Organizing Pneumonia and Lung Injury

American College of Radiology™

We Have No Relevant Disclosures

Papers

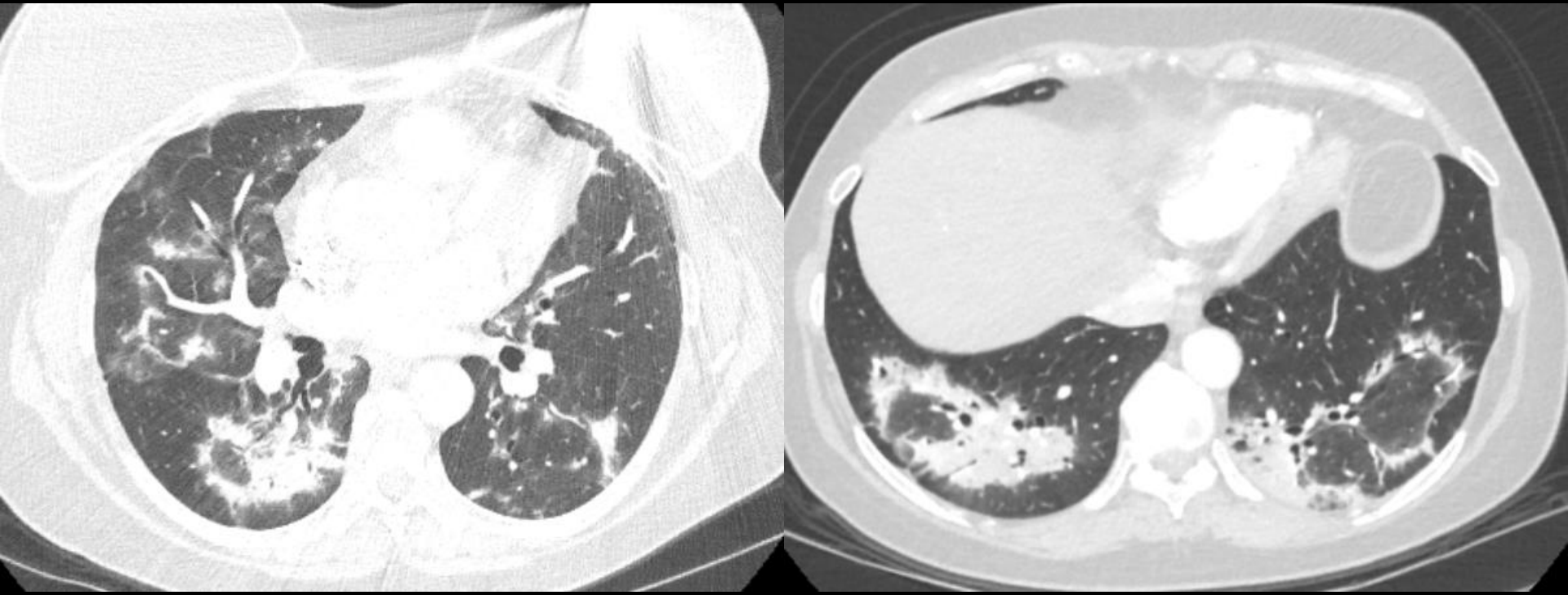
- Kligerman, Seth. “Pathogenesis, Imaging, and Evolution of Acute Lung Injury.” *Radiologic Clinics of North America* 60, no. 6 (November 2022): 925–39. https://doi.org/10.1016/j.rcl.2022.06.005.
- Marquis, Kaitlin M., Mark M. Hammer, Kacie Steinbrecher, Travis S. Henry, Chieh-Yu Lin, Adrian Shifren, and Constantine A. Raptis. “CT Approach to Lung Injury.” *RadioGraphics* 43, no. 7 (July 1, 2023): e220176. https://doi.org/10.1148/rg.220176.
- Obadina, E T, J M Torrealba, and J P Kanne. “Acute Pulmonary Injury: High-Resolution CT and Histopathological Spectrum.” *The British Journal of Radiology* 86, no. 1027 (July 2013): 20120614. https://doi.org/10.1259/bjr.20120614.

Lung Injury Terms

- Organization – granulation tissue proliferation due to lung injury
- Organizing Pneumonia - normal response to an insult (in most cases)
- Diffuse Alveolar Damage – severe, often exaggerated response to injury (pathologic diagnosis)
- Acute Lung Injury – clinical syndrome in patients with pathologic DAD

56-year-old with breast cancer, cough

56-year-old with breast cancer, cough



Typical appearance of organizing pneumonia

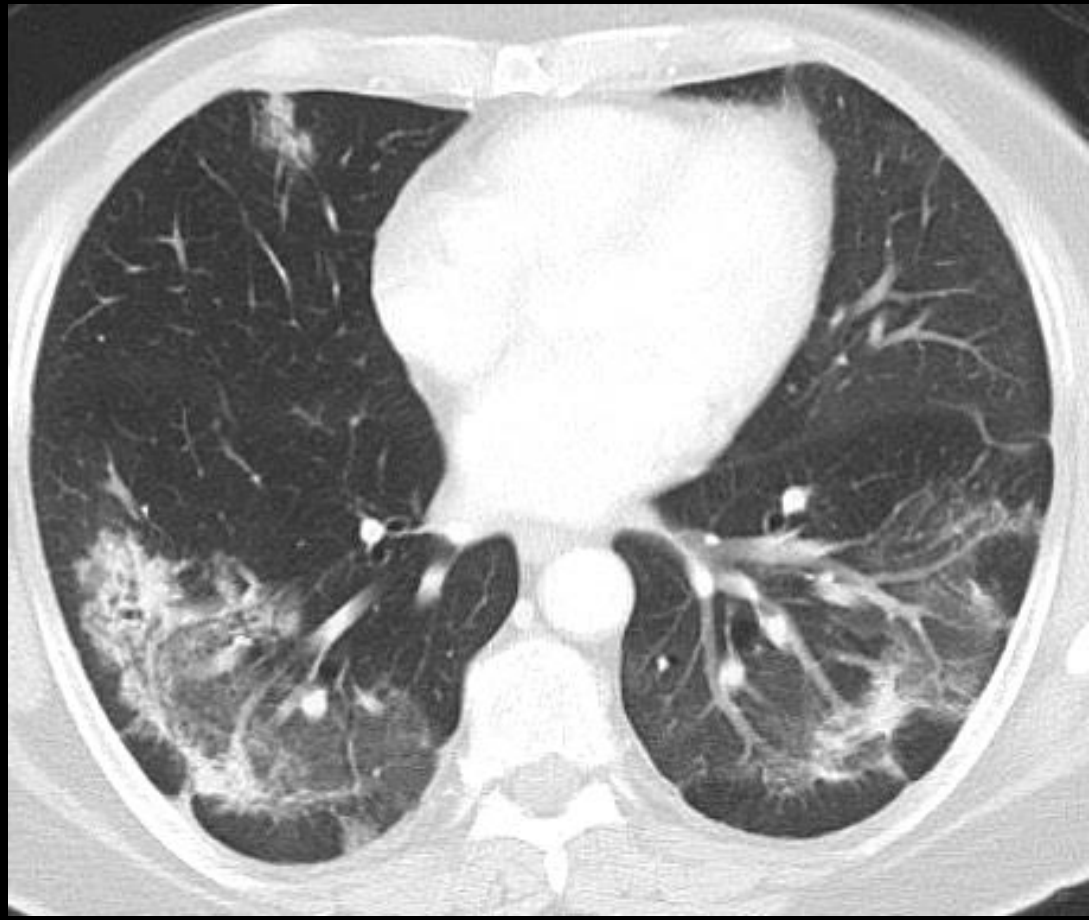
OP Typical Features:

- Lower lobe > upper
- Symmetric
  - Peribronchovascular
  - Peripheral
  - Perilobular
- Sharply demarcated

Drug Reaction

OP Typical Features:

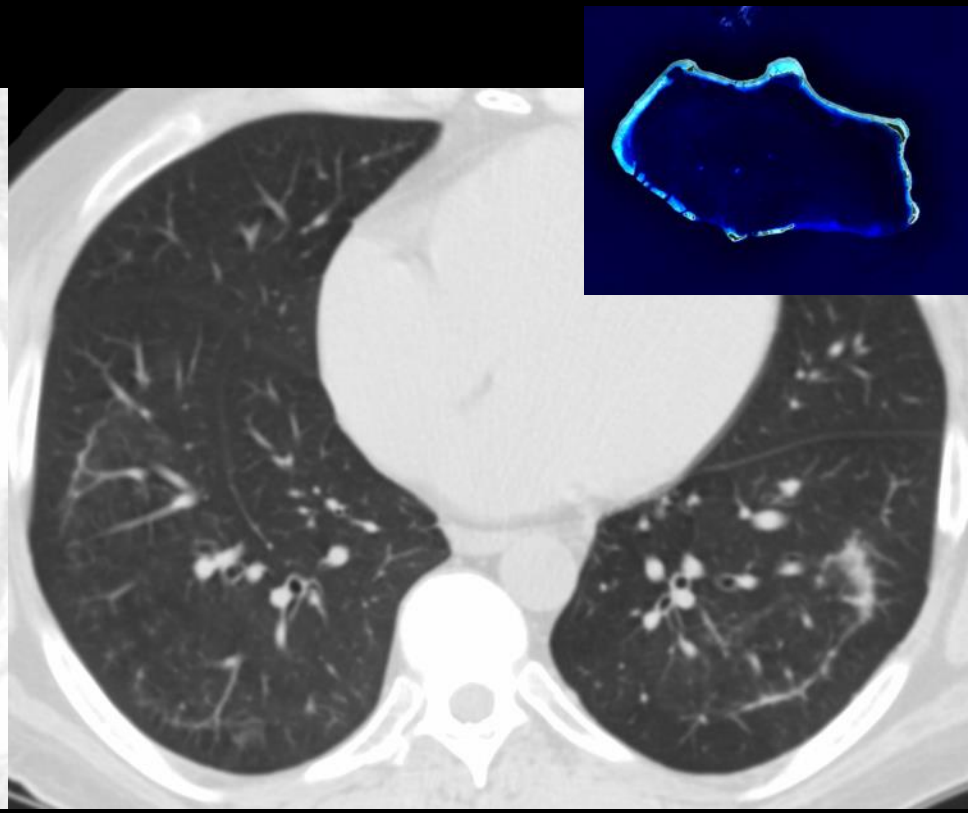
- Lower lobe > upper
- Symmetric
  - Peribronchovascular
  - Peripheral
  - Perilobular
- Sharply demarcated



Drug Reaction

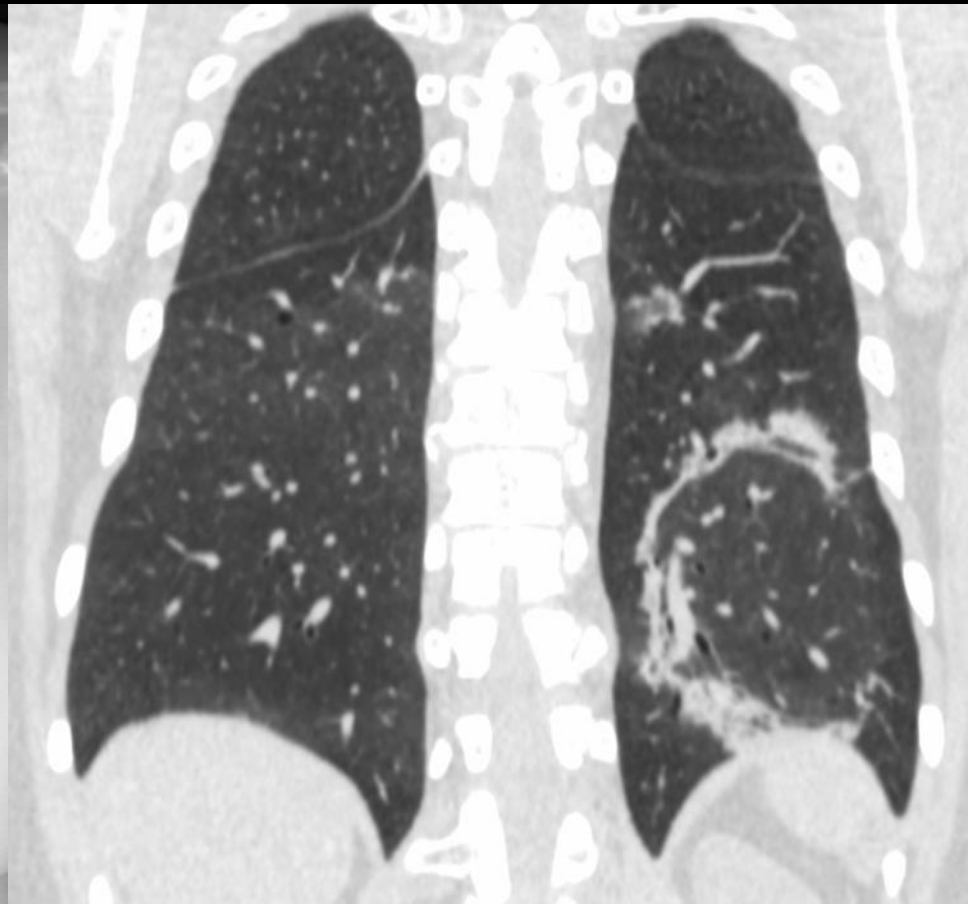
“Signs” of OP

Reverse Halo

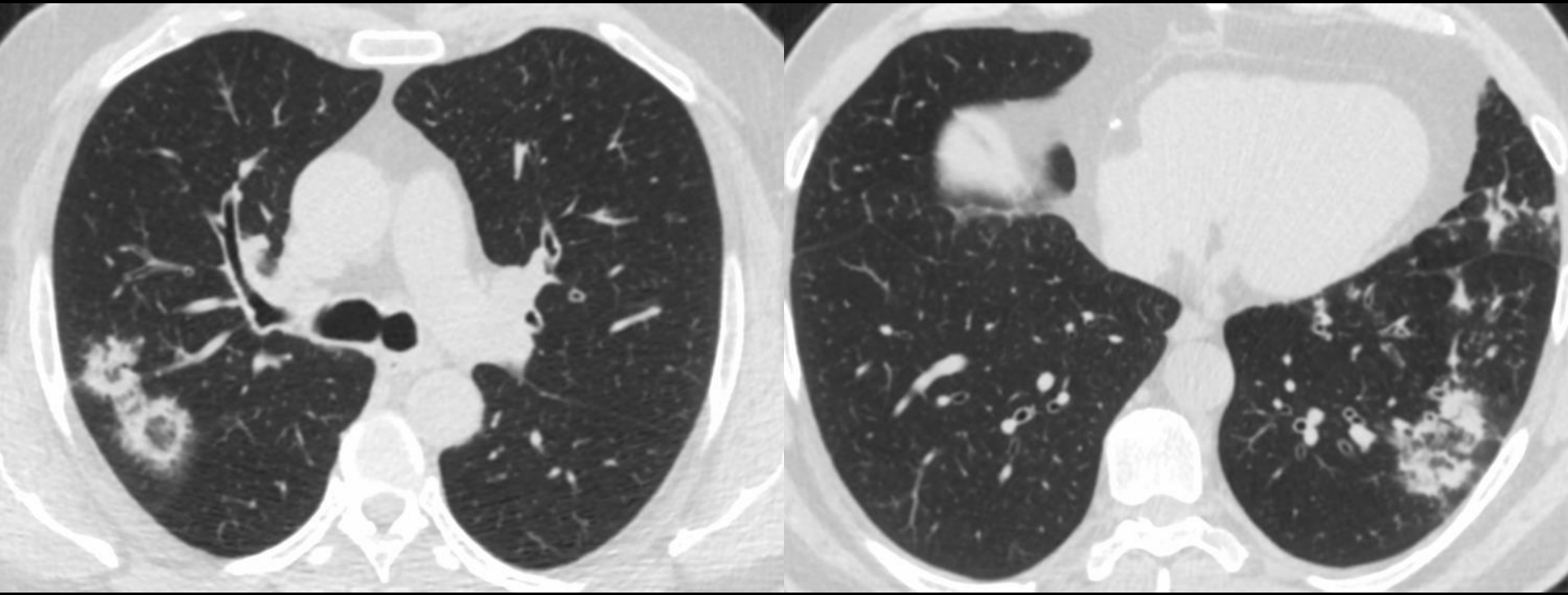


Atoll

Subacute cough after cocaine use

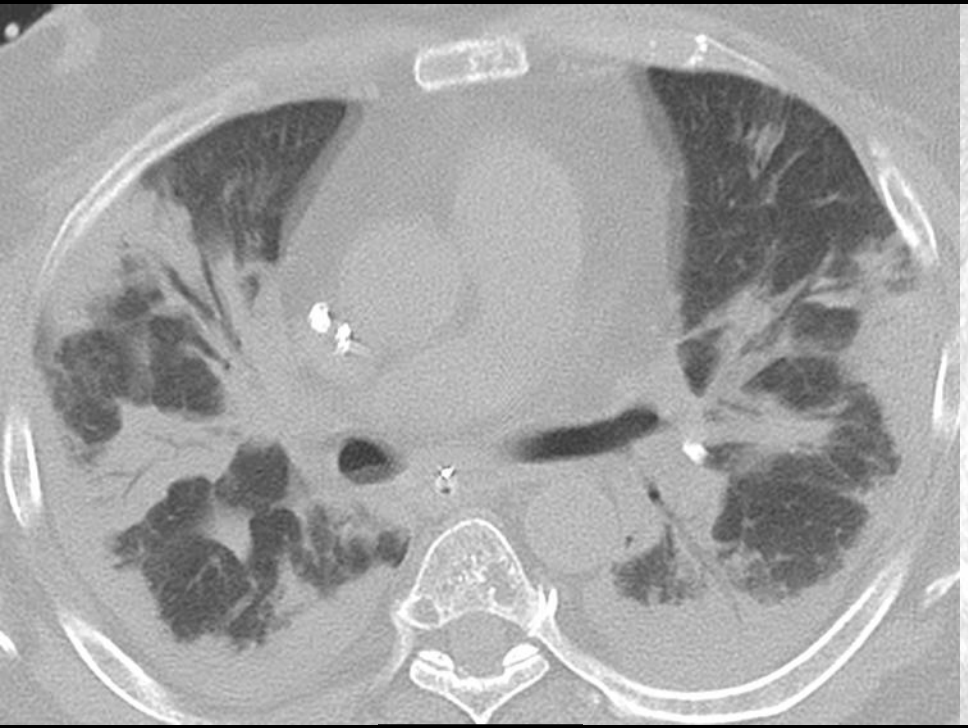


74-year-old with cough

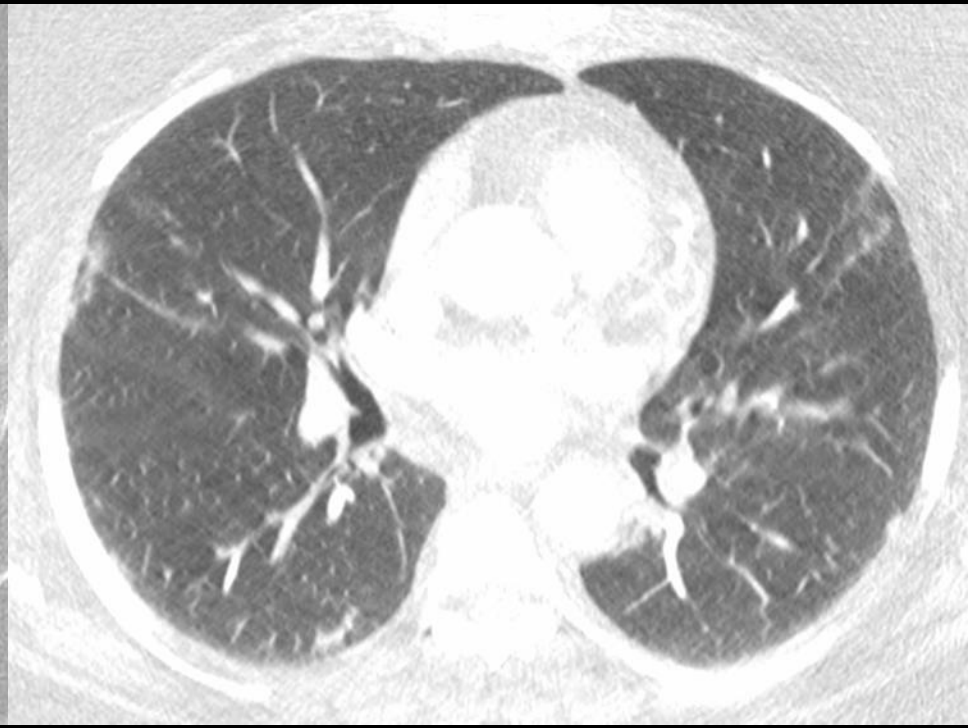


Chlamydia pneumoniae

Two Cases of Influenza A



Severe



Mild

OP Typical Features:

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- Symmetric
  - Peribronchovascular
  - Peripheral
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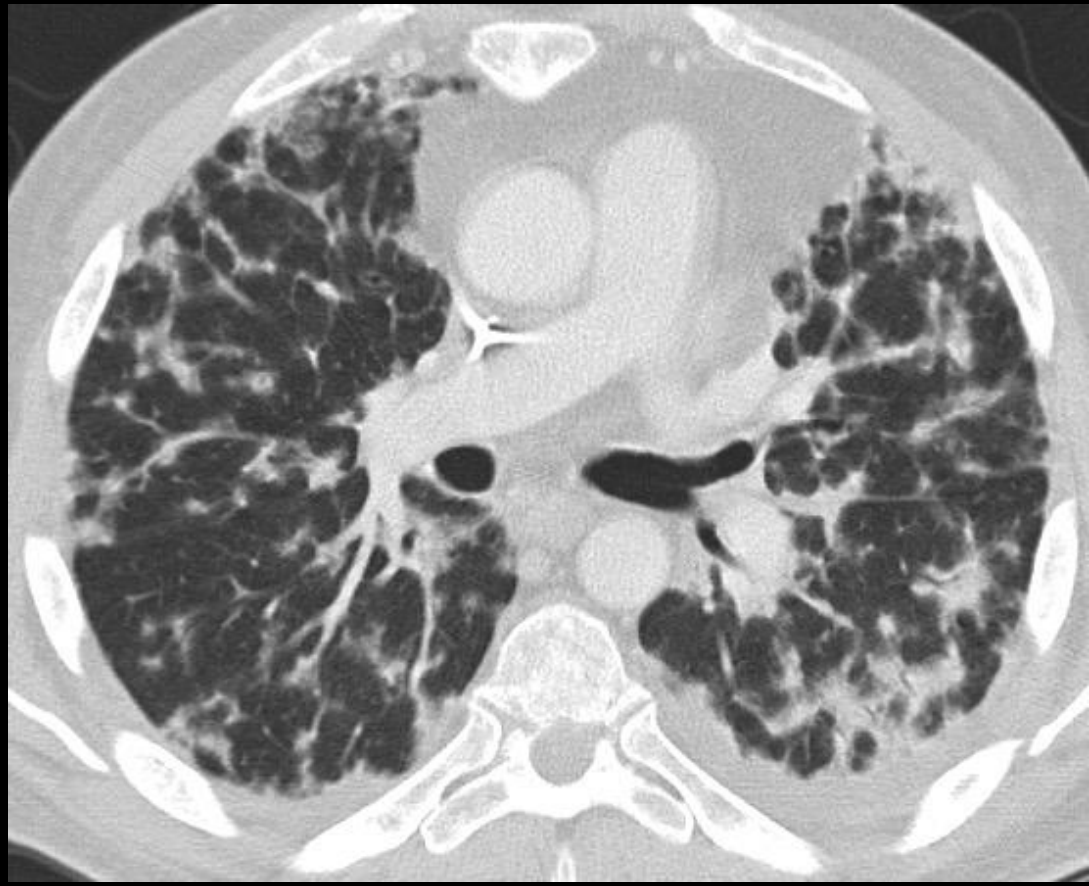
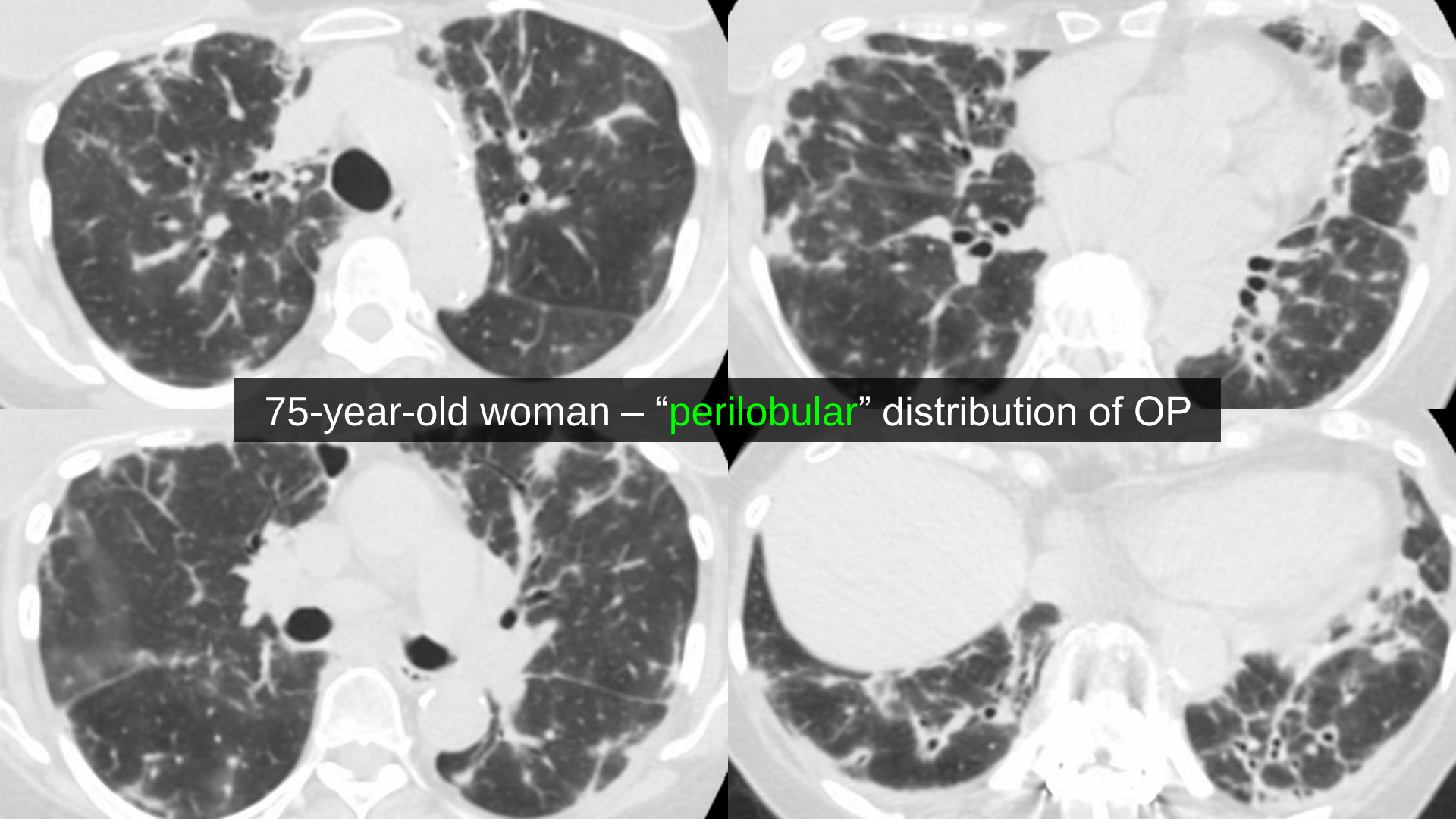
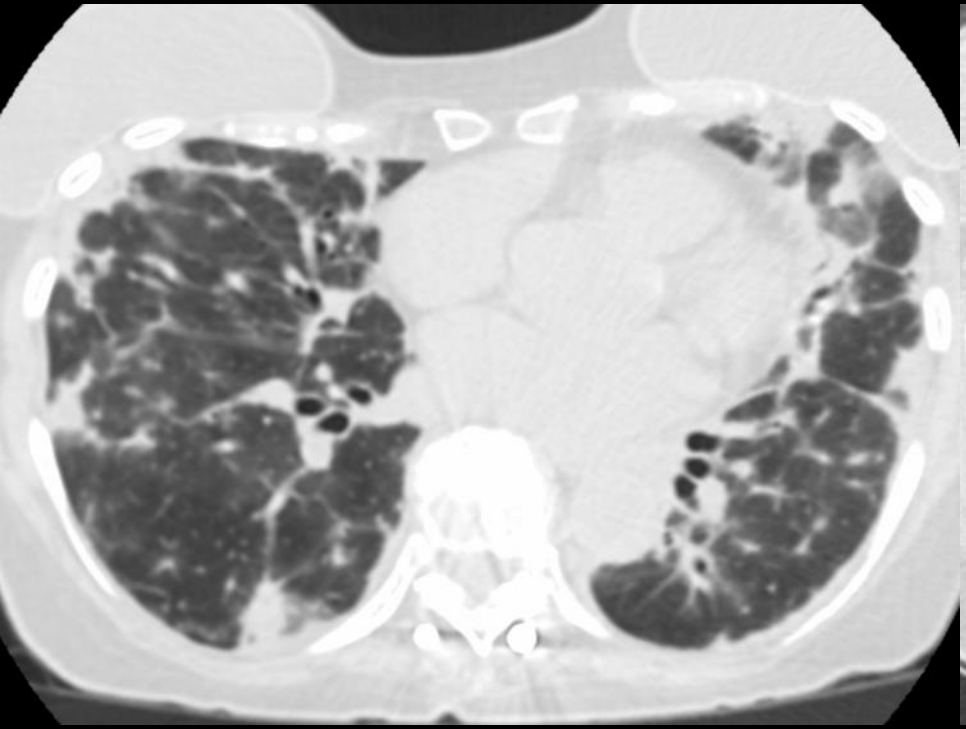
- Sharply demarcated



Drug Reaction


75-year-old woman – “perilobular” distribution of OP

Perilobular distribution of OP



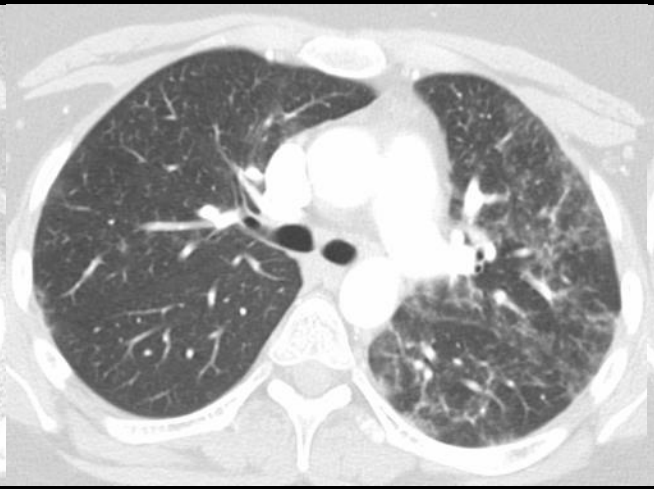
(nitrofurantoin use; 2 months later stopped drug + steroids)

OP is Usually Steroid Responsive

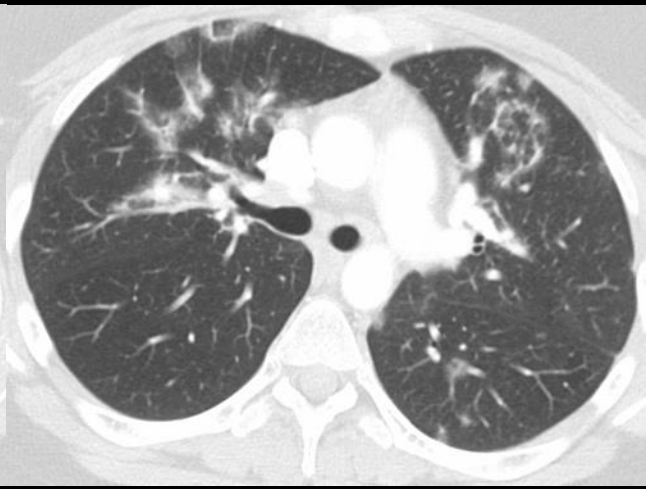
After steroids

OP can Relapse

21-year-old with COP

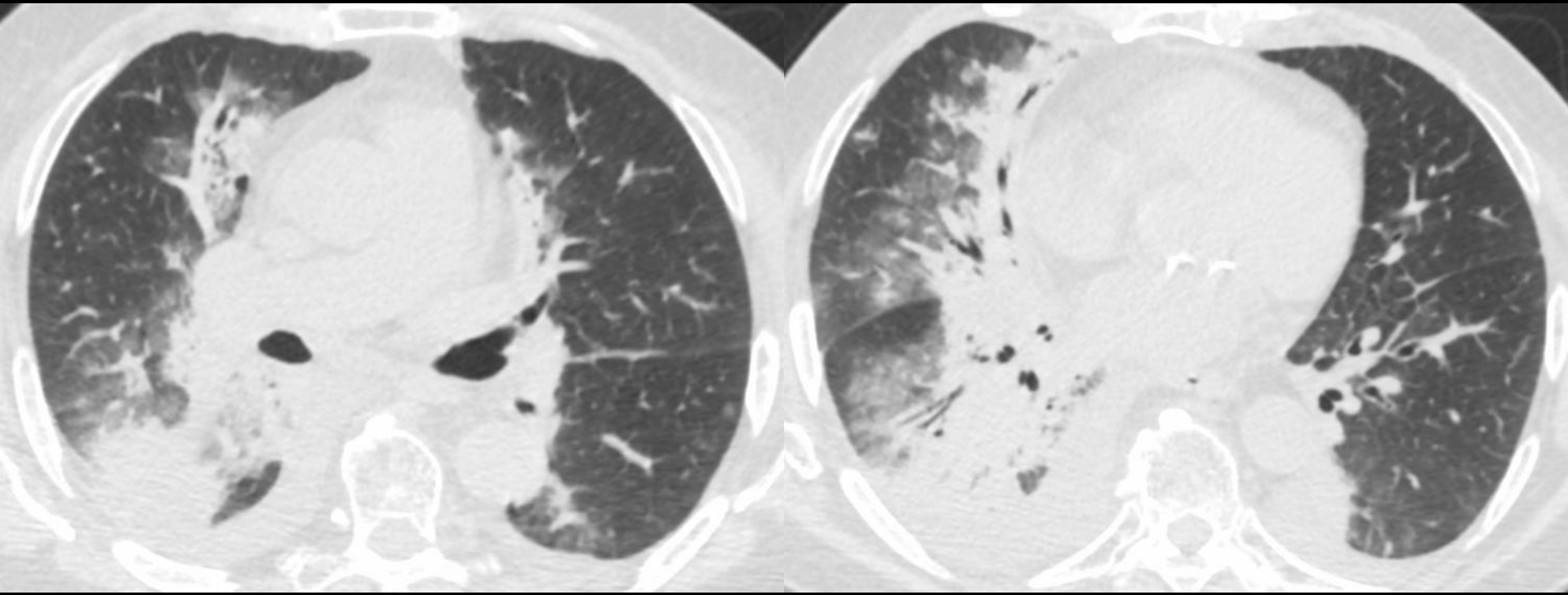


Improves on steroids

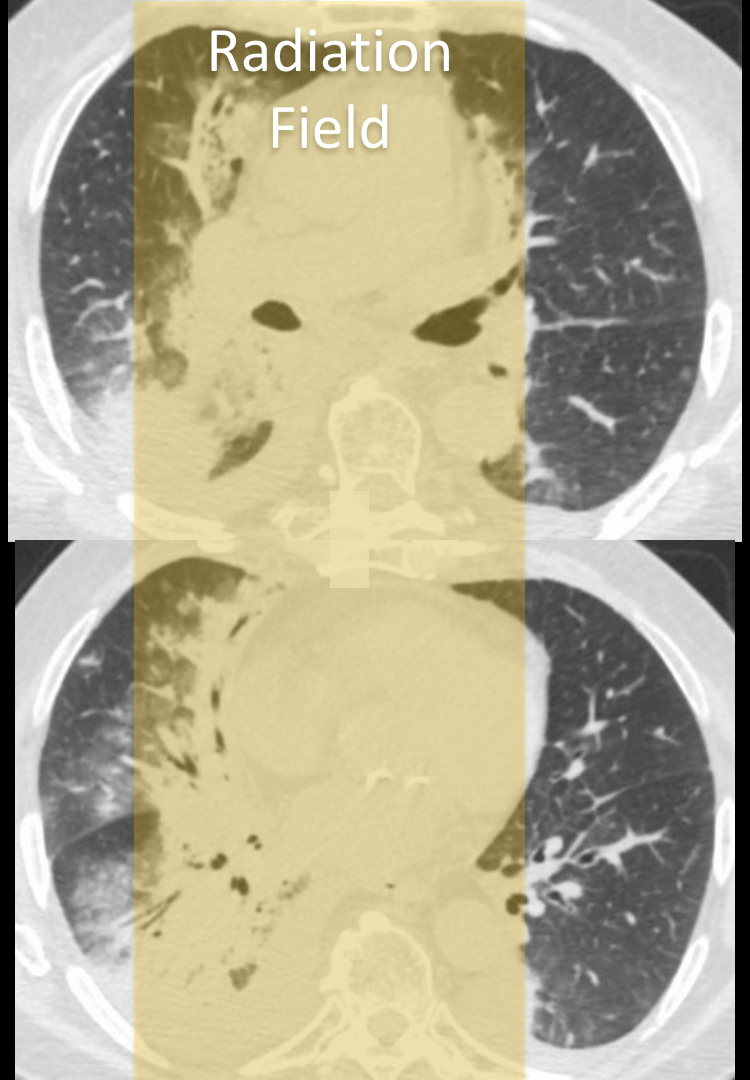


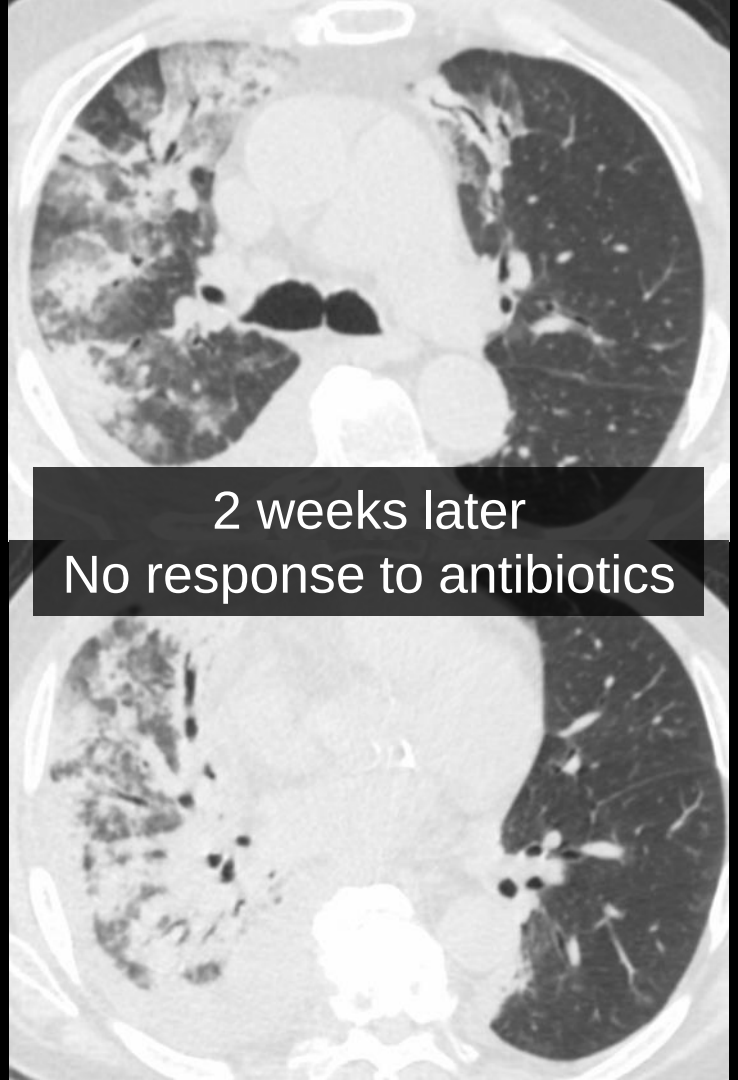
Taper steroids
Symptoms return

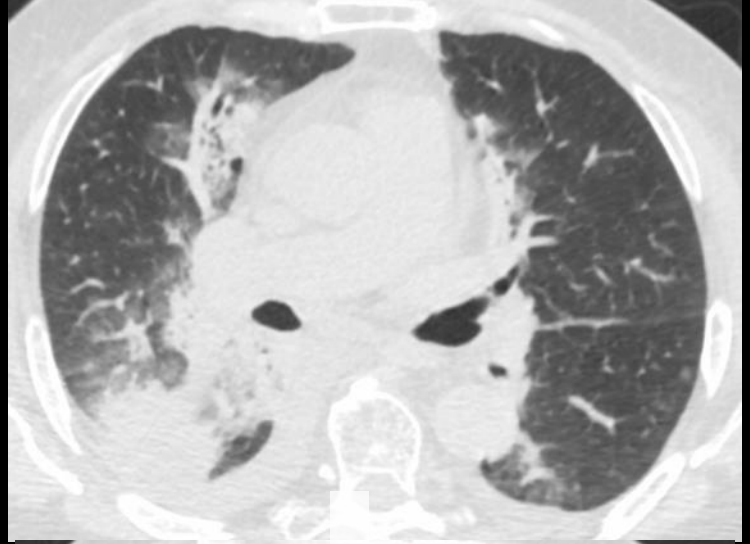
OP Can Be Asymmetric

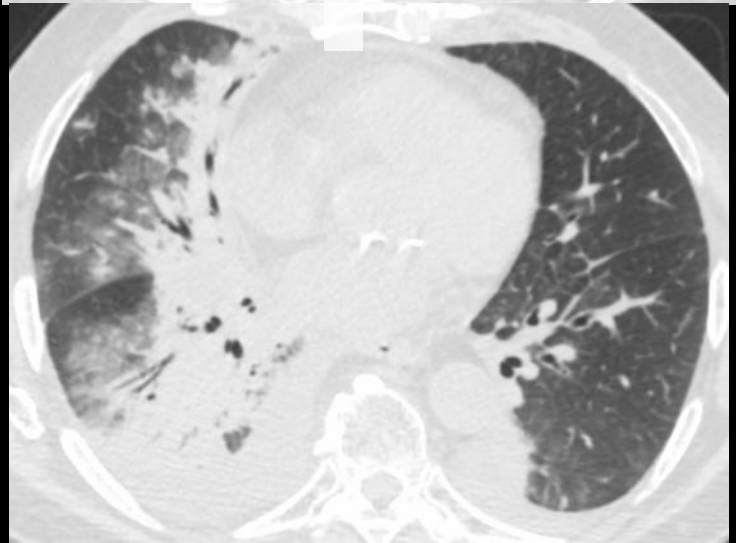


Multiple myeloma, cough and low grade fever


Radiation
Field

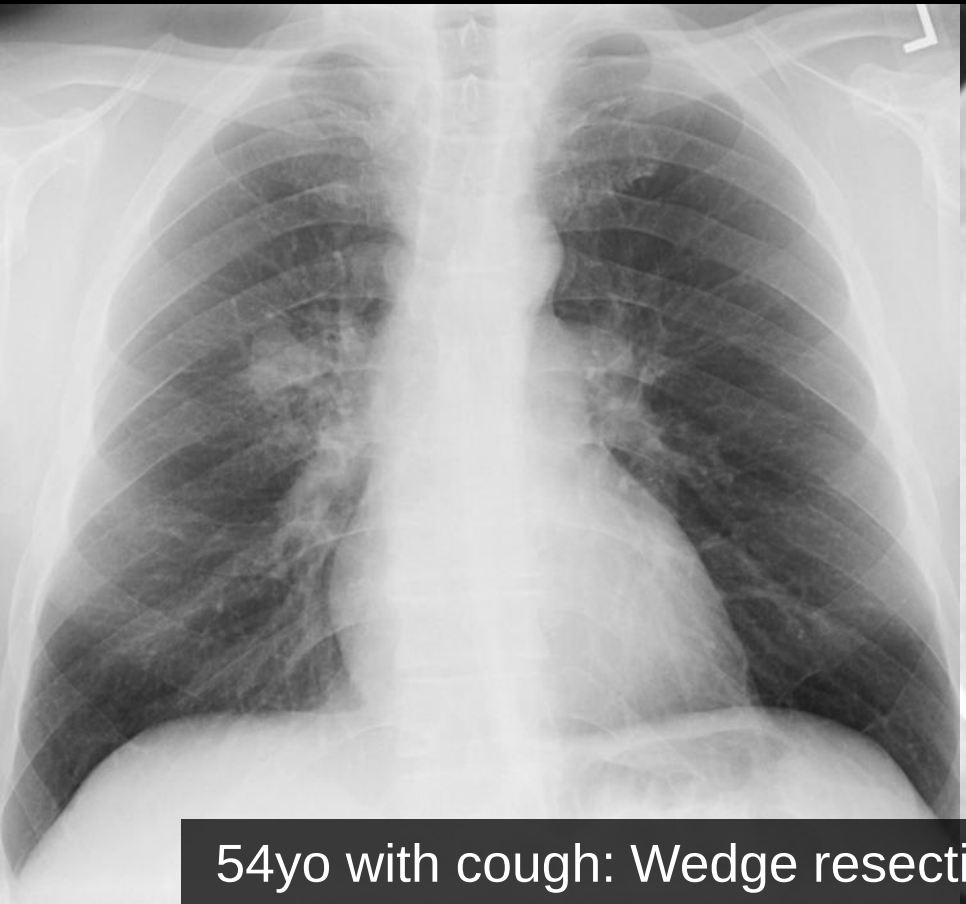

2 weeks later
No response to antibiotics

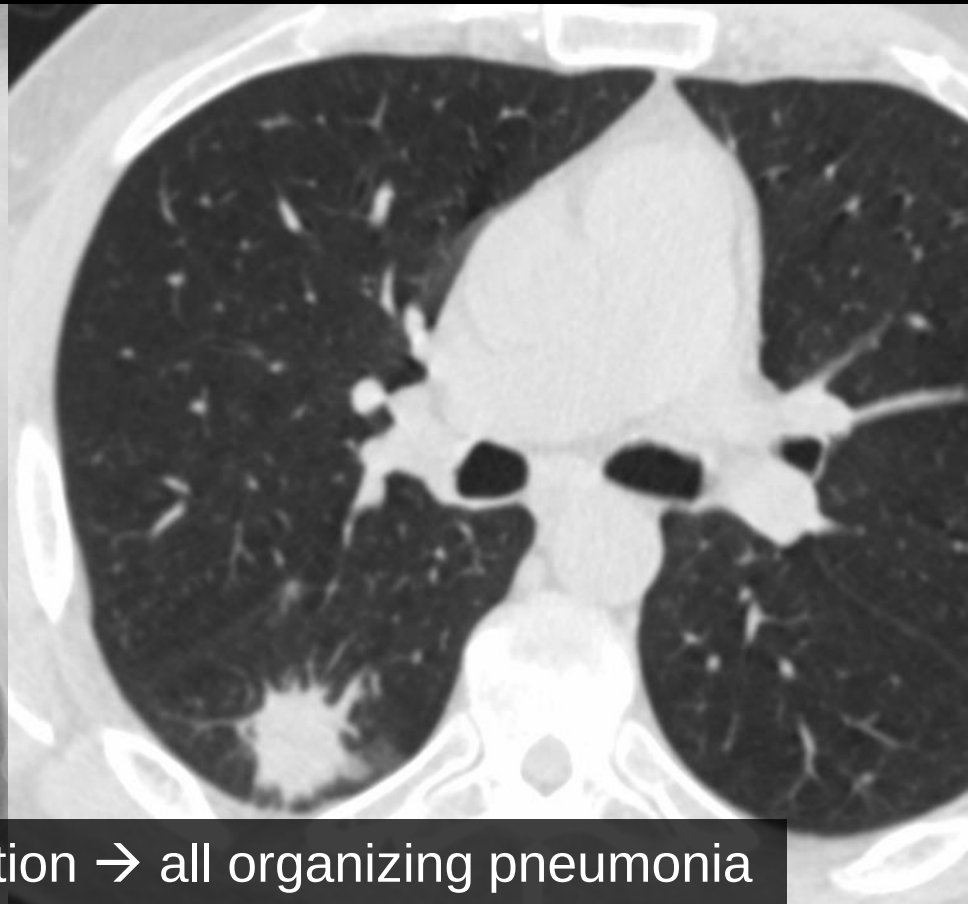




2 months later after steroids

OP Can Be Asymmetric

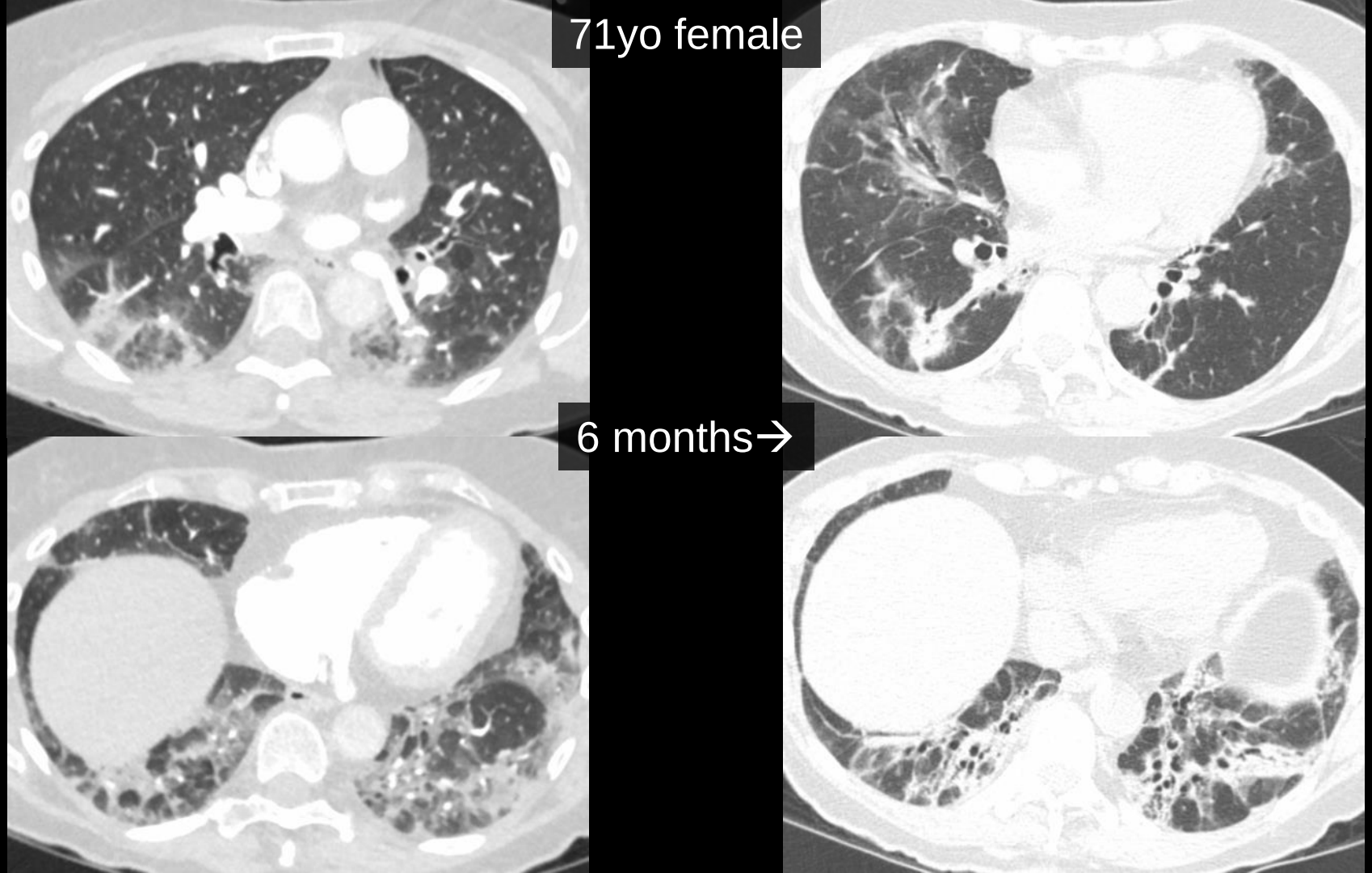




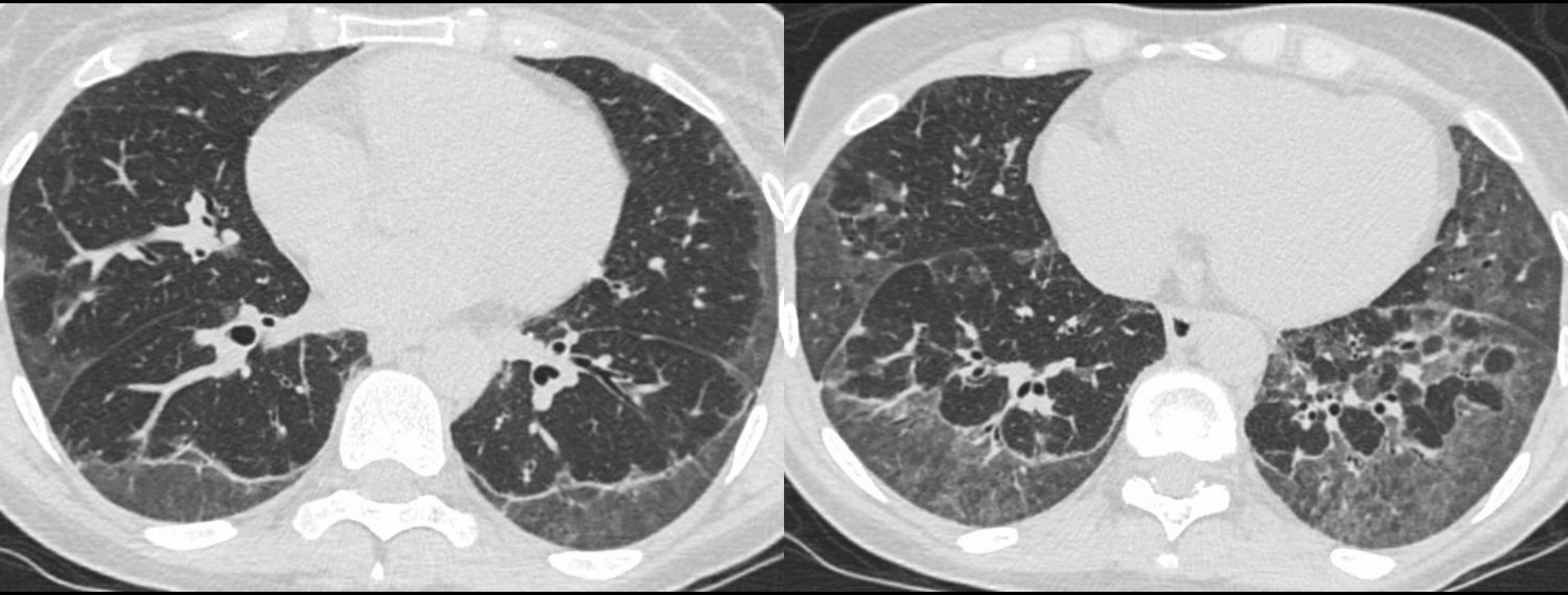
54yo with cough: Wedge resection → all organizing pneumonia

OP Clinical Presentation & Outcomes

- Subacute presentation over weeks to months
- Variable symptoms (usually “not that sick”)
  - Cough
  - Fever
  - Asymptomatic
- Corticosteroids → 80% recover
  - (may relapse or progress to fibrosis)

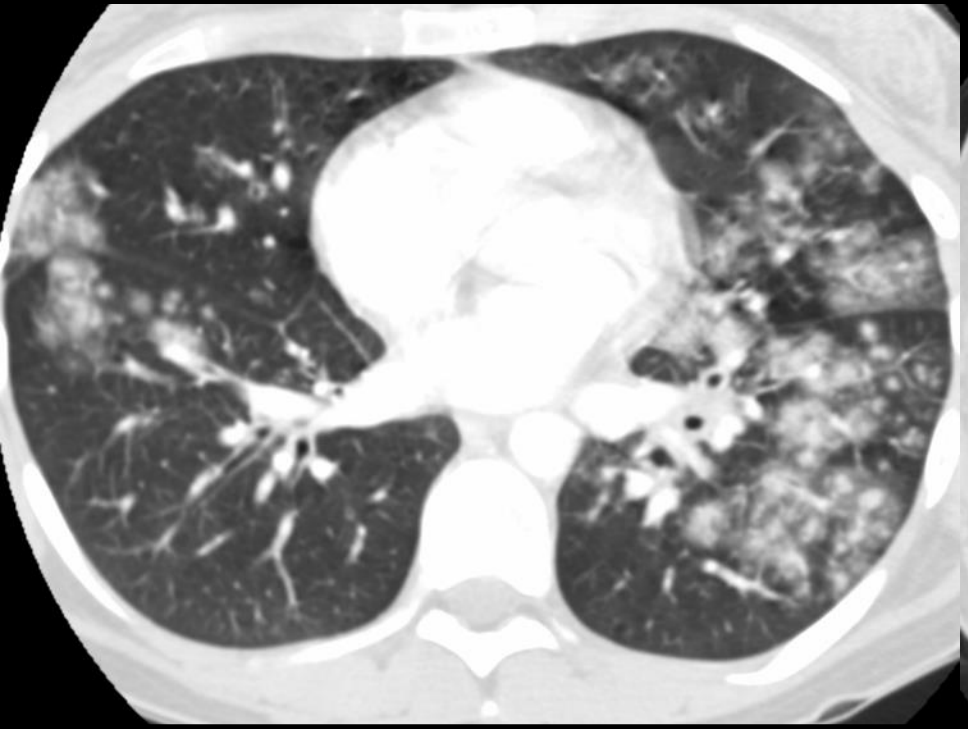

71yo female
6 months→

OP may be a component of another disease

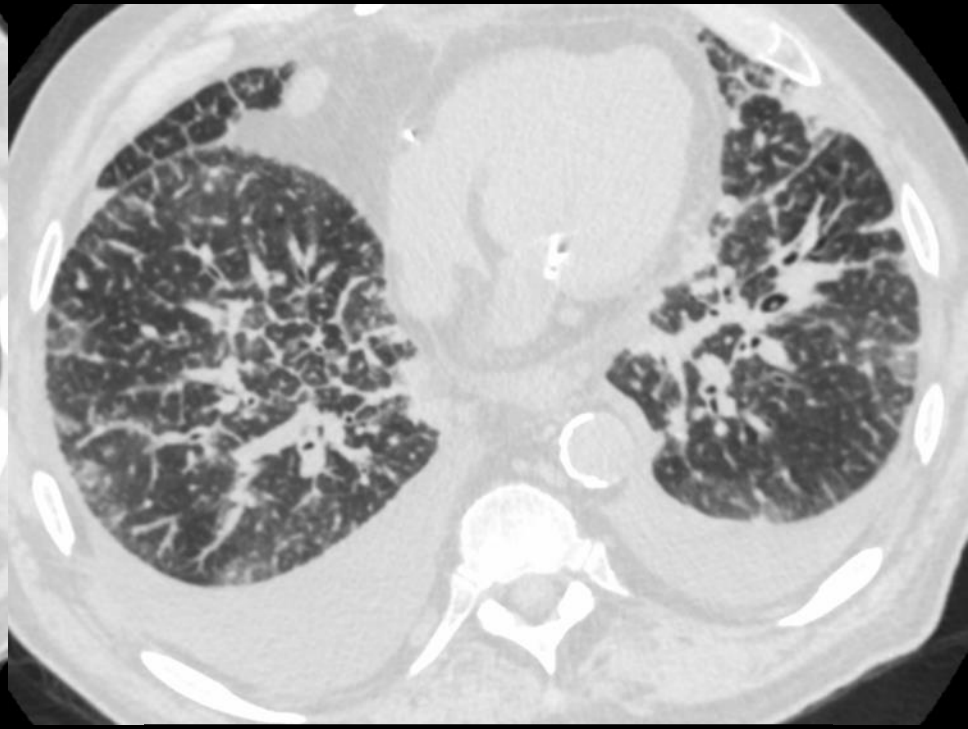


44-year-old with connective tissue disease

NOT Organizing Pneumonia

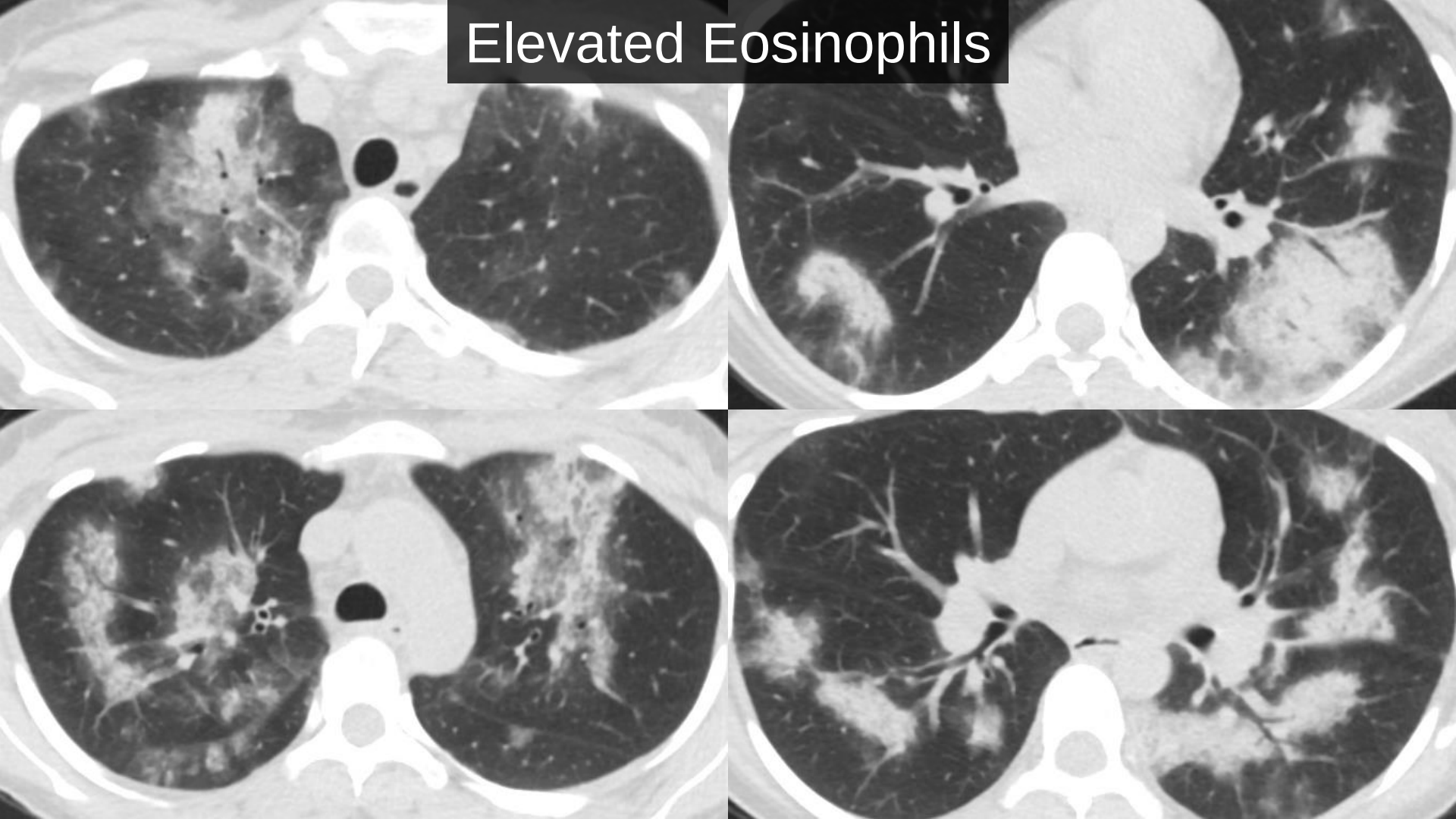


Centrilobular Nodules, Asymmetric - Infection



Septal Thickening - Edema

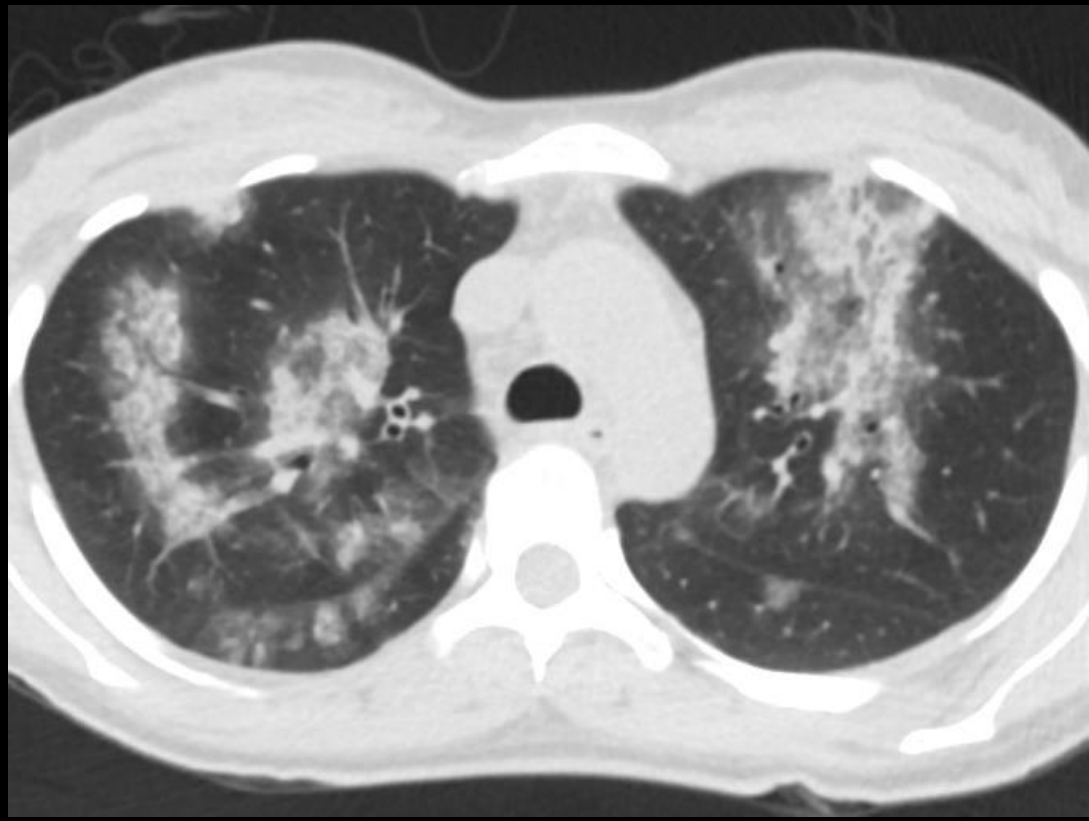
Elevated Eosinophils



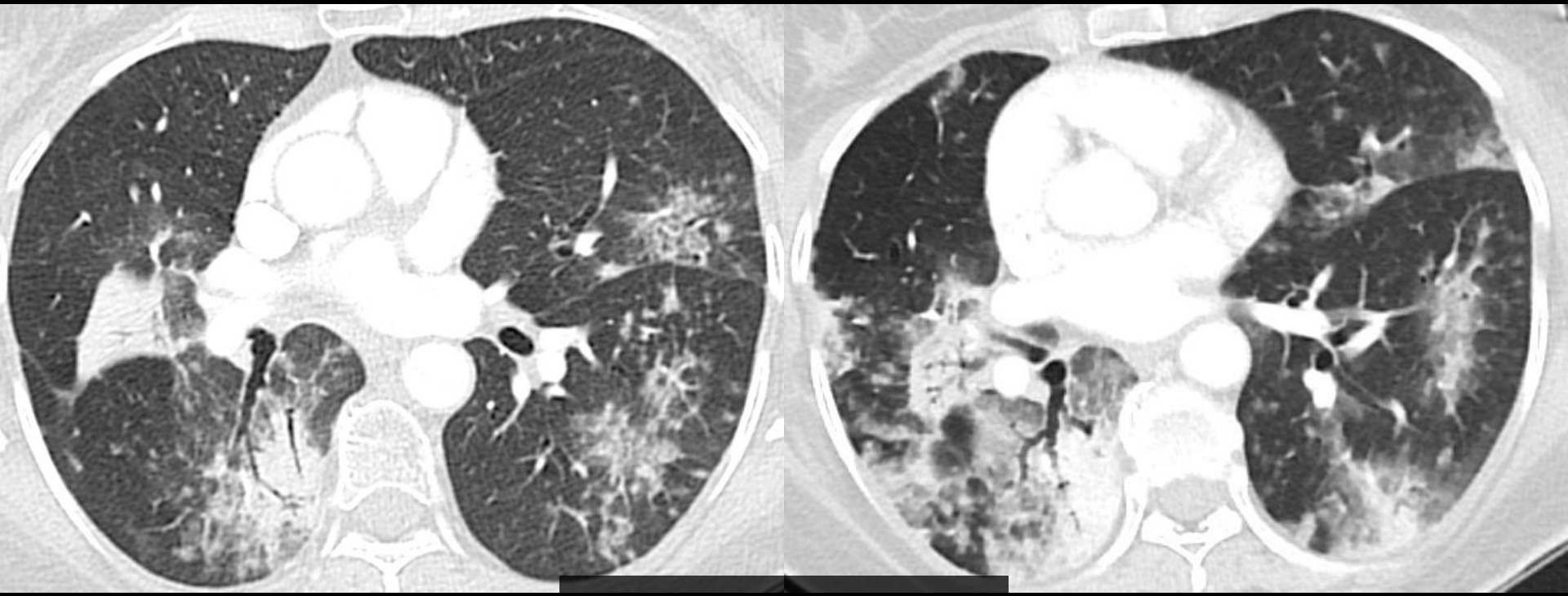
Chronic Eosinophilic Pneumonia

- Upper lobe
- Symmetric

- Organizing pneumonia
- ‘Reverse batwing’



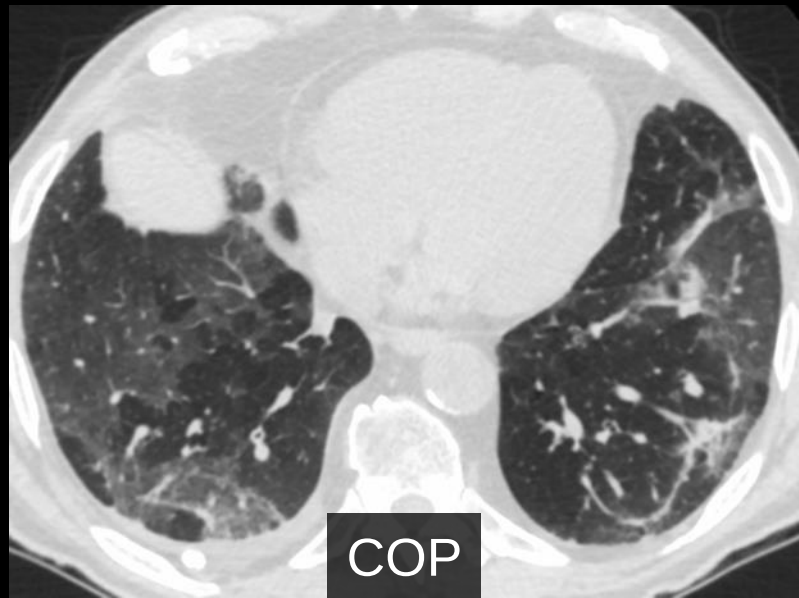
Adenocarcinoma (not OP)



2 years later →

Organizing Pneumonia Recap

- Normal response to lung injury
- Usually bilateral and symmetric
- Usually “not that sick”
- Steroid responsive



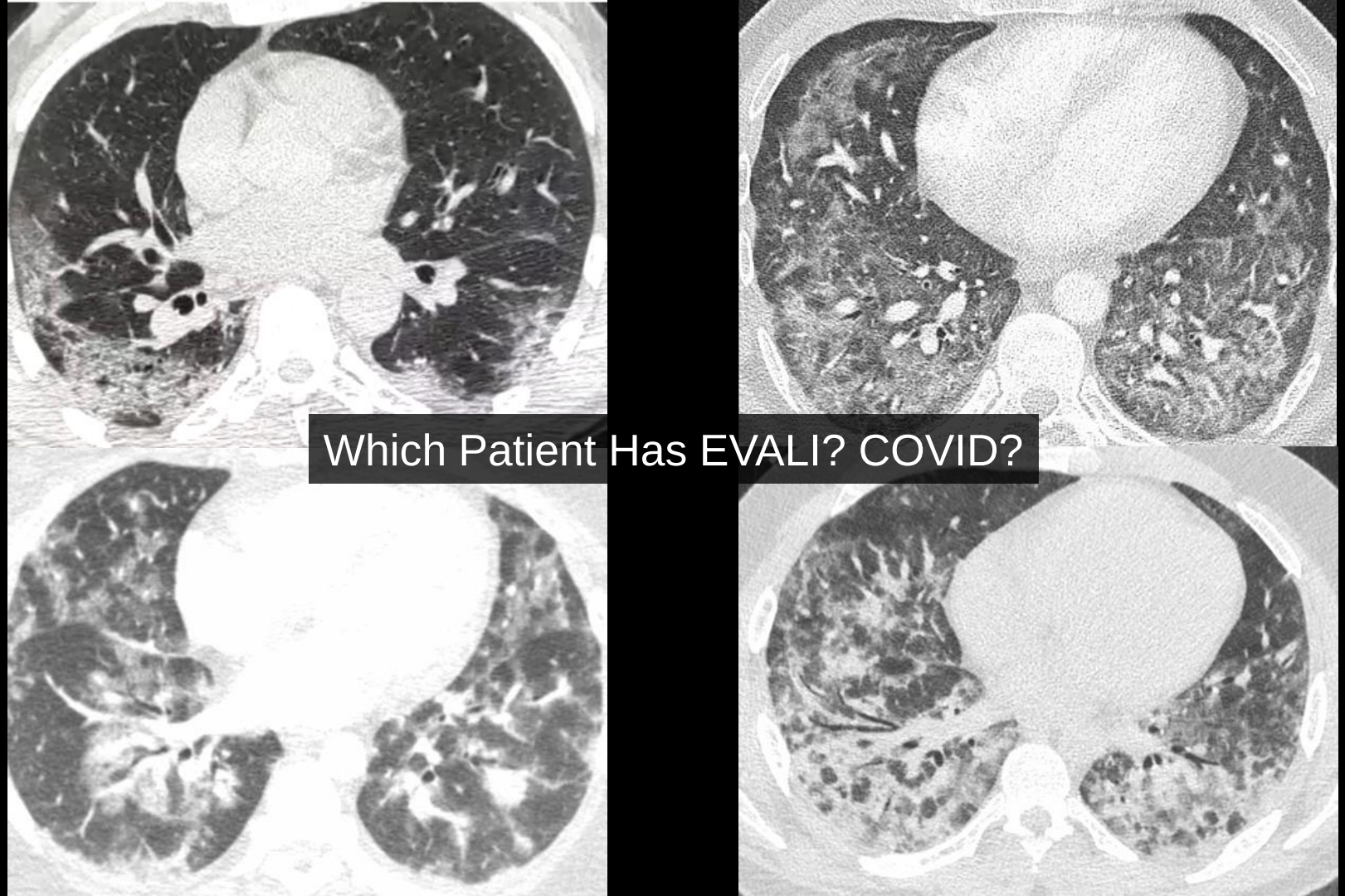
Acute Lung Injury

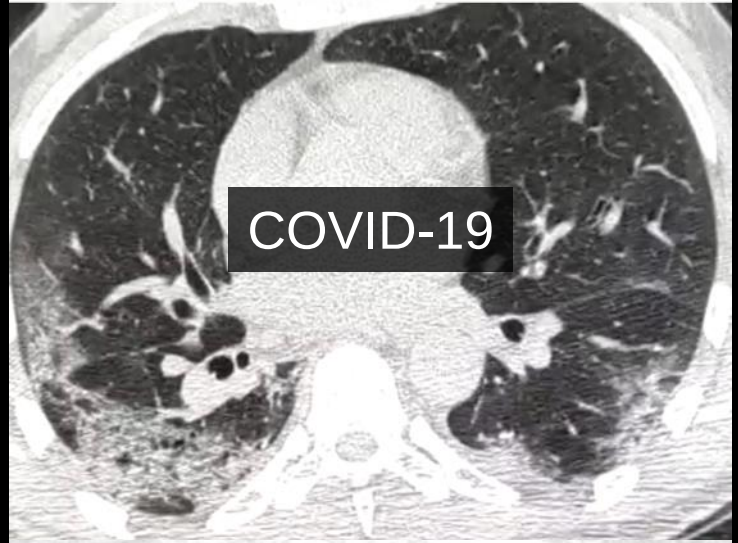
Diffuse Alveolar Damage

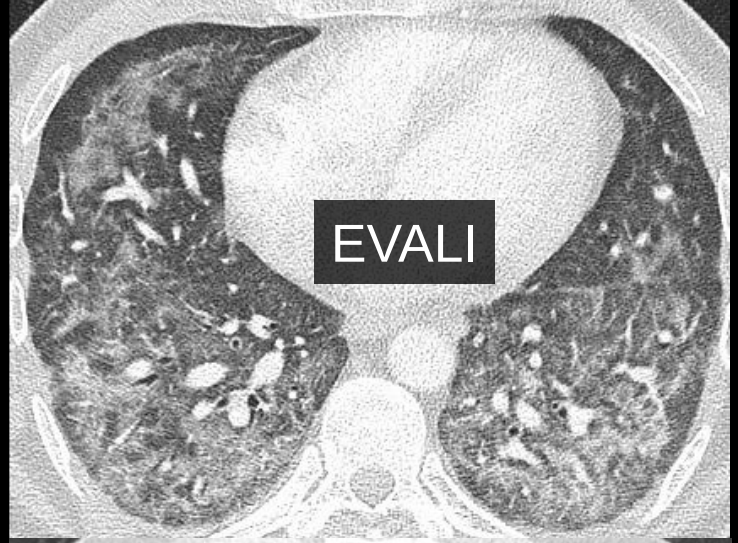
SEVERE (and often exaggerated) response to lung injury

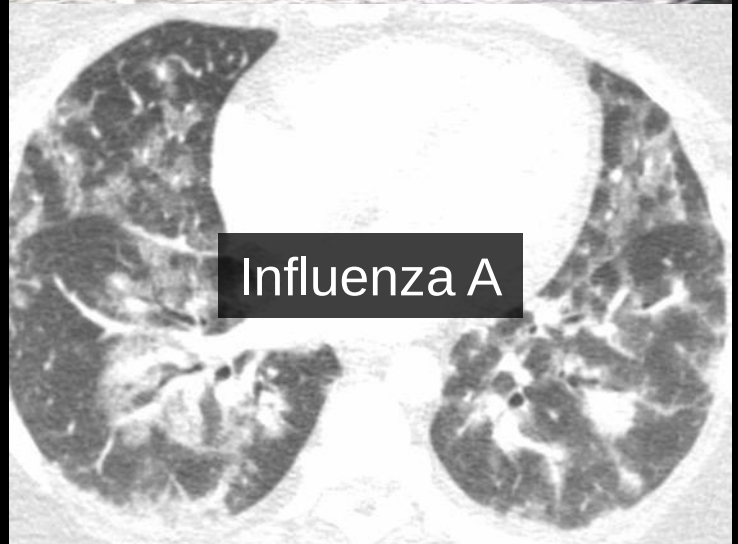
Acute Lung Injury

Clinical syndrome of histologic DAD


Which Patient Has EVALI? COVID?

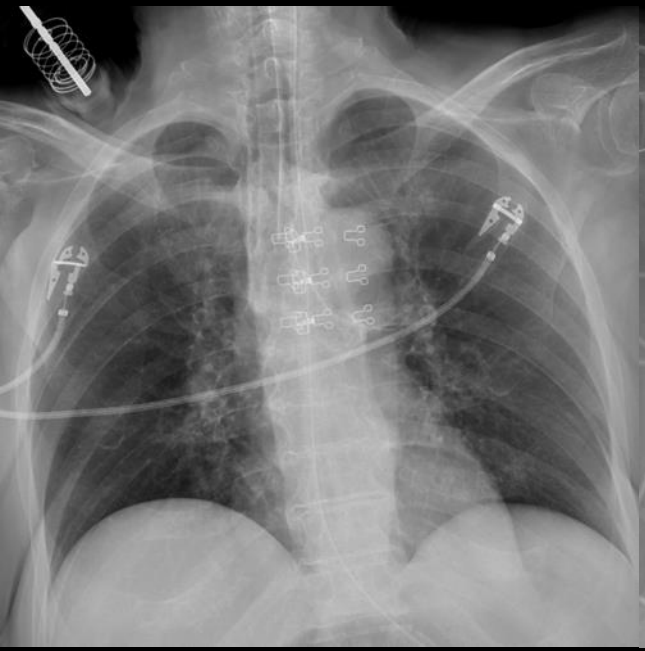

COVID-19


EVALI

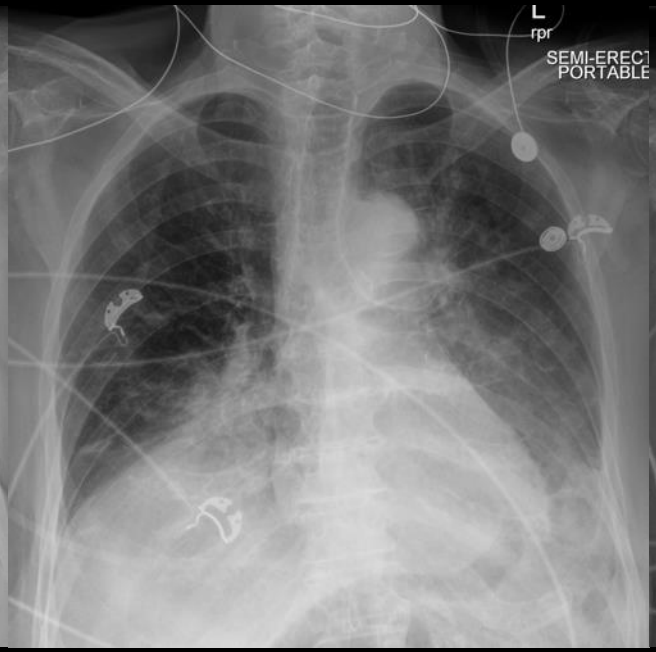

Influenza A


Antisynthetase Syndrome

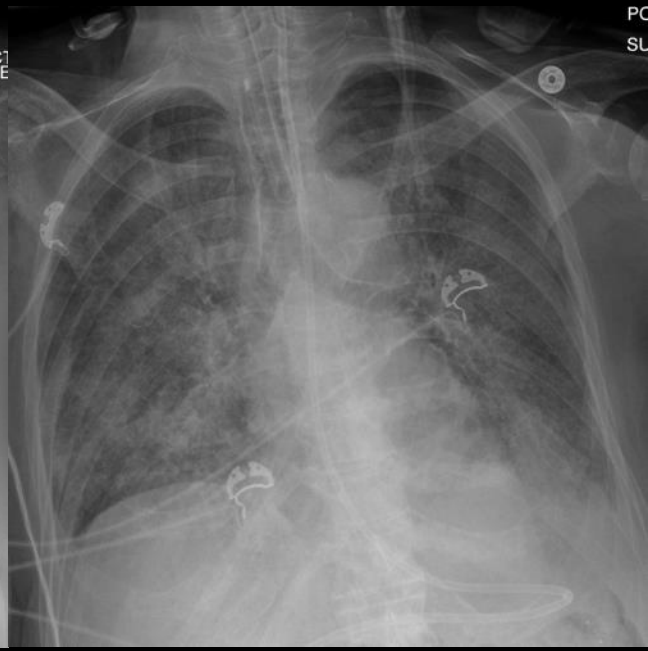
73-year-old with witnessed aspiration



HD #1

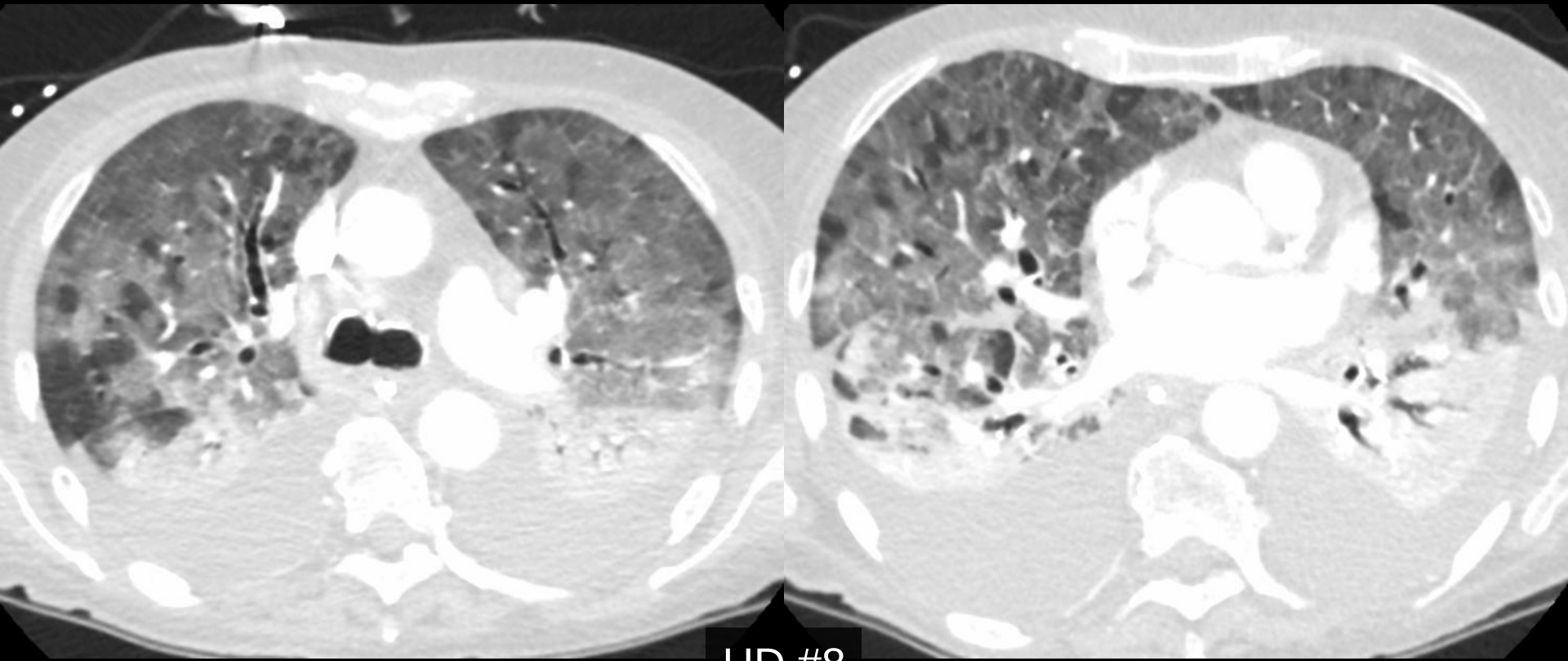


HD #3



HD #8

Diffuse Alveolar Damage



HD #8

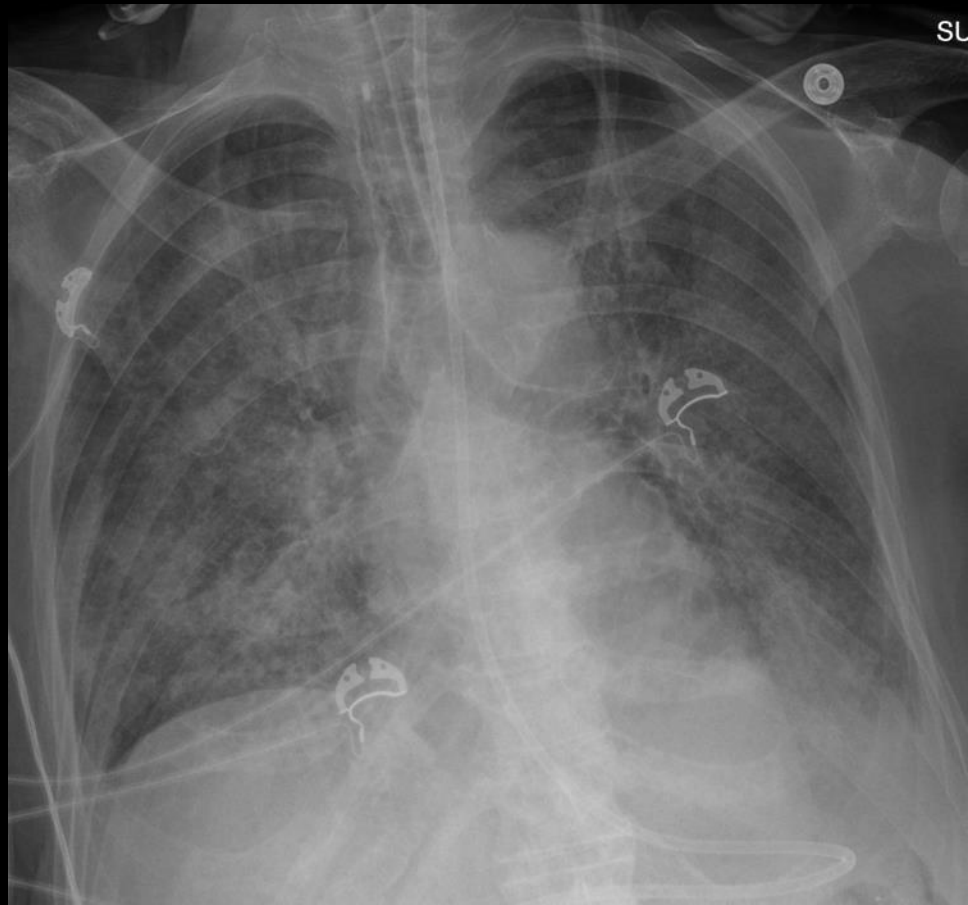
Diffuse Alveolar Damage

- Histologic correlate of acute lung injury
- Damage to the alveoli and lung vasculature
- Fluid/cells flood the lung
- Exaggerated immune response
- Numerous causes → similar result

Acute Respiratory Distress Syndrome

- New/worsening symptoms after a known insult
- Impaired oxygenation
- *Bilateral opacities not fully explained by edema, effusions, atelectasis, or nodules*

(most cases of ARDS have DAD on histology)



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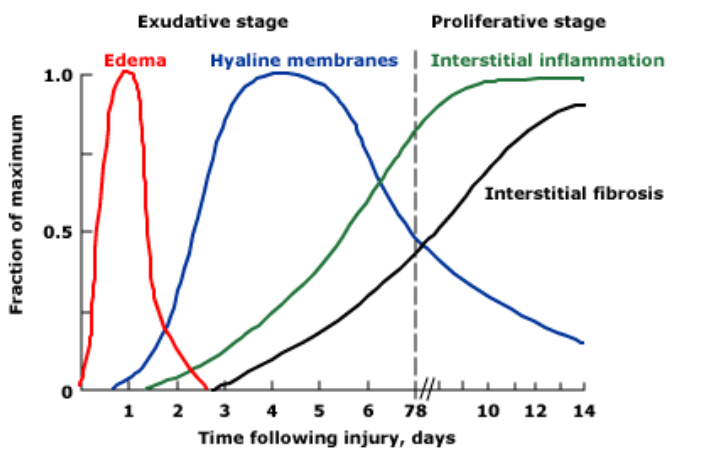
Imaging findings depend on timing

Time course of acute respiratory distress syndrome (ARDS)



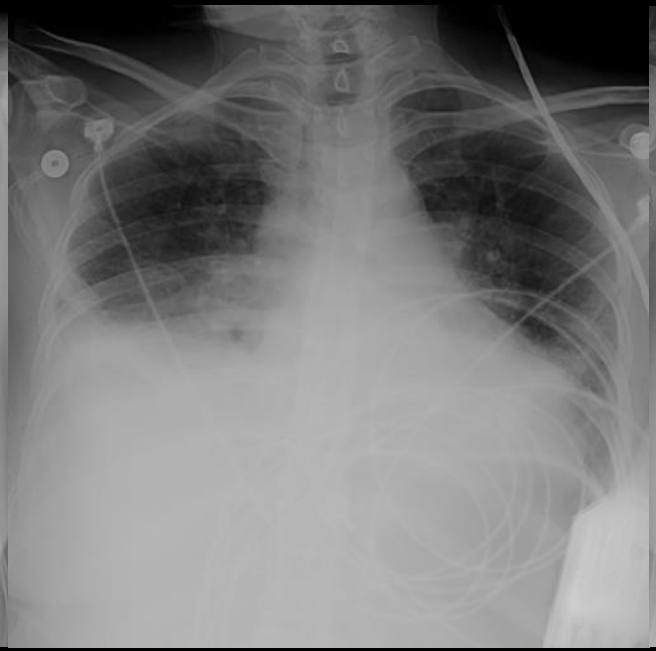
Schematic representation of the time course of the acute respiratory distress syndrome (ARDS). During the early (or exudative) phase, the lesion is characterized by high permeability pulmonary edema followed by the formation of hyaline membranes. After seven to ten days, a proliferative phase may develop, with marked interstitial inflammation, fibrosis, and disordered healing.

Redrawn from Katzenstein AA, Askin FB. Surgical Pathology of Non-neoplastic Lung Disease. Saunders, Philadelphia, 1982.

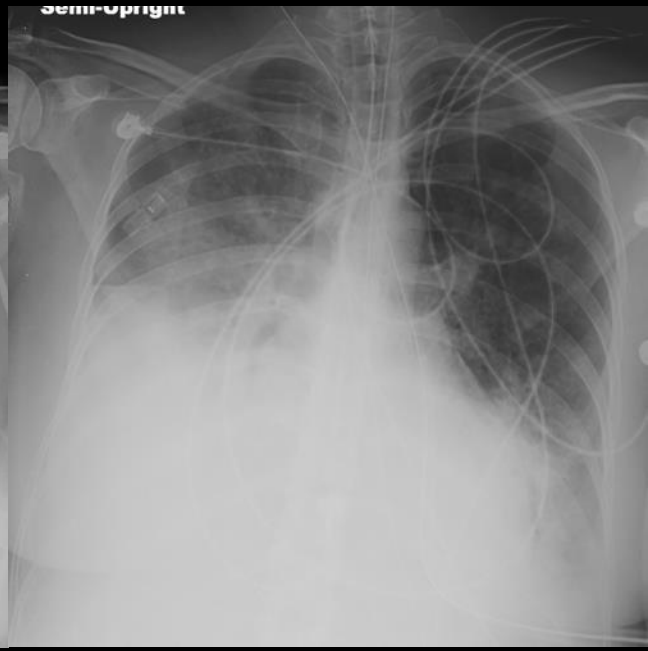
- Acute (exudative) phase
- Organizing (proliferative) phase
- Fibrotic phase

Natural Evolution of ARDS

POD #1

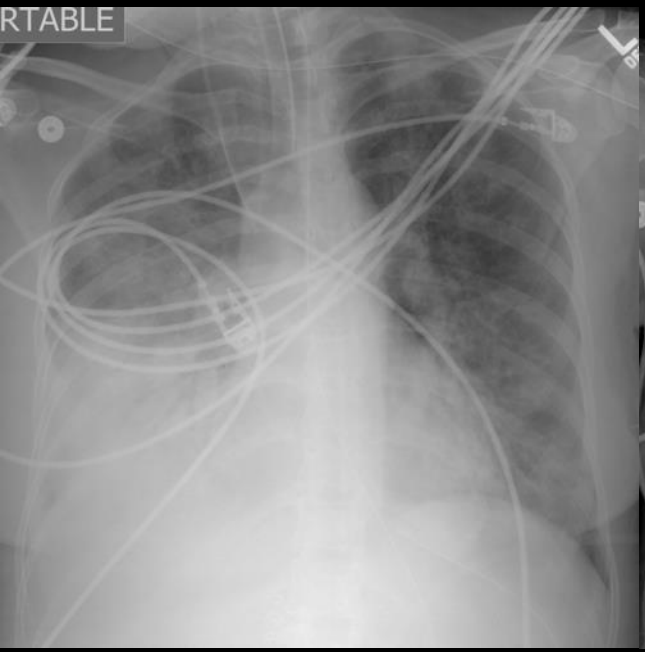


POD #3

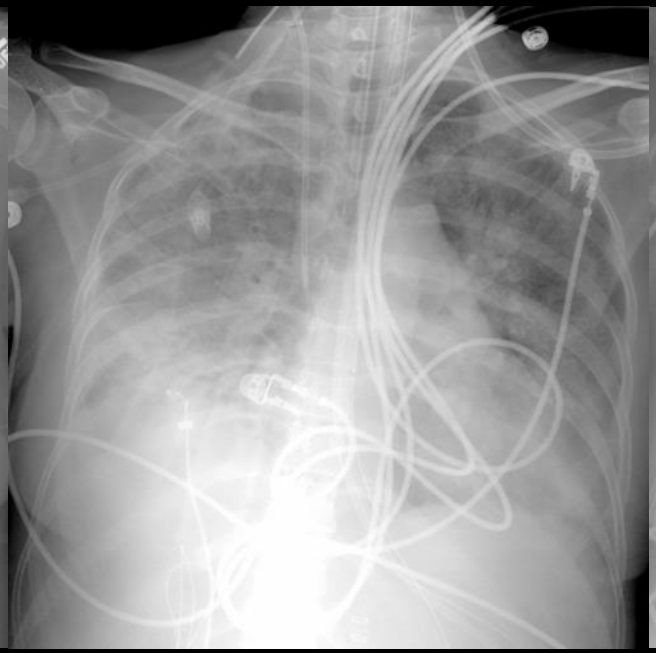


POD #4

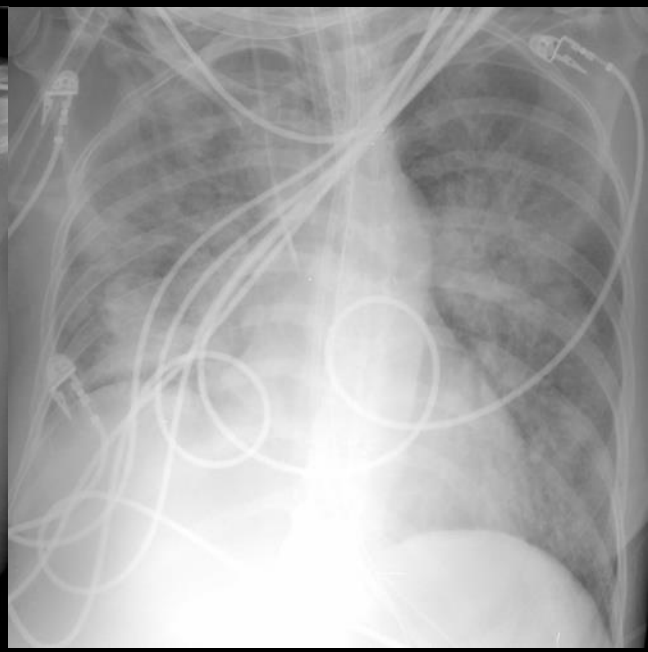
Natural Evolution of ARDS



POD #5

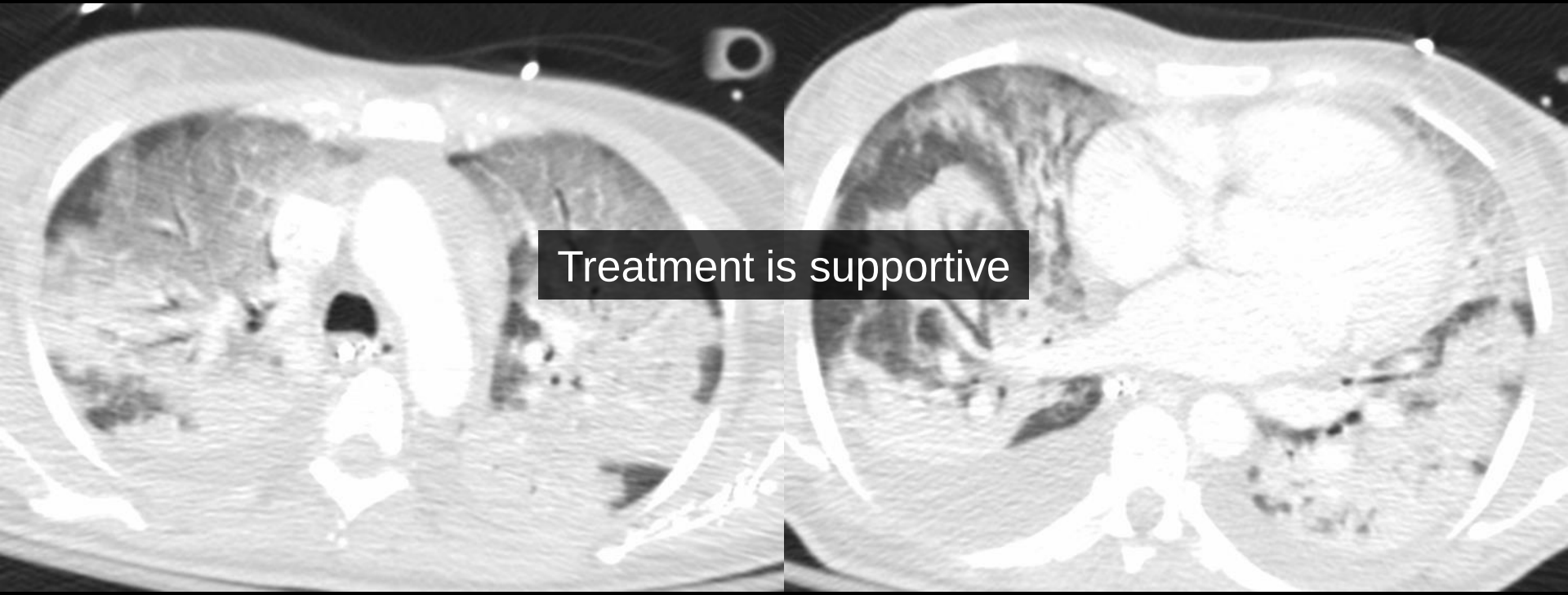


POD #6



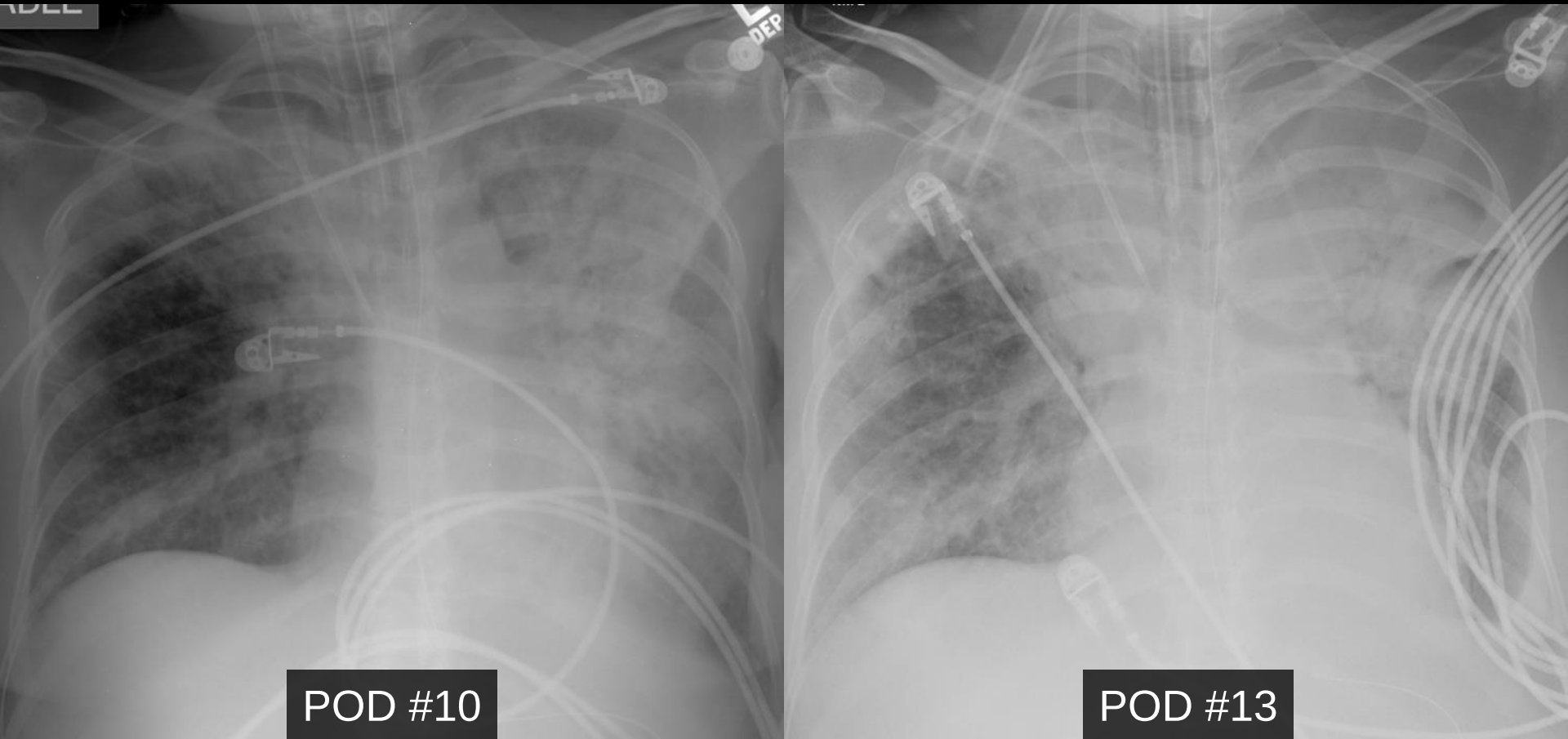
POD #7

Natural Evolution of ARDS

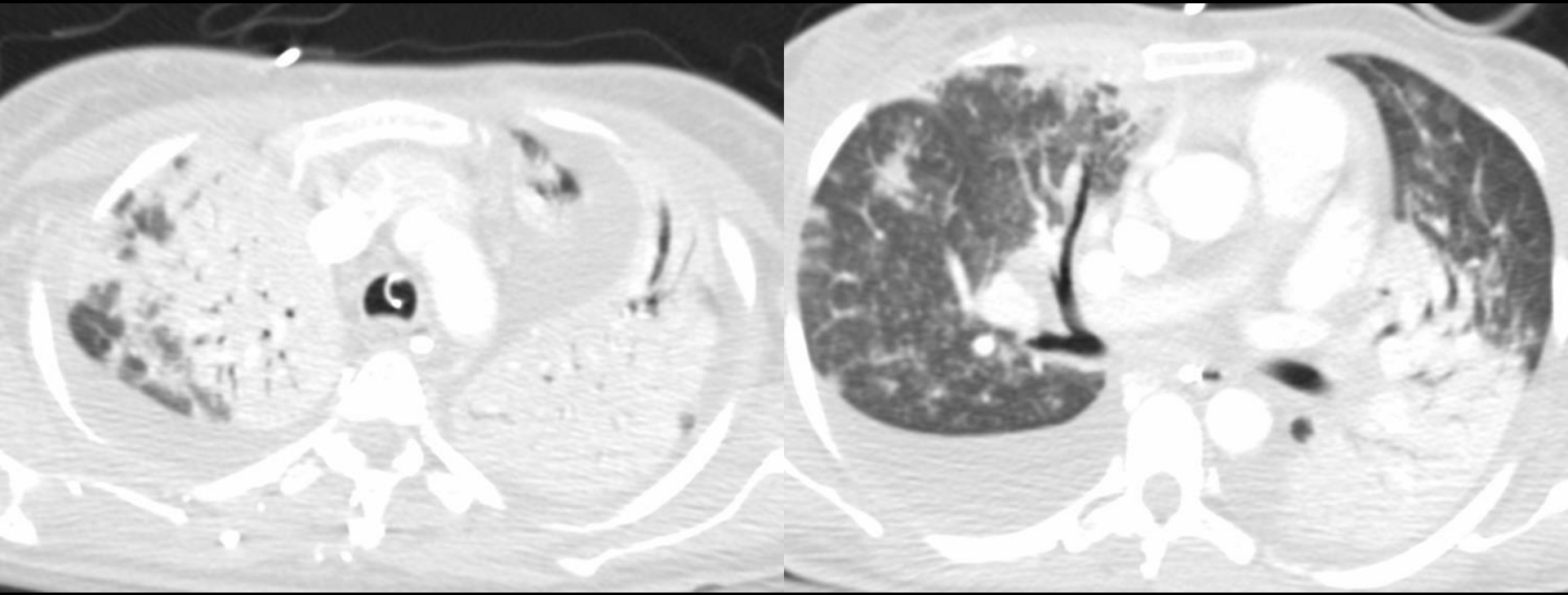


POD #7

Natural Evolution of ARDS

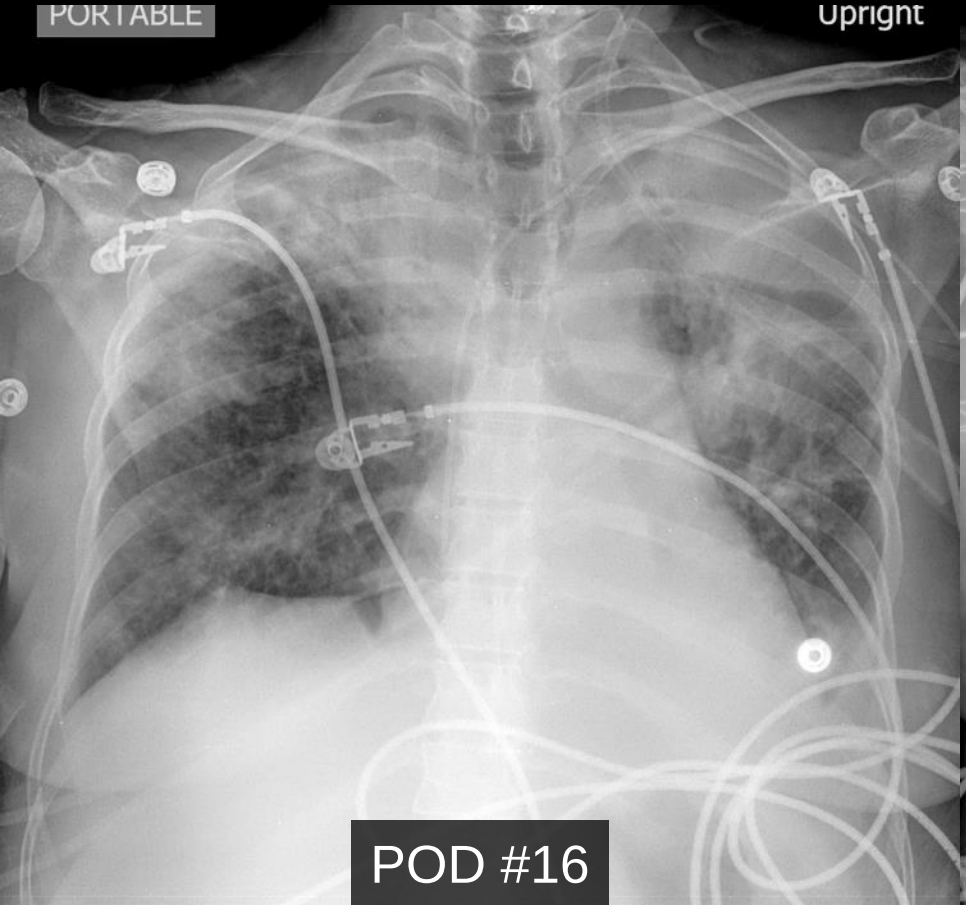


Natural Evolution of ARDS



POD #13

Natural Evolution of ARDS



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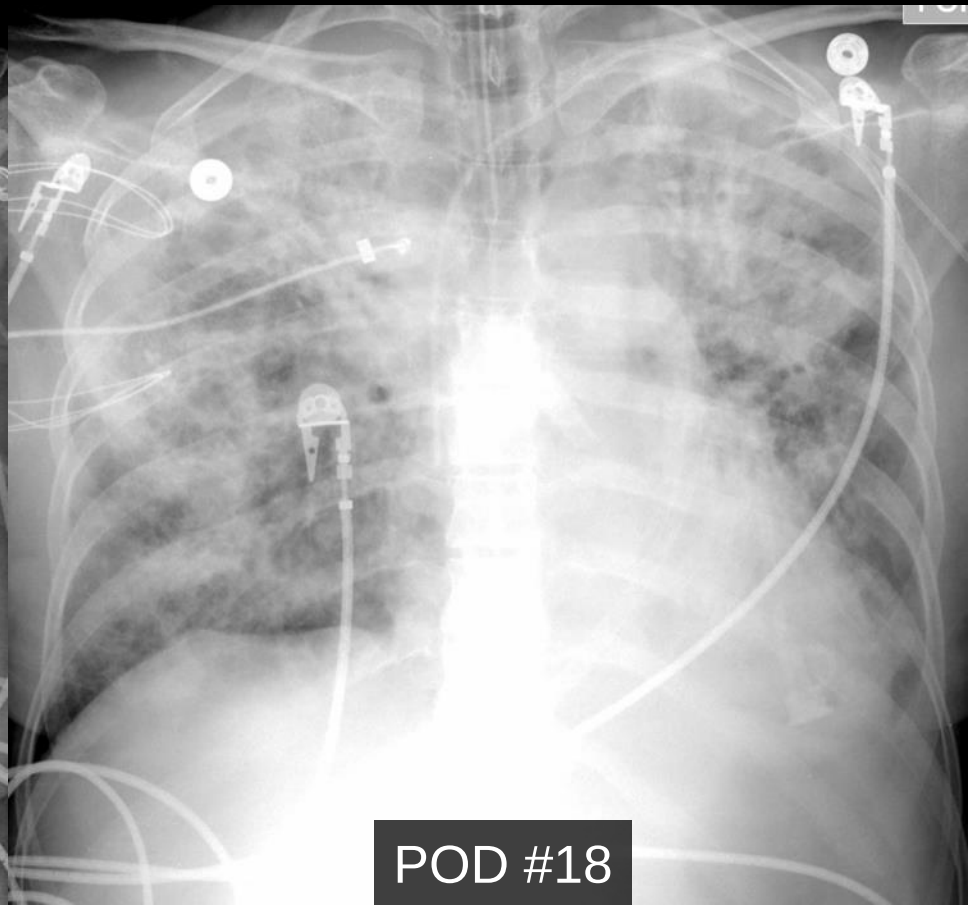
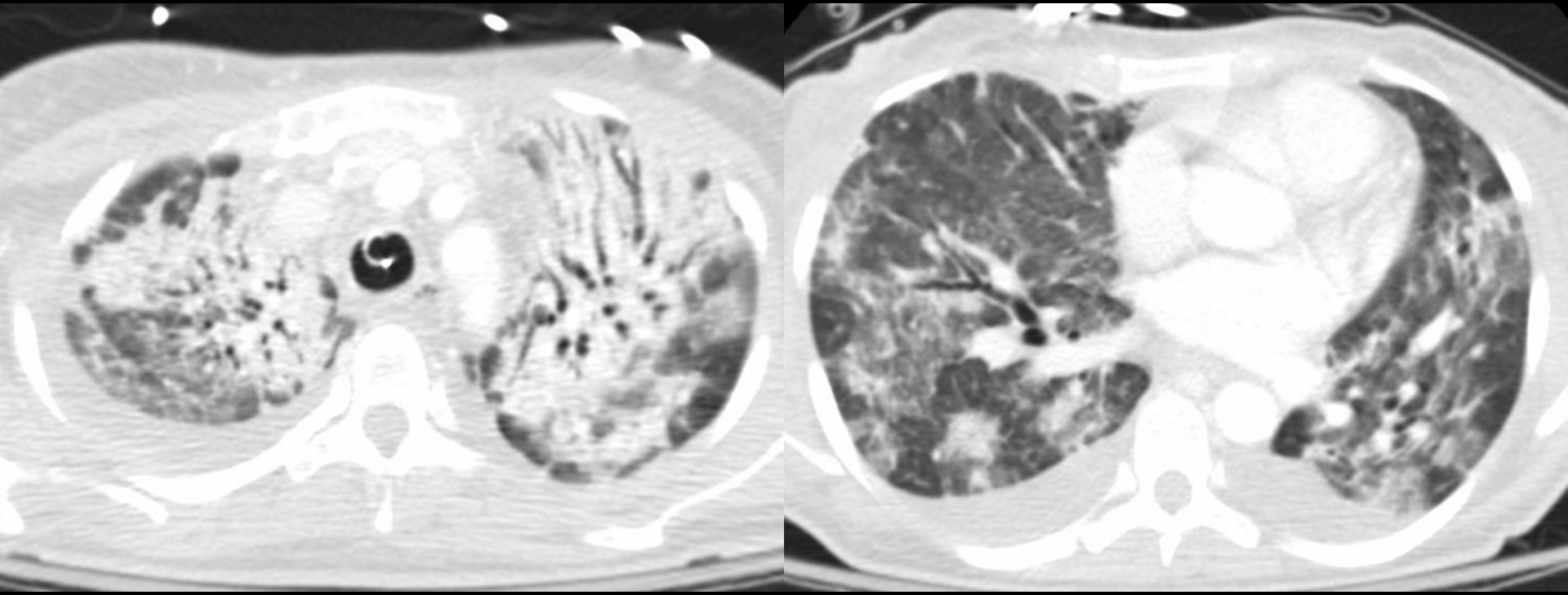


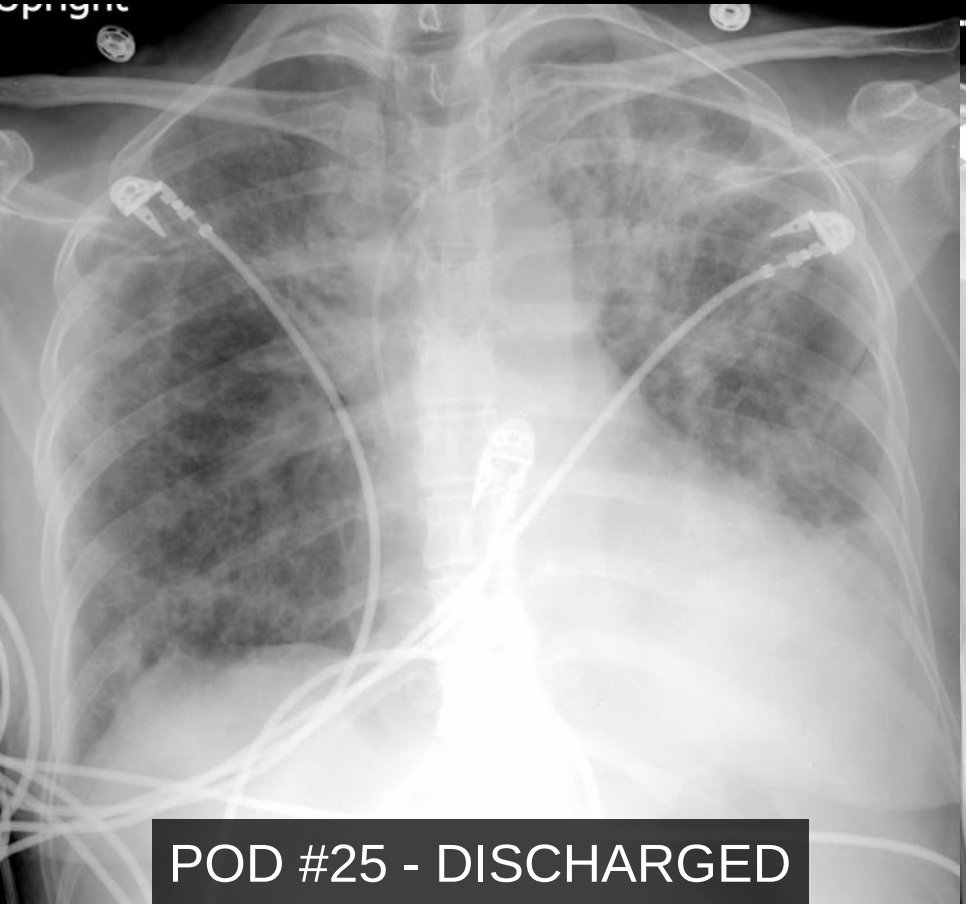
POD #18

Natural Evolution of ARDS



POD #19

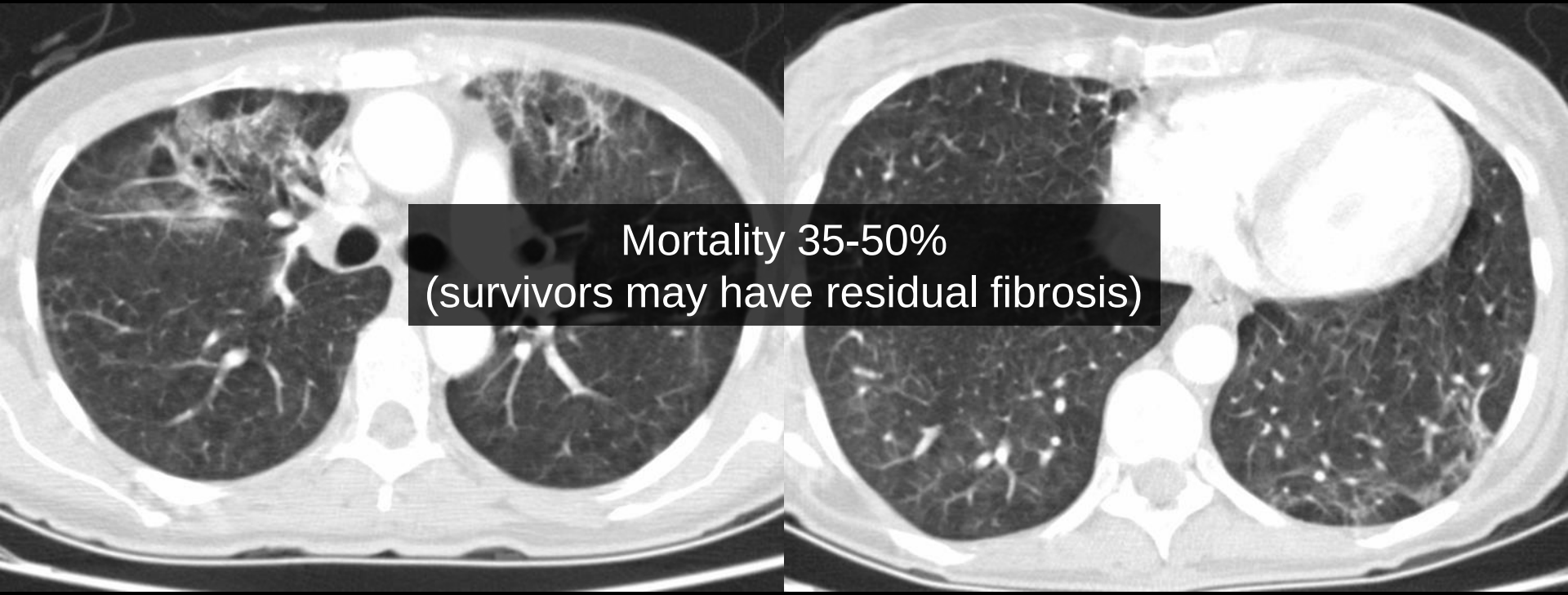
Natural Evolution of ARDS



POD #25 - DISCHARGED

POD #40 – Follow Up Visit

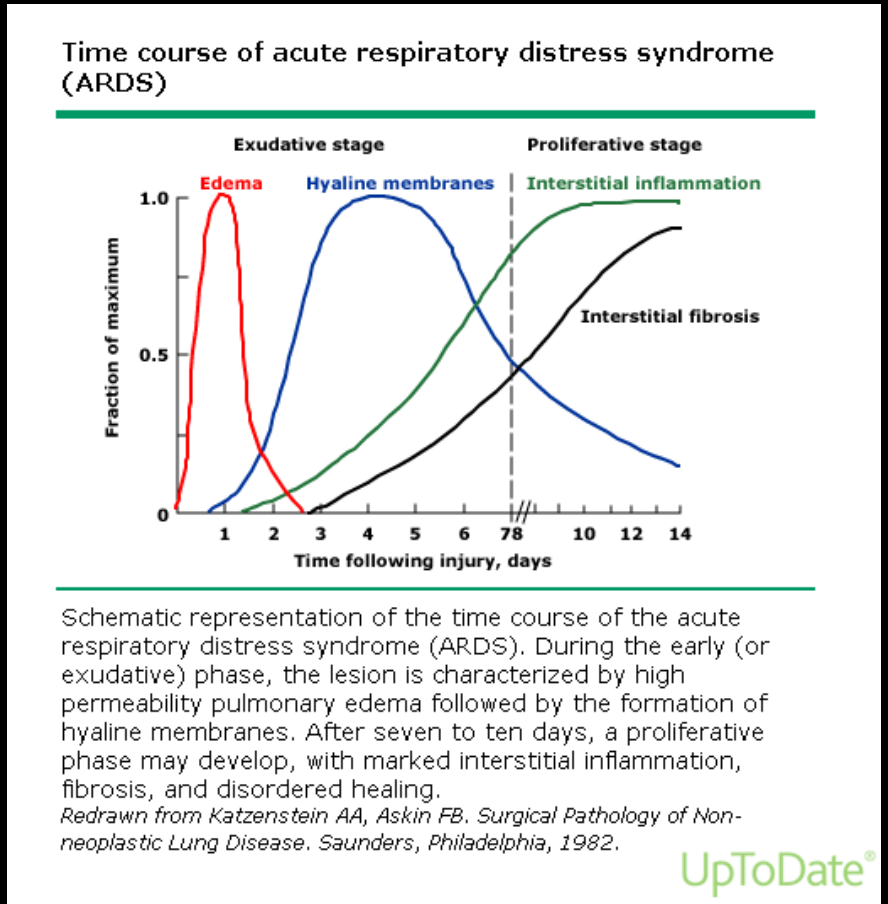
Natural Evolution of ARDS



Mortality 35-50%
(survivors may have residual fibrosis)

POD #40 – Follow Up Visit

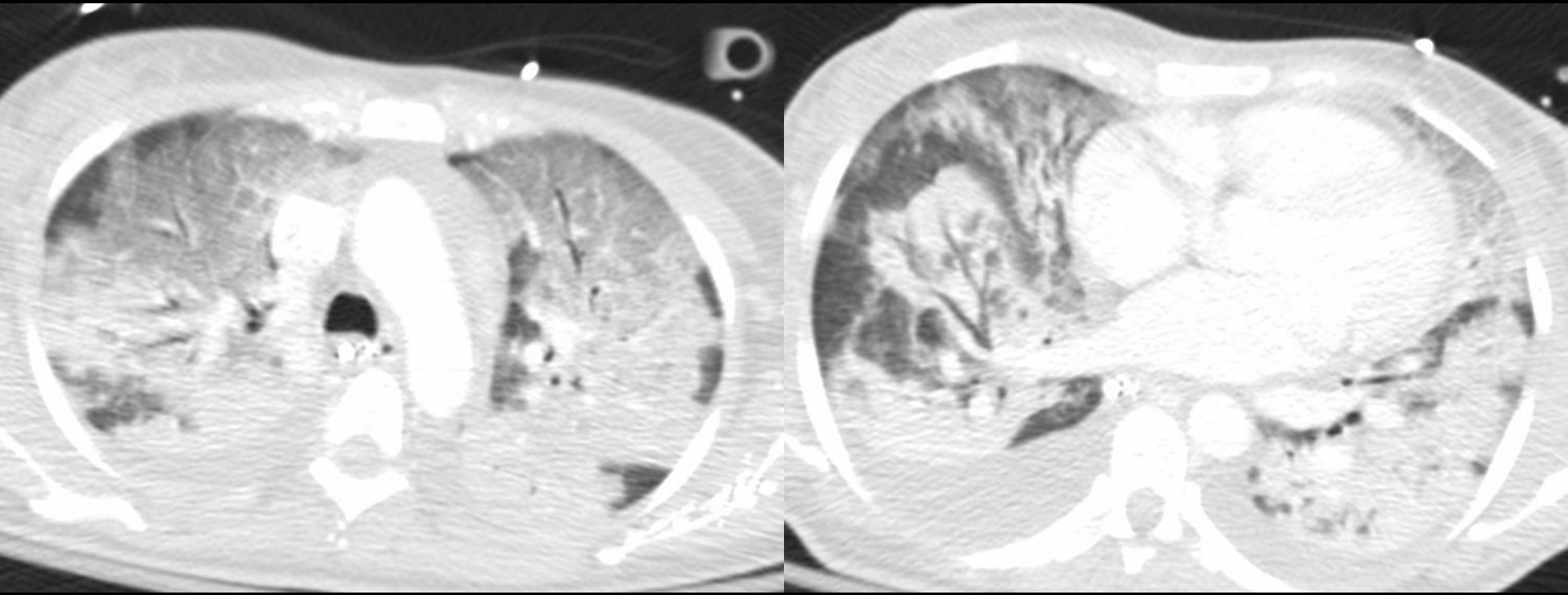
Imaging findings depend on timing



Acute Phase – Permeability Edema

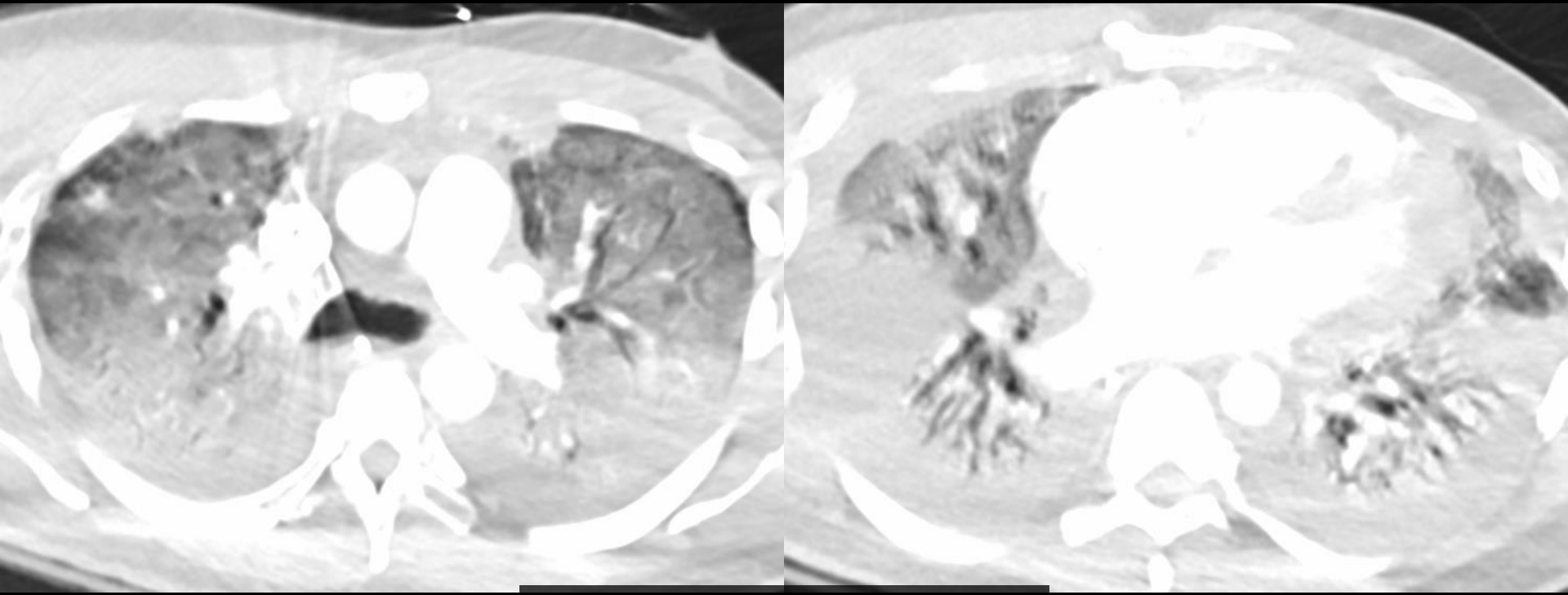
- First week
- Diffuse but often with areas of lobular sparing
- Gravity dependent gradient

Acute (Exudative Phase)



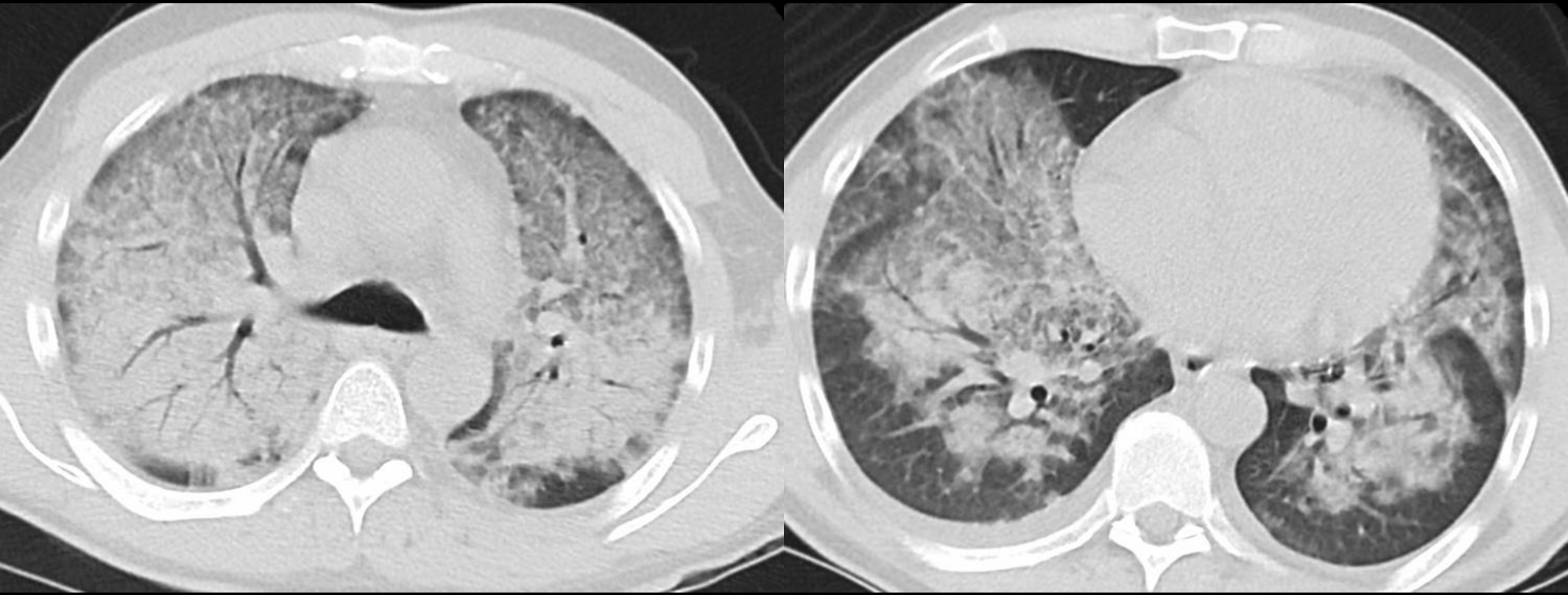
POD #7 – Surgery, Sepsis

Acute (Exudative Phase)



40-year-old with MDA-5
Exudative Phase – HD #7

Acute (Exudative) Phase



43-yo with kidney/pancreas transplant – ARDS from PJP pneumonia
Exudative Phase – HD #5

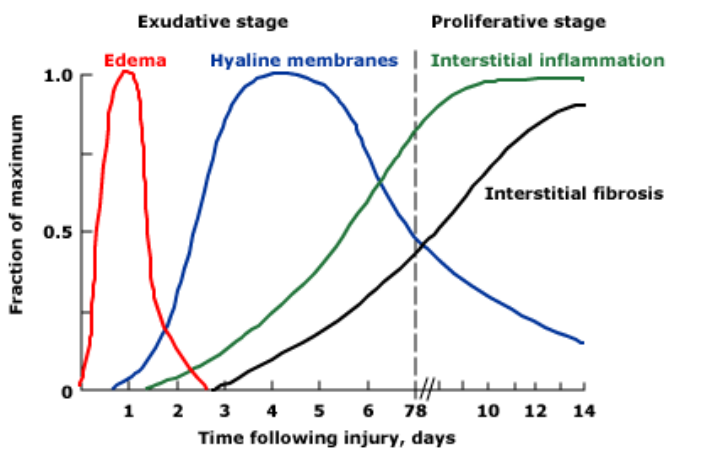
Acute (Exudative) Phase

Myositis

Sepsis

Imaging findings depend on timing

Time course of acute respiratory distress syndrome (ARDS)



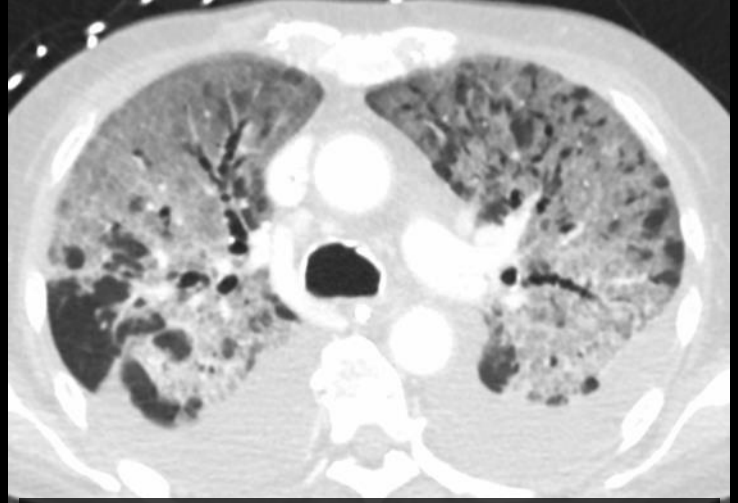
Schematic representation of the time course of the acute respiratory distress syndrome (ARDS). During the early (or exudative) phase, the lesion is characterized by high permeability pulmonary edema followed by the formation of hyaline membranes. After seven to ten days, a proliferative phase may develop, with marked interstitial inflammation, fibrosis, and disordered healing.

Redrawn from Katzenstein AA, Askin FB. Surgical Pathology of Non-neoplastic Lung Disease. Saunders, Philadelphia, 1982.

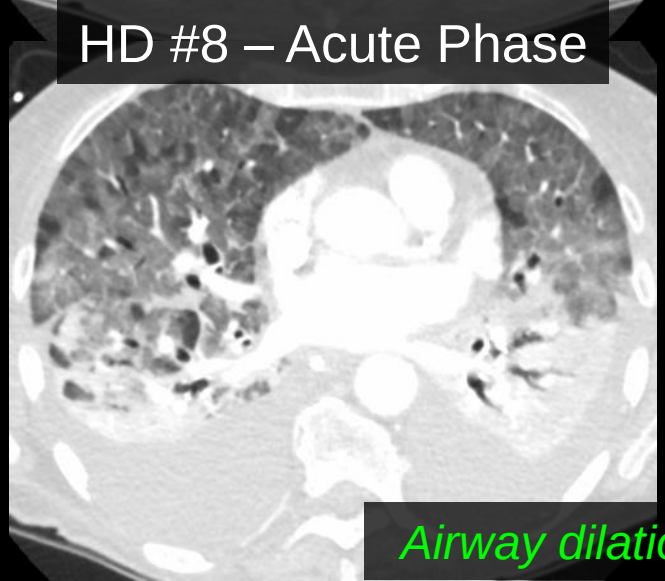
Proliferative Phase – Organization (+/- Fibrosis)

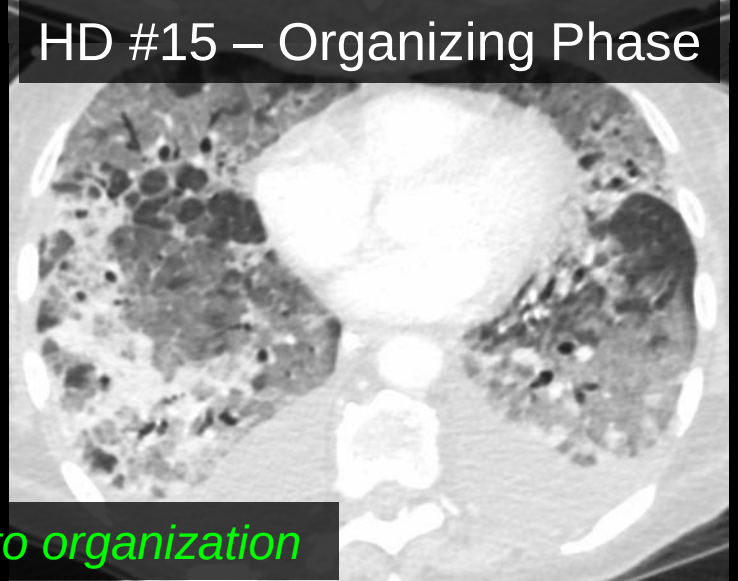
- GGO/consolidation improve
- Volume loss
- Reticulation/traction
- *OP coexists with DAD in many cases*

HD #8 – Acute Phase



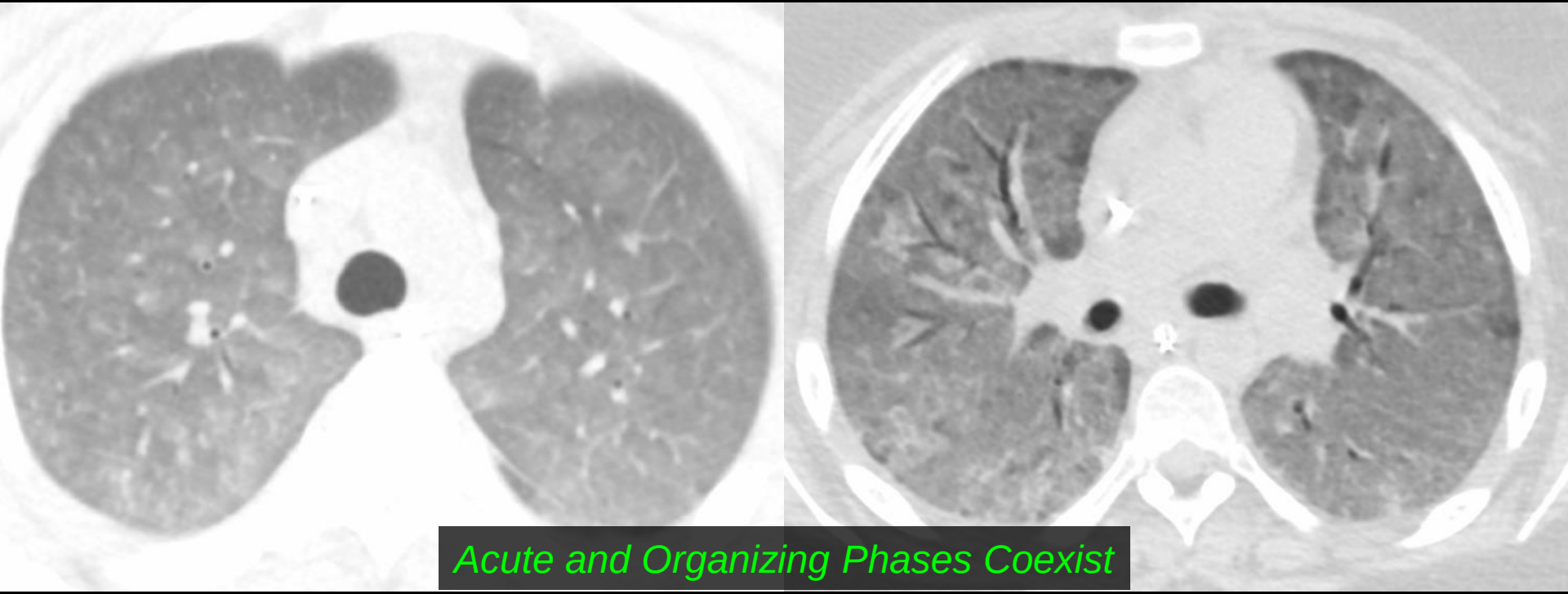
HD #15 – Organizing Phase





Airway dilation is a clue to organization

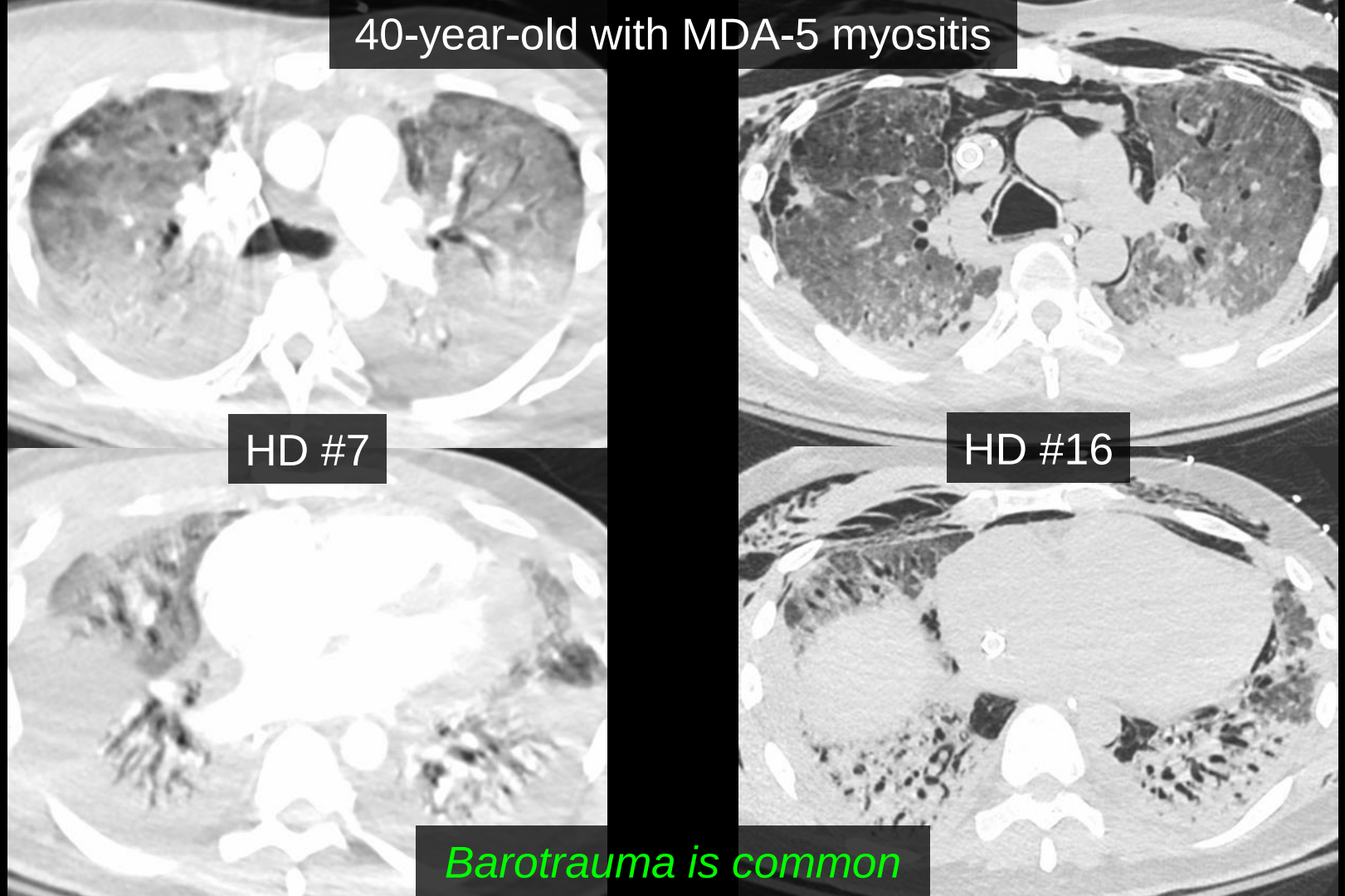
Evolution to Organizing Phase



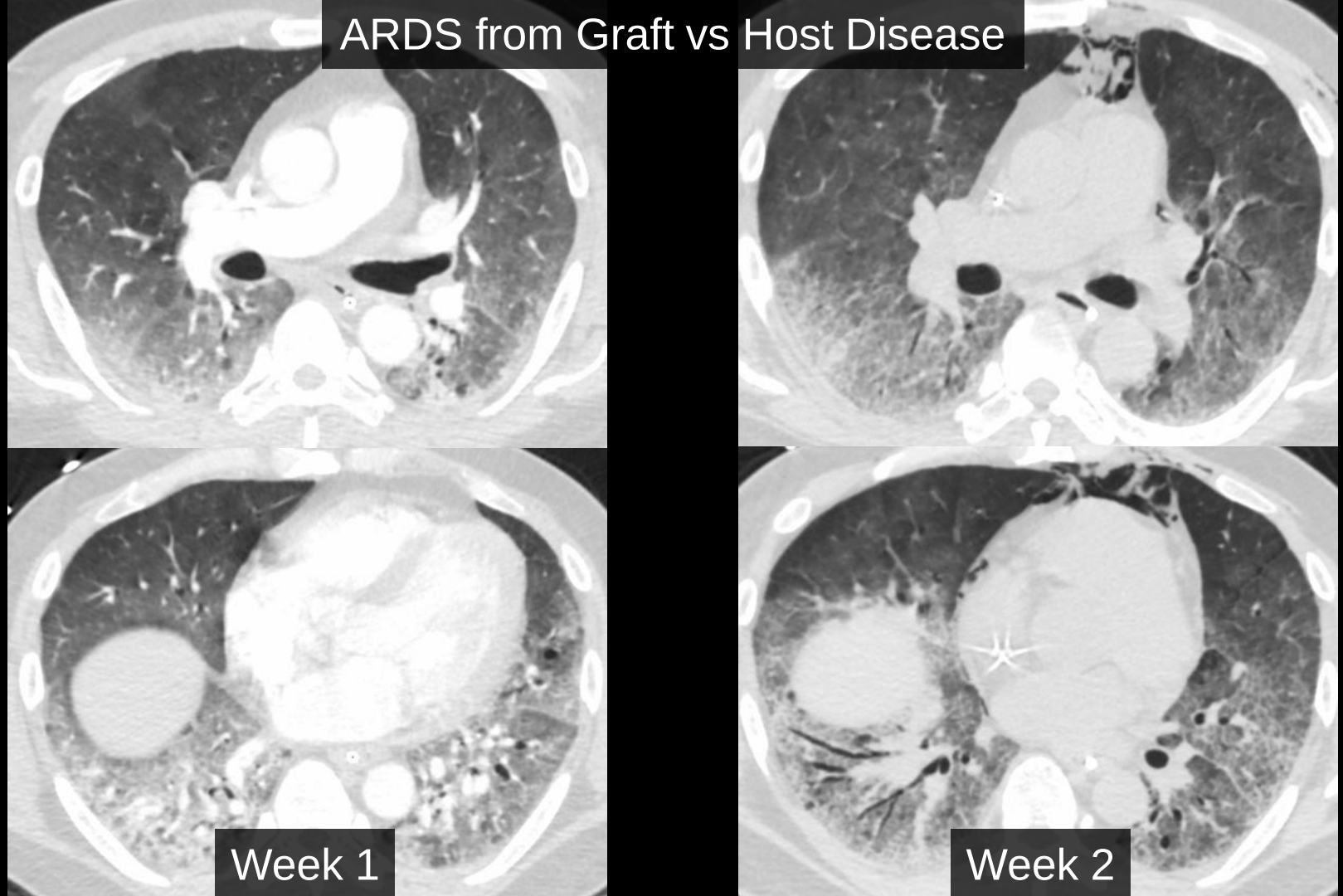
Acute and Organizing Phases Coexist

Sepsis – Week 1

Week 2

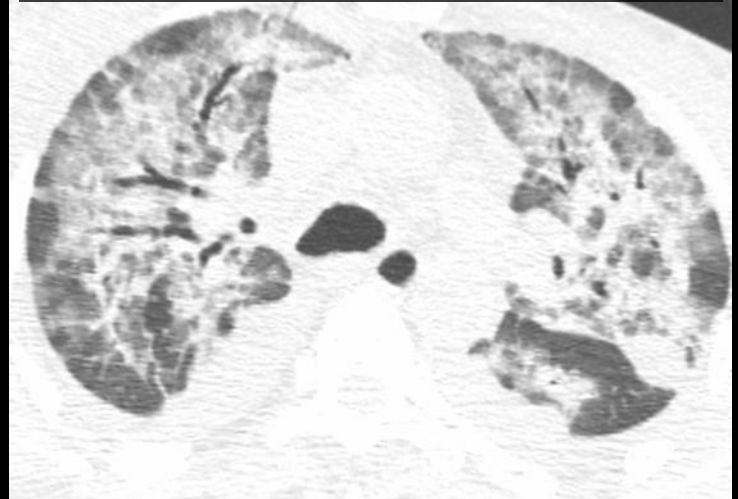

40-year-old with MDA-5 myositis
HD #7
HD #16
Barotrauma is common

ARDS from Graft vs Host Disease

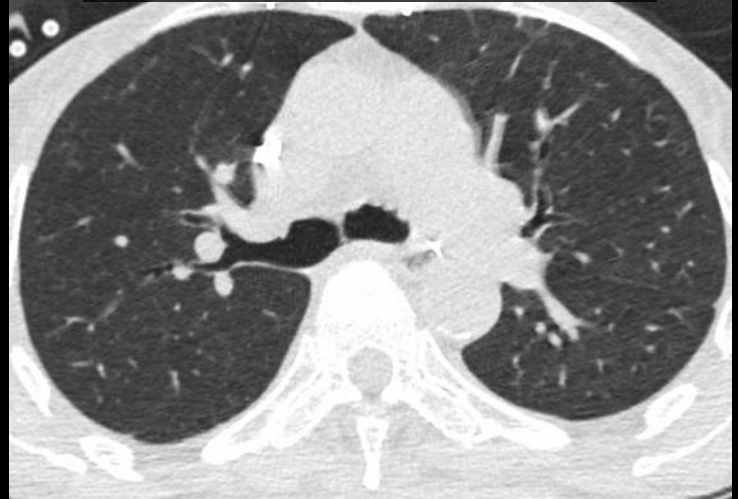


Lung Transplant – Acute Rejection

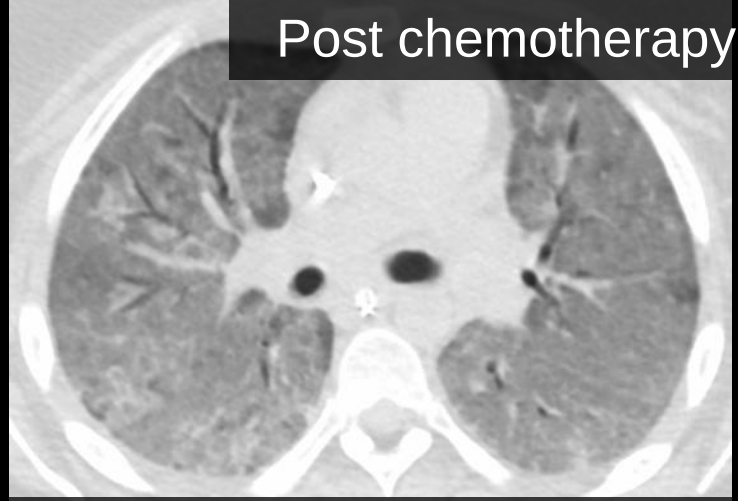
Organizing Phase → Weeks



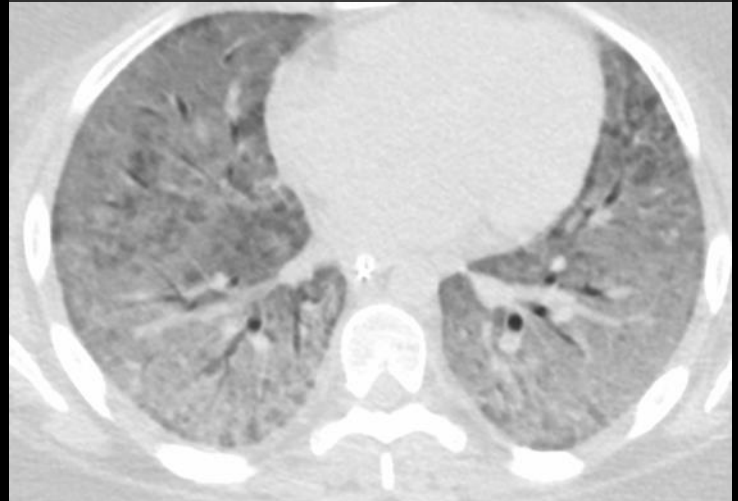
Resolution → Months



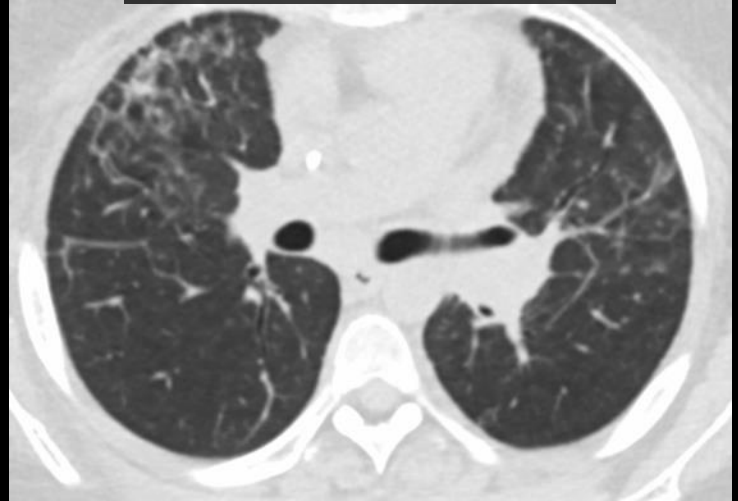
Post chemotherapy and radiation for Hodgkin



Acute/Organizing Phase Overlap

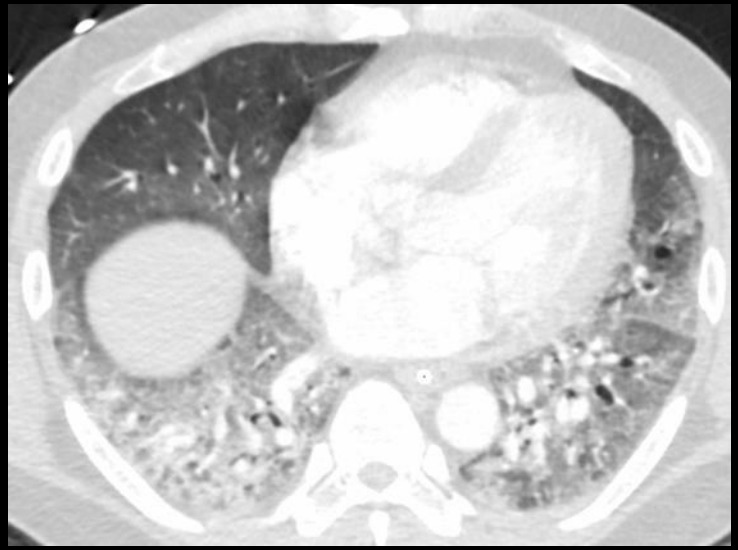


Fibrosis → Months

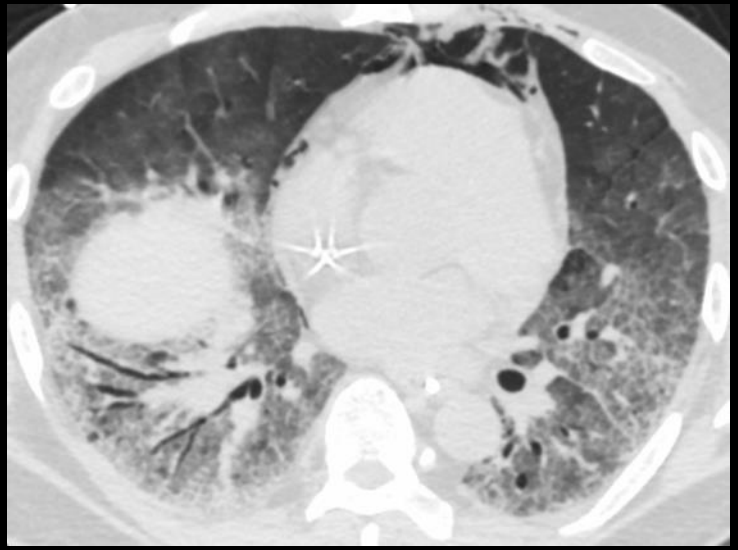


DAD/ALI/ARDS Recap

Acute Phase
Permeability Edema

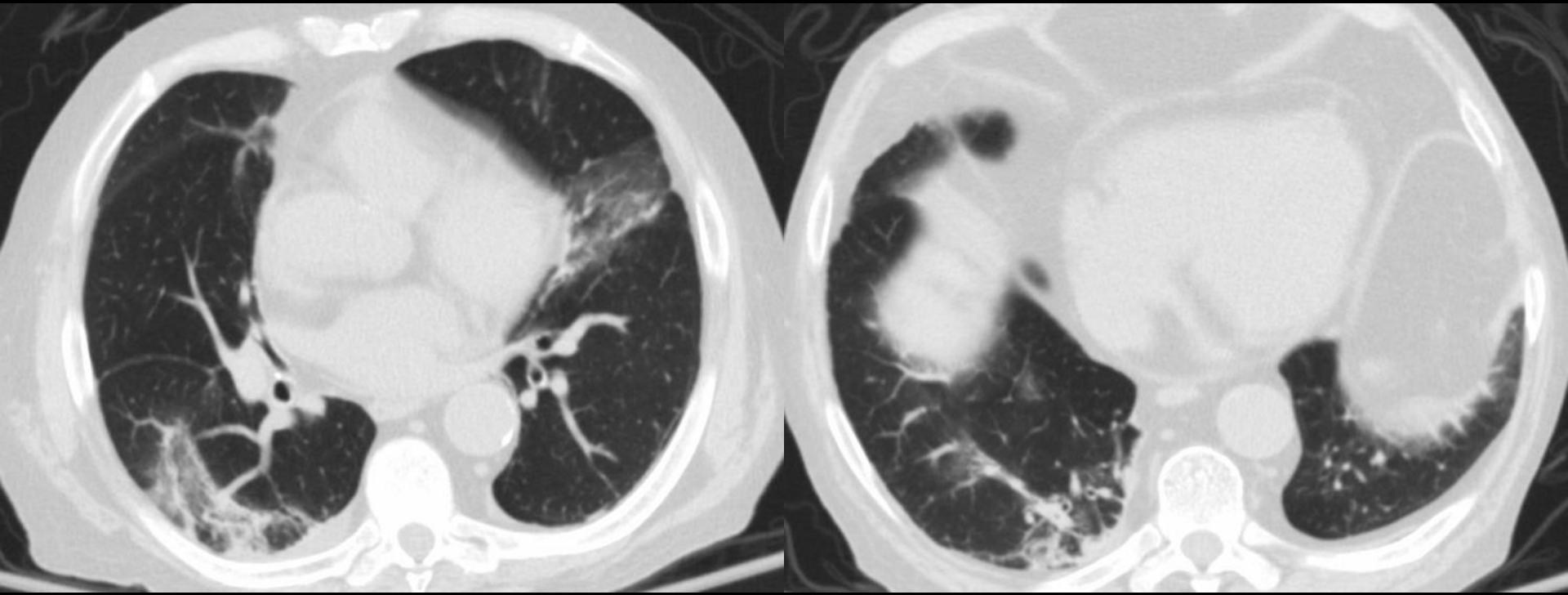


Proliferative Phase
Organization



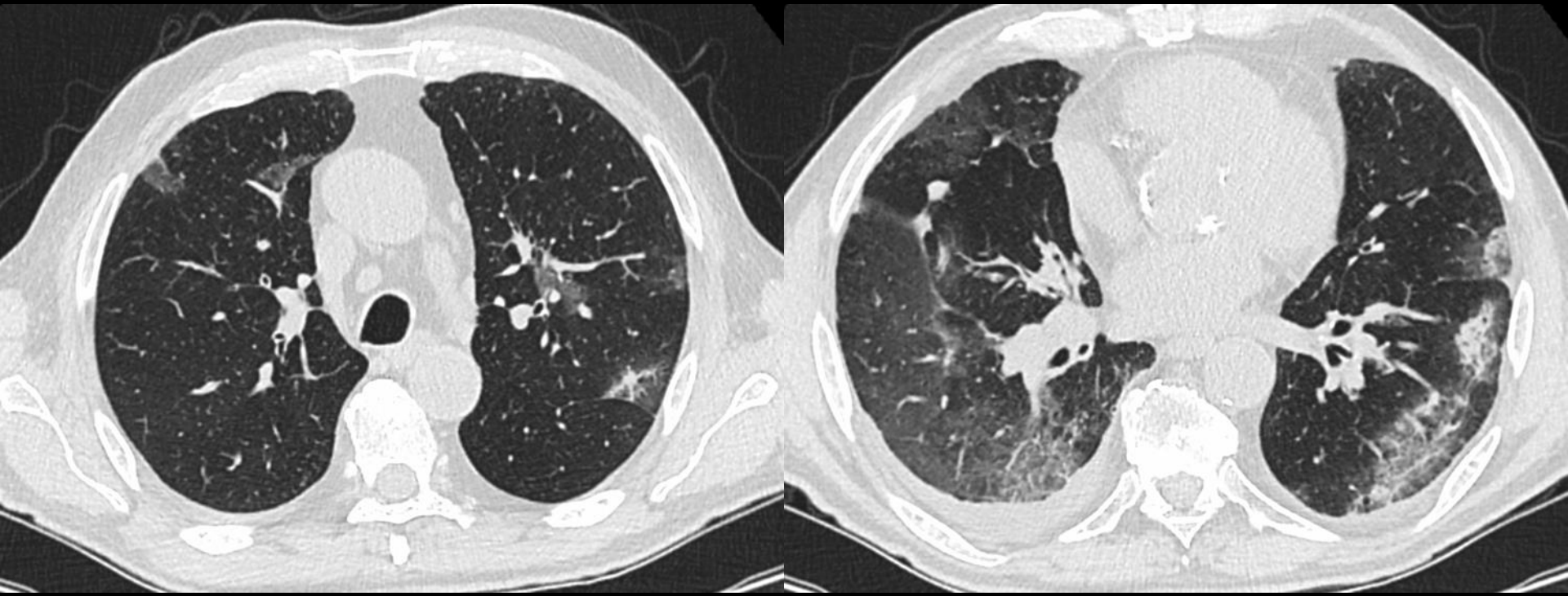
Organizing Pneumonia is often a component of DAD

COVID



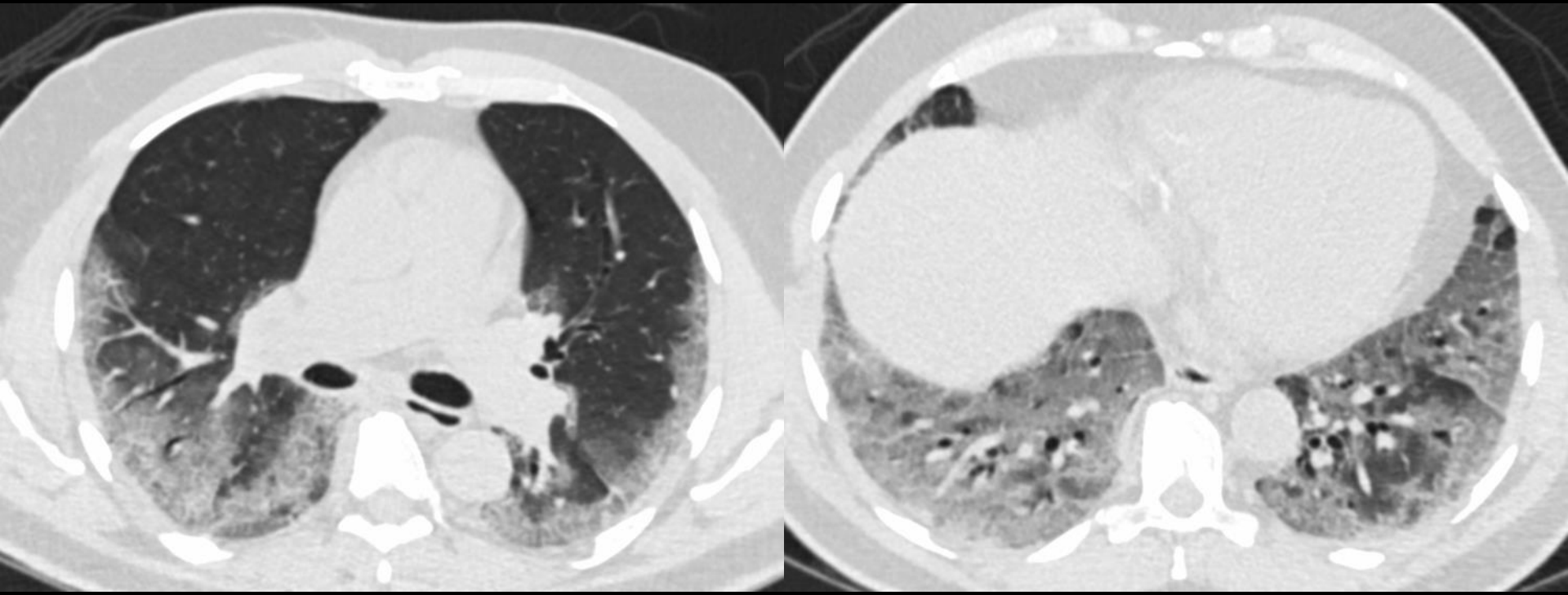
Bilateral peripheral consolidation/Atoll → Organizing Pneumonia

Not COVID - COP



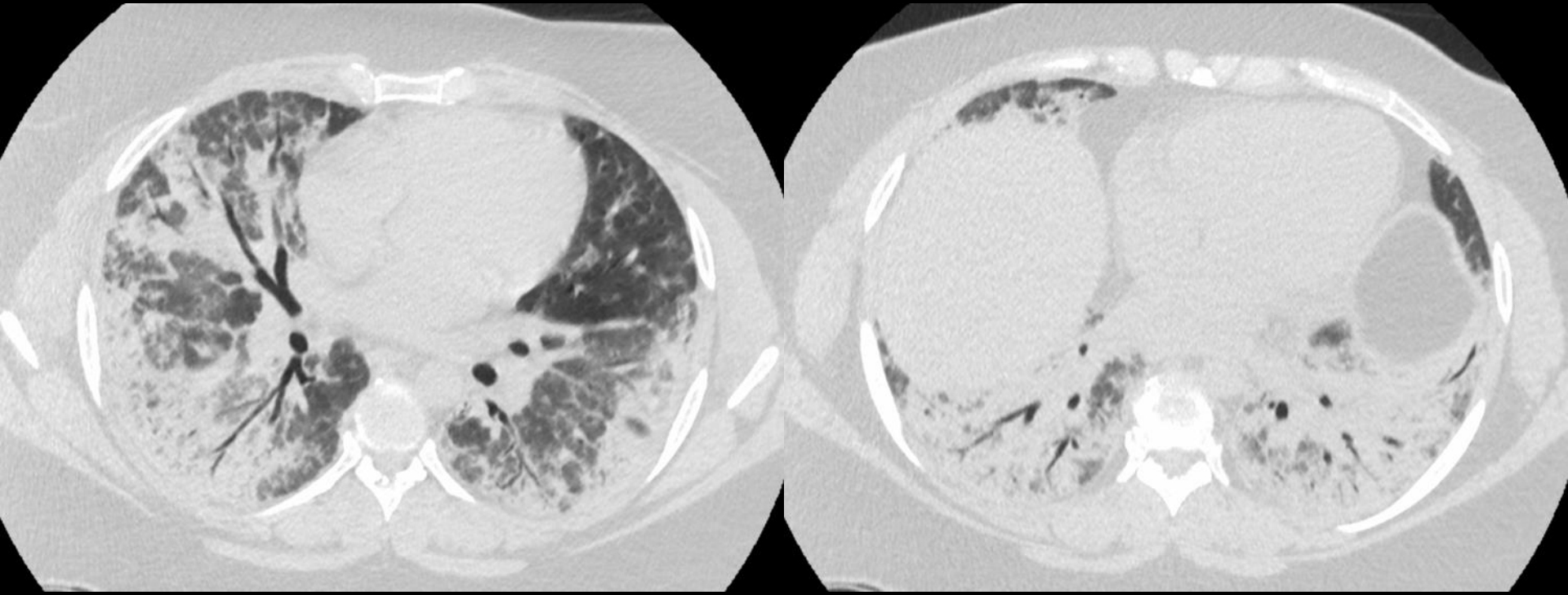
Organizing pneumonia → (at least 15 negative COVID PCRs)

COVID



Bilateral symmetric GGO + traction → Organizing phase of lung injury

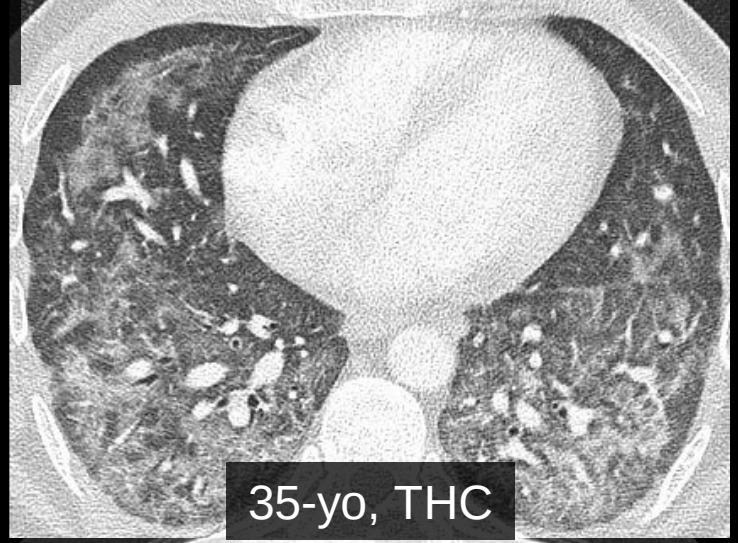
Not COVID - Dermatomyositis



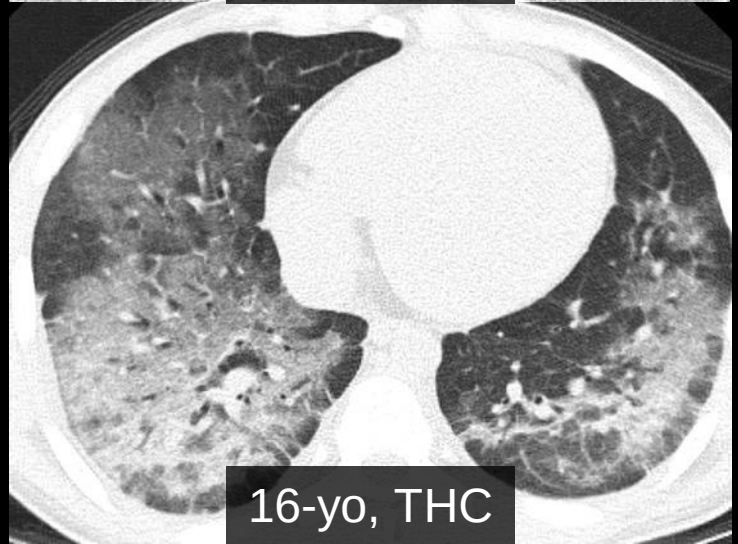
Acute + organizing phase of lung injury

EVALI

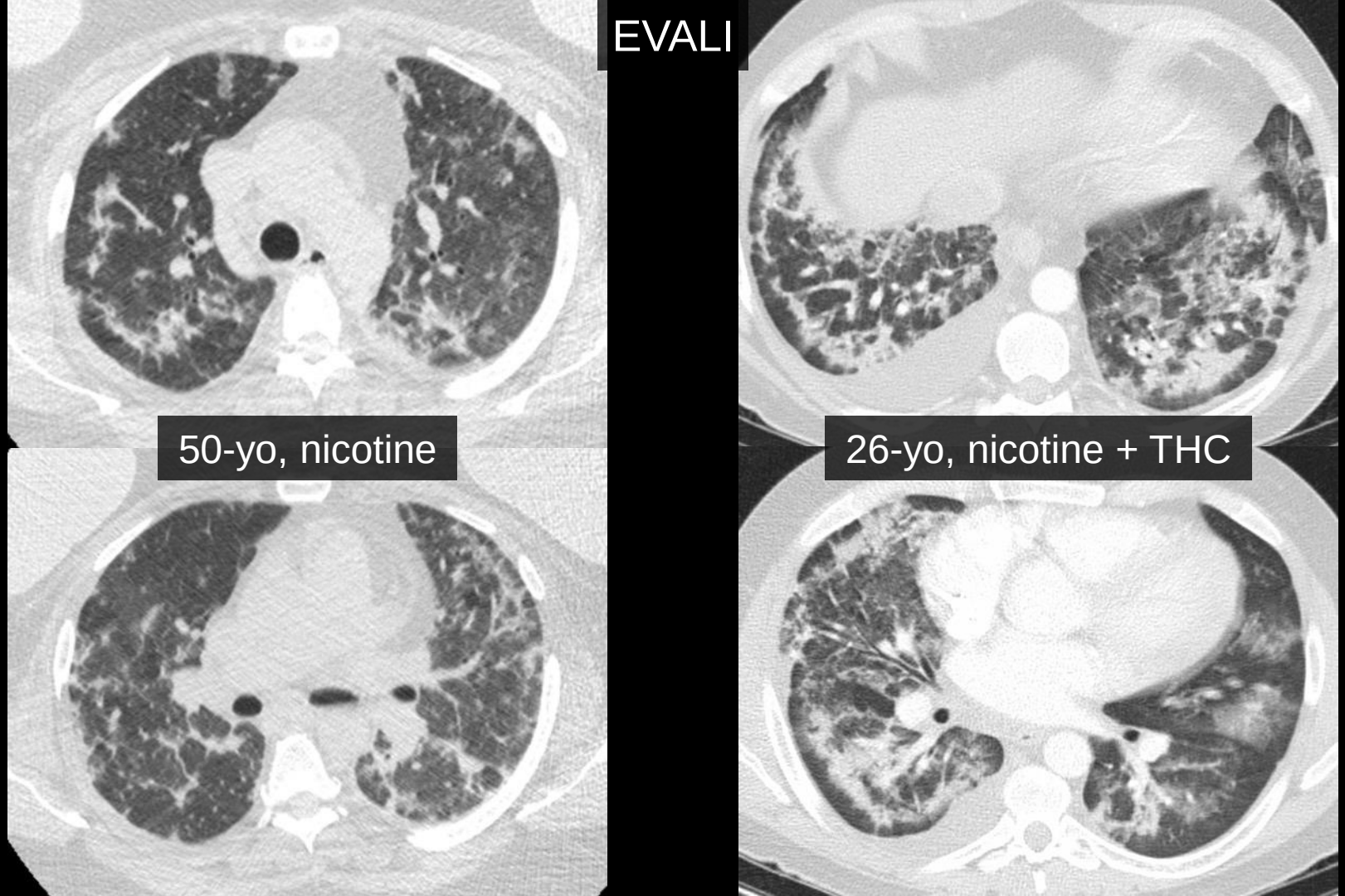
23-yo, THC



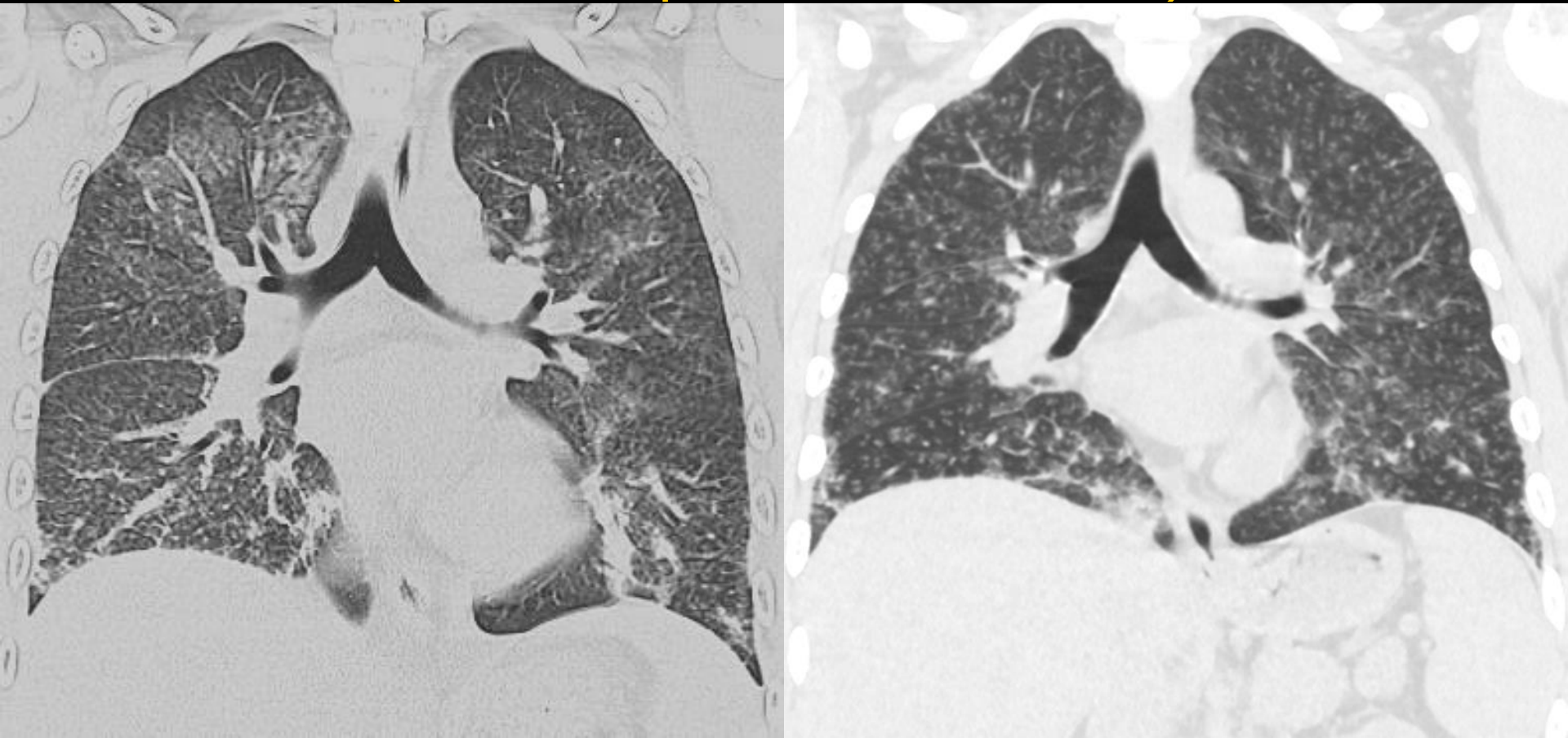
35-yo, THC



16-yo, THC


EVALI
50-yo, nicotine
26-yo, nicotine + THC

Centrilobular Nodules Seen in EVALI (but not reported with COVID)



Questions?