Hospital Day 12

Between Day 1-12:

- Day 1, right chest tube placed
- Day 6, thoracostomy with additional large bore chest tube placed
- Daily trending of chest x-rays

Modality:

- Chest plain film

Key findings:

- Significant clearance of right pleural effusion compared to Day 0 CXR with re-expansion of right lung
- Small remaining right effusion with small right basilar loculated pneumothorax
- Stable small left pleural effusion
- Small chest tube and large bore chest tube in place

Patient treatment and outcome

- Pleural fluid culture from Hospital Day 1 grew *streptococcus anginosus*
- Hospital Day 1: Right chest tube placed with suction drainage
- Hospital Day 6: Thoracostomy for adhesion reduction in addition to placement of large bore tube with suction drainage
- Both tubes removed by Hospital Day 15 upon adequate drainage
- Patient completed 14 total days of antibiotics
- Patient discharged to skilled nursing facility on Hospital Day 17 in stable condition

Discussion:

Imaging work-up for Pleural Effusion in Setting of Suspected Recent Pneumonia

- Chest x-ray
 - Evaluate airway, breathing, circulation
 - Relative low radiation exposure (<0.1 mSv) , usually appropriate¹
 - Cost: \$280 National Average²
 - **Sensitivity 0.51** (95% CI: 0.33-0.68; p<0.001), **Specificity 0.91** (95% CI: 0.68-0.98; p<0.001) for pleural effusion³
- Thorax Ultrasound
 - Evaluate for fluid, free air, masses
 - Relative no radiation exposure (0 mSv), appropriateness is debated¹
 - Cost: Can be similar to or less than chest plain film cost⁴
 - **Sensitivity 0.94** (95% CI: 0.88-0.97; p<0.001), **Specificity 0.98** (95% CI: 0.92-1.0; p<0.001) for pleural effusion³

References:

1. American College of Radiology. (2023). ACR Appropriateness Criteria: Workup of Pleural Effusion or Pleural Disease. *American College of Radiology*. <https://acsearch.acr.org/docs/3158179/Narrative>
2. Madison, B. (2023, November 27). How much do X-Rays cost? It depends. *GoodRx*. <https://www.goodrx.com/health-topic/diagnostics/how-much-do-x-rays-cost>
3. Yousefifard M, Baikpour M, Ghelichkhani P, Asady H, Shahsavari Nia K, Moghadas Jafari A, Hosseini M, Safari S. Screening Performance Characteristic of Ultrasonography and Radiography in Detection of Pleural Effusion; a Meta-Analysis. *Emerg (Tehran)*. 2016 Winter;4(1):1-10. PMID: 26862542; PMCID: PMC4744606.
4. *How much does an ultrasound cost? - CareCredit*. (2023, October 13). <https://www.carecredit.com/well-u/well-u/health-wellness/ultrasound-cost/>

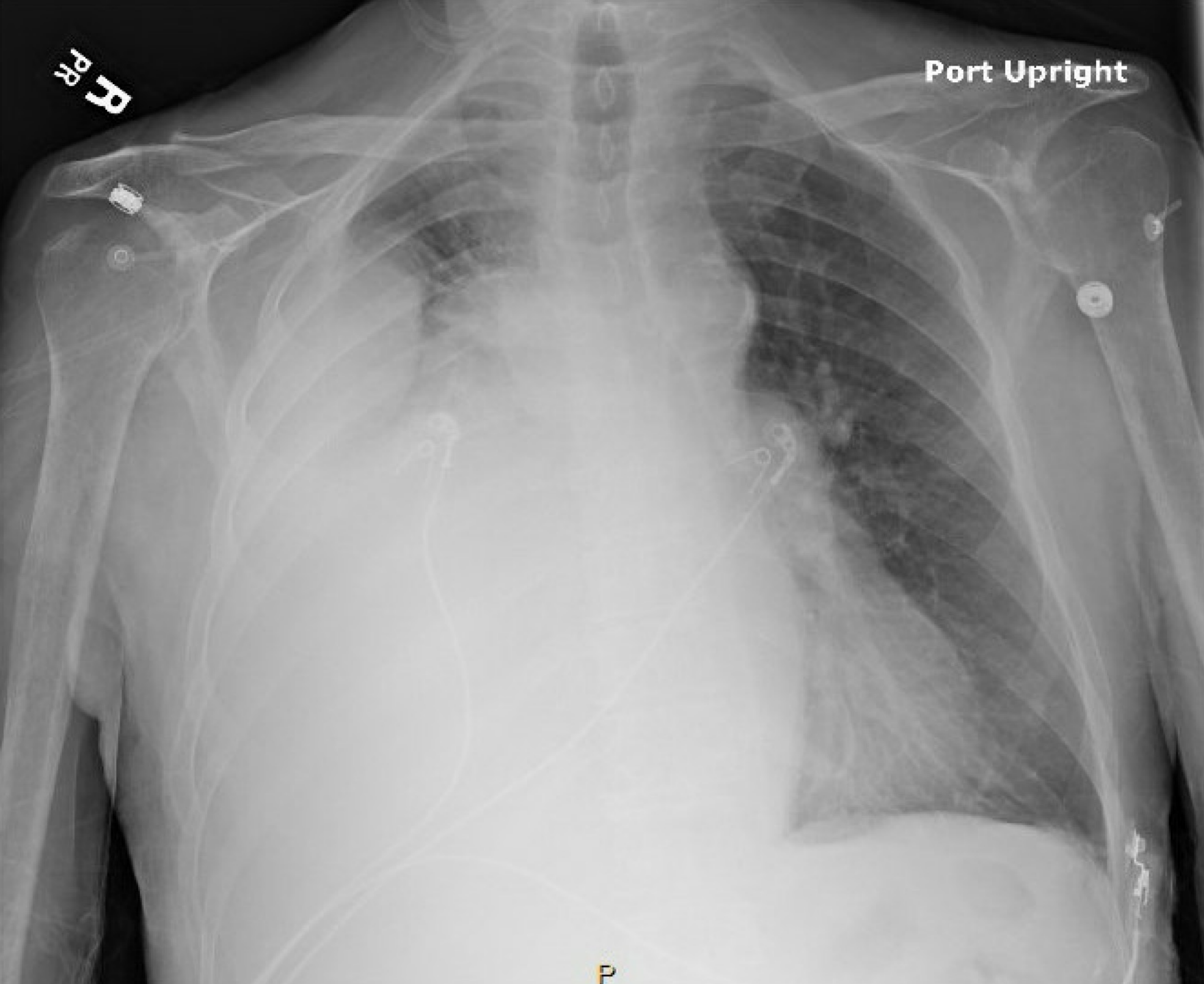
Discussion:

Imaging work-up for Pleural Effusion in Setting of Suspected Recent Pneumonia (continued)

- CT Chest with IV Contrast
 - Further detailed characterization of suspected pleural effusion to evaluate extent of disease
 - Relative moderate radiation exposure (1-10 mSv)¹
 - Typically appropriate in setting of suspected pleural effusion, particularly when there is evidence of significant effusion affecting lung expansion^{1, 2}
 - Cost: Can be \$800 to \$2000+³
 - Pleural enhancement **sensitivity 84%**, 95% confidence interval [CI], 62%-94%; **specificity 83%**, 95% CI, 75%-89%⁴
 - Pleural thickening **sensitivity 68%**, 95% CI, 56%-77%; **specificity 87%**, 95% CI, 80%-92%⁴
 - Loculation **sensitivity 52%**, 95% CI, 44%-59%; **specificity 89%**, 95% CI, 82%-94%⁴

References:

1. American College of Radiology. (2023). ACR Appropriateness Criteria: Workup of Pleural Effusion or Pleural Disease. *American College of Radiology*. <https://acsearch.acr.org/docs/3158179/Narrative>
2. Hallifax, R., Talwar, A., Wrightson, J., Edey, A., & Gleeson, F. (2017). State-of-the-art: Radiological investigation of pleural disease. *Respiratory Medicine*, 124, 88–99. <https://doi.org/10.1016/j.rmed.2017.02.013>
3. Bsn, D. W., RN. (2022, August 18). How much does a CT scan cost? *GoodRx*. <https://www.goodrx.com/health-topic/procedures/ct-scan-cost>
4. Zetting, D., D'Antonoli, T. A., Wilder-Smith, A., Bremerich, J., Roth, J. A., & Sexauer, R. (2021). Diagnostic Accuracy of Imaging Findings in Pleural empyema: Systematic Review and Meta-Analysis. *Journal of Imaging*, 8(1), 3. <https://doi.org/10.3390/jimaging8010003>



Pleural Effusion on CXR

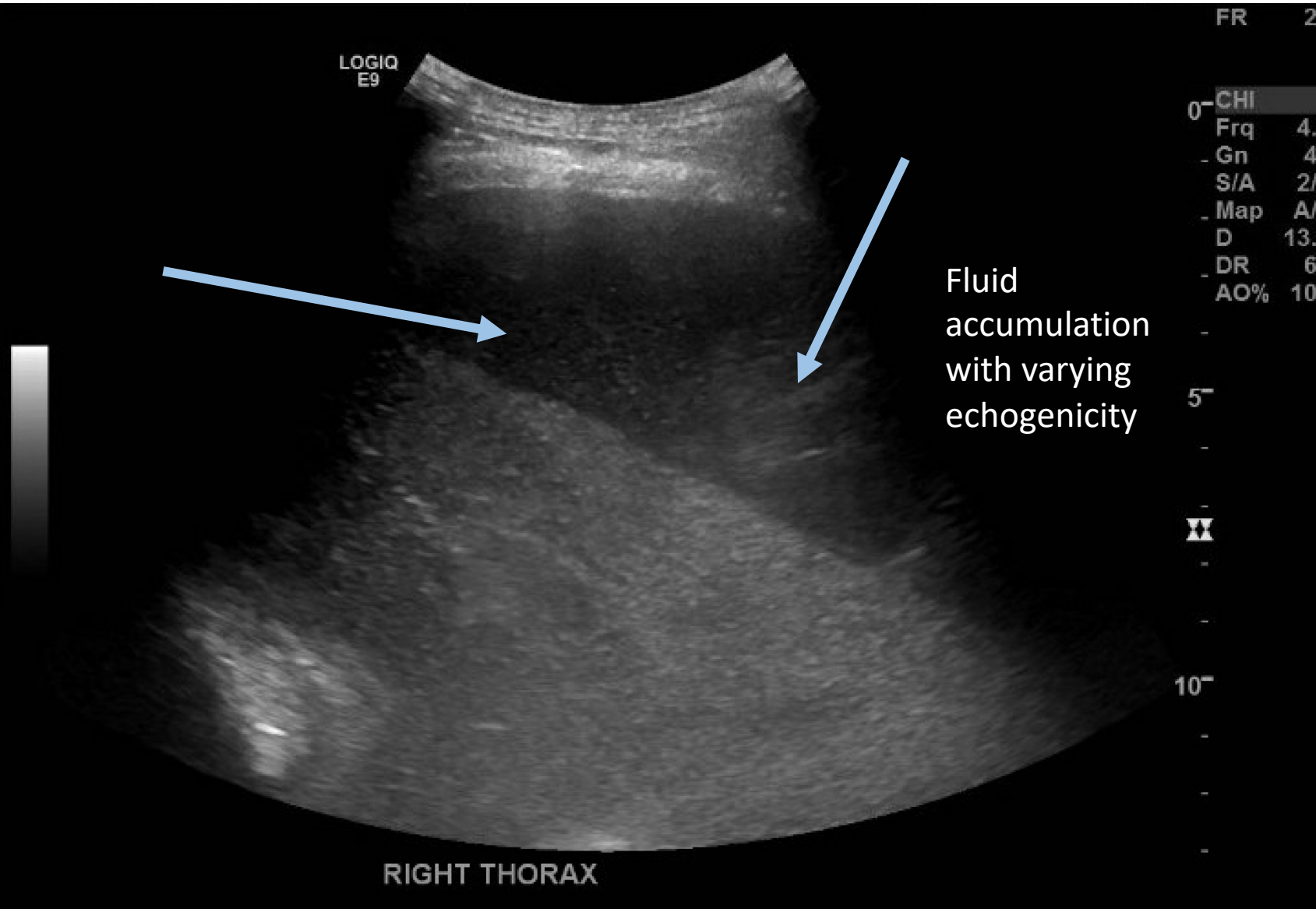
Findings to Consider:

- Opacification with obscured structures, costophrenic blunting
- Unilateral vs. bilateral
- Trachea and mediastinum positioning for differential
 - Shift towards: collapsed lung
 - Centered: consolidation, mass, pulmonary edema
 - Shift away: Pleural effusion, large mass
- Loculated (adhesions) vs. parapneumonic

References: Hallifax, R., Talwar, A., Wrightson, J., Edey, A., & Gleeson, F. (2017). State-of-the-art: Radiological investigation of pleural disease. *Respiratory Medicine*, 124, 88–99. <https://doi.org/10.1016/j.rmed.2017.02.013>

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Jones J, Sharma R, González Herrera G, et al. Pleural effusion. Reference article, Radiopaedia.org, <https://doi.org/10.53347/rID-6159>



Pleural Effusion on Ultrasound

Findings to Consider:

- Assess for typical “pleural stripes” and “comet tails” of normal pleural sliding
- Hypoechoic or anechoic separation between pleura and lung suggests fluid presence
- Evidence of varying echogenic properties of fluid suggests exudative effusion

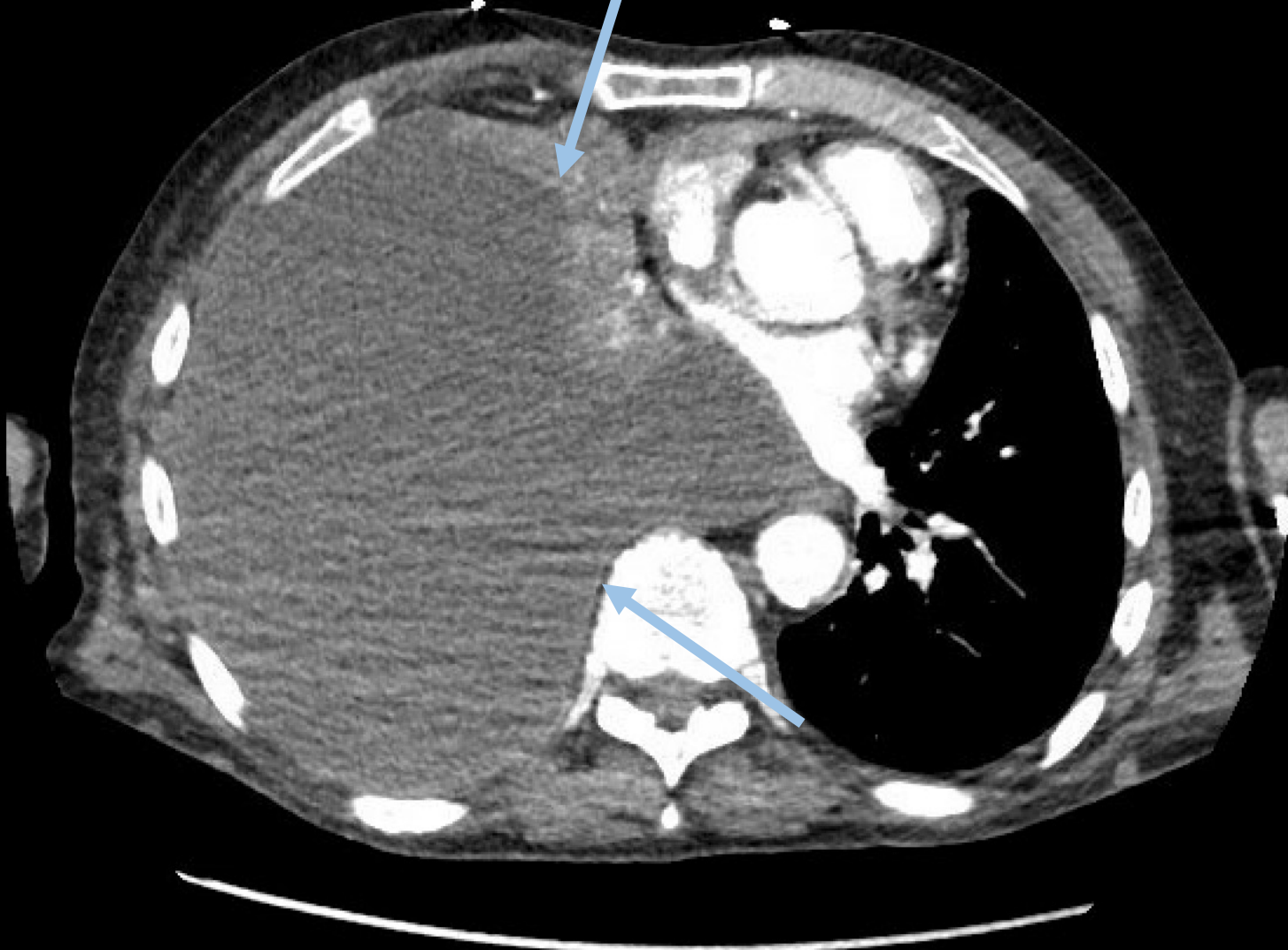
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Weerakkody Y, Silverstone L, Elfeky M, et al. Pleural empyema. Reference article, Radiopaedia.org, <https://doi.org/10.53347/rID-7336>



Split pleura sign



Pleural Effusion on CT Chest

Findings to Consider:

- Fluid will be hyper-attenuated compared to air
- Pleural thickening could suggest empyema, although it can be present in simple parapneumonic effusion as well
- “Split-pleura” sign refers to evidence of thickened inner visceral pleura separated from outer parietal pleura by fluid suggesting empyema
- Abscesses typically present with spherical thickened wall lesions and presence of air or gas within abscess separate from normal lung

Reference: Hallifax, R., Talwar, A., Wrightson, J., Edey, A., & Gleeson, F. (2017). State-of-the-art: Radiological investigation of pleural disease. *Respiratory Medicine*, 124, 88–99. <https://doi.org/10.1016/j.rmed.2017.02.013>



UNC Top Three Teaching Points

1. Chest x-ray, CT Chest with IV contrast, and thoracic ultrasound are effective modalities of identifying pleural effusions with high specificity
2. The combination of these imaging modalities may help with characterizing pleural effusion into exudative vs. transudative and parapneumonic vs. loculated in cases of suspected infectious processes
3. Confirmation of effusion characterization requires analyzing the fluid to determine next steps in management

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American College of Radiology. (2023). ACR Appropriateness Criteria: Workup of Pleural Effusion or Pleural Disease. *American College of Radiology*. <https://acsearch.acr.org/docs/3158179/Narrative>

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