Pneumocystis Pneumonia: The radiology of an AIDS-defining illness

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Summary

- Why radiology of PCP is important.
- Several patients without a known diagnosis of HIV who present with typical radiographic features of PCP.
- Atypical radiographic features of PCP.
- A differential diagnosis.

Delays in HIV diagnosis

- Of the 1,039,000-1,185,000 individuals estimated to have HIV, 24-27% do not know their diagnosis (CDC).
- The greatest delay in getting appropriate HIV care is the delay between primary infection and HIV testing.

Delays in HIV diagnosis

- Two retrospective studies examined this delay diagnosis between HIV infection and HIV testing…
- Liddicoat et al found the median delay in diagnosis of HIV was 5 prior visits to the same institution.
- Kuo et al found 23 of their subjects made a total of 53 healthcare visits prior to a diagnosis.

Delays in HIV diagnosis

Table 2. Characteristics of HIV-infected Patients Who Received Medical Care at Boston Medical Center Prior to Their HIV Diagnosis (*N* = 221)

	Characteristics	*n* (%)
Race/ethnicity	African-American	109 (49)
	White	27 (12)
	Hispanic	28 (13)
	Haitian/African	50 (23)
	ther	7 (3)
	3 to 24	10 (5)
	5 to 34	68 (31)
	5 to 44	96 (43)
	5 to 54	36 (16)
	5+	10 (5)
	ale	146 (66)
	Female	75 (34)
CD4* (cells/μl)	≥200	124 (56)
	<200	96 (44)

* N = 220.
† *Age at time of DEU clinic presentation.*

44% of individuals with CD4 < 200 had to make more than one visit to BMC before they were diagnosed with HIV

Liddicoat RV et al. J Gen Intern Med. 2004; 19:349-56.

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Delays in HIV diagnosis

Table 3. By Visit Site, the Percentage of Visits Where HIV Testing Was Recommended or Considered by a Clinician Stratified by Trigger Category

Visit Site	HIV Testing Was Recommended or Considered				
	Category 1 Trigger % (n*/total†)	Category 2 Trigger % (n/total)	Category 3 Trigger % (n/total)	Category 4 Trigger % (n/total)	Total % (n/total)
Primary care	67 (45/67)	42 (27/65)	22 (20/91)	7 (6/83)	32 (98/306)
ED	23 (19/84)	16 (10/64)	11 (11/104)	3 (3/118)	12 (43/370)
Urgent care center	62 (56/90)	41 (36/87)	31 (22/72)	6 (3/51)	39 (117/300)
STD clinic	100 (8/8)	89 (8/9)	74 (51/69)	100 (2/2)	78 (69/88)
Obstetrics/ gynecology	0 (0/4)	20 (1/5)	10 (5/48)	8 (5/62)	9 (11/119)
Other/ specialist	29 (8/28)				11 (12/114)
Hospital	68 (60/88)				47 (103/218)

* *n = number of HIV recommended/discuss*
† *Total number of visits at that clinical site*
ED, emergency department; STD, sexually

Only 23% of individuals with opportunistic infections or other known HIV coinfections were recommended to have an HIV test in the ED

Liddicoat RV et al. J Gen Intern Med. 2004; 19:349-56.

Patient FC

- 45 year old man previously healthy presents with 1 month of DOE
- ED visit 4 weeks earlier, CXR read as “normal”, d/c’ed home with azithromycin
- Now returns to the ED with continued symptoms and low grade fever
- SHx: lives with HIV+ partner, last HIV test 5 years ago, tested HIV-

Patient FC – Physical Exam

V/S: afebrile, HR 67 BP 149/94 O2 Sat 97% at rest, 92% with ambulation

HEENT: + thrush

Cardiac: nl S1, S2, no mrg

Lungs: LCA b/l

Ext: no c/c/e

Patient FC – Labs

LDH: 343

WBC: 9.7

ABG: 7.48/33/157

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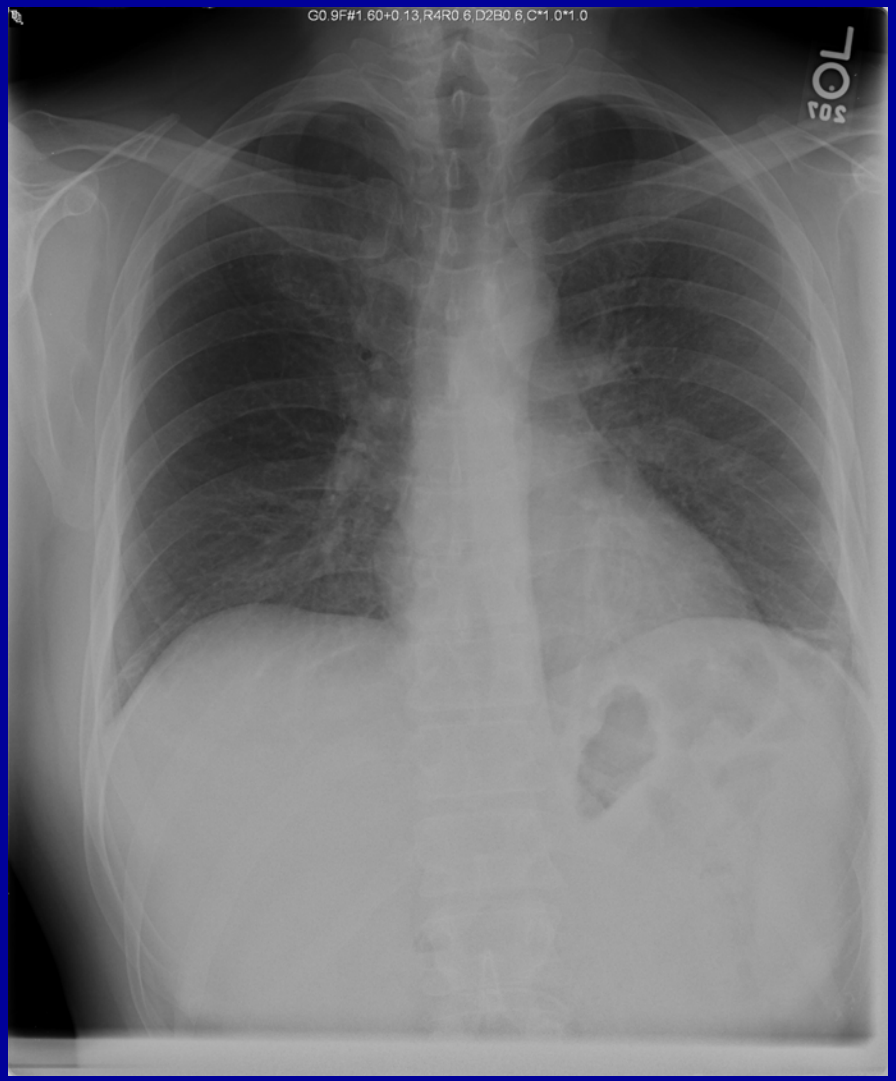
FC – CXR 10/31

Note the basilar reticular pattern R>L



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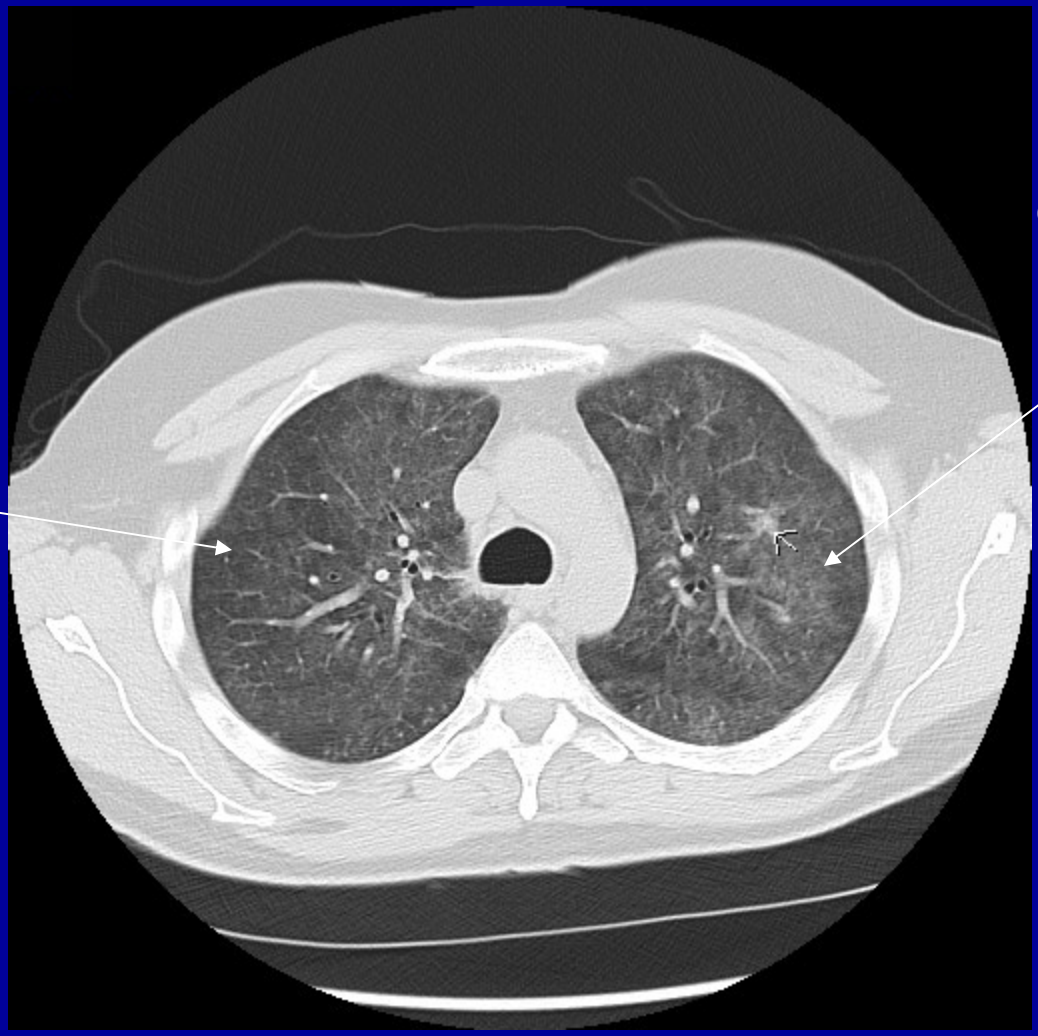
FC – CT 10/31



Thickening of intralobular septae

Ground glass opacity, primarily in upper zones

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Clinical features of PCP

- Continues to be most prevalent opportunistic infection in patients with HIV
- CD4 count < 200 cells/mm3
- Symptoms:
  - Subtle onset of DOE
  - Nonproductive cough
  - Low grade fever
  - Acute dyspnea and pleuritic CP with pneumothorax

Clinical features of PCP

- On physical exam:
  - Tachypnea
  - Tachycardia
  - Normal lung auscultation findings

In the setting of HIV

- Greater organism burden
- Reduced neutrophil response
- Higher diagnostic yield of sputum samples and bronchoalveolar lavage
- Better oxygenation during infection
- Better survival than non-HIV infected patients
- Mortality rate of 10-20%; higher with required mechanical ventilation

Pneumocystis itself

- Tropism for the lung
- Alveolar pathogen without invasion of the host
- Only disseminates in the setting of severe immunocompromise or overwhelming infection

Diagnosis

- Radiographically, PCP has very typical features
- Boiselle et al found radiologists had 75% accuracy in establishing the diagnosis between TB, bacterial PNA and PCP in a blinded study.

Typical radiographic features

- Diffuse, perihilar, reticular or granular opacities
- Ground glass opacities
- Thin-walled cystic lesions possible

CT features of PCP PNA

- Exudative alveolitis w/ accumulation of fluid, organisms, fibrin, debris in alveolar spaces → ground glass opacity
- Mosaic distribution with normal lung adjacent to diseased lung
- Interlobular reticulation w/ septal infiltration by mononuclear cells and edema

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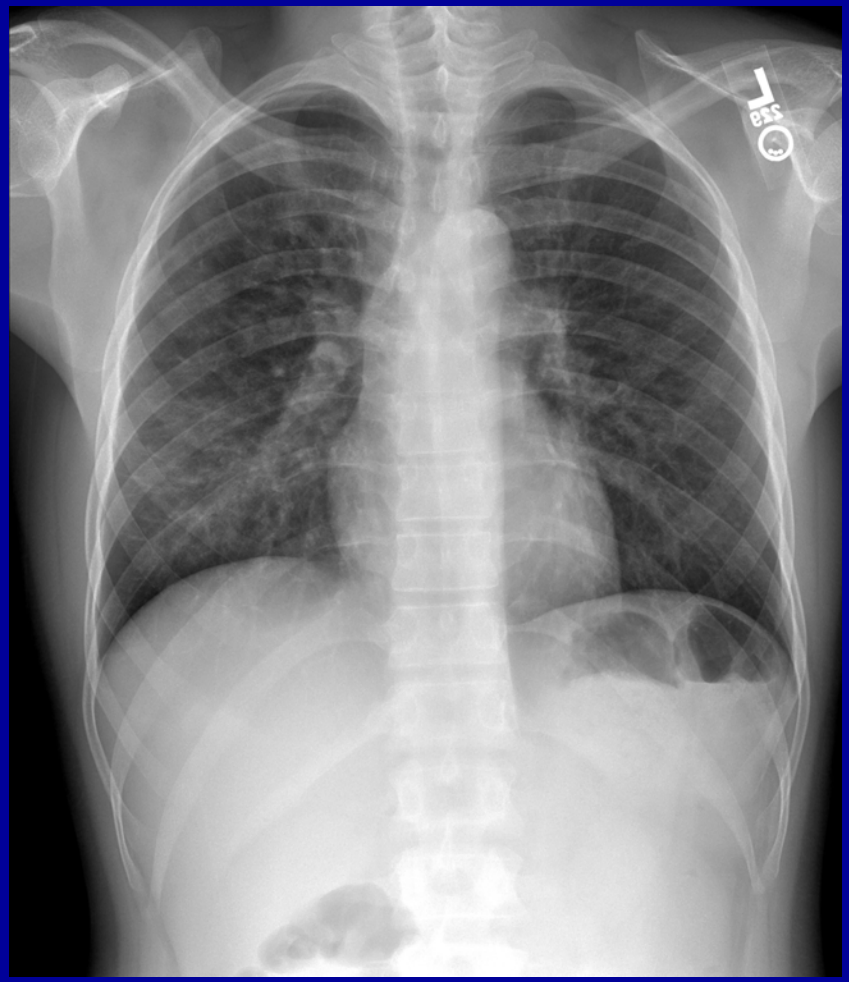
Companion patient 1 – AP CXR



- Pt JTA, 41 y/o male p/w 2-3 months of weight loss and 1 week of DOE
- Noted to be HIV+ with CD4 16 during admission
- Tmax 100.4, delta MS, LDH 452

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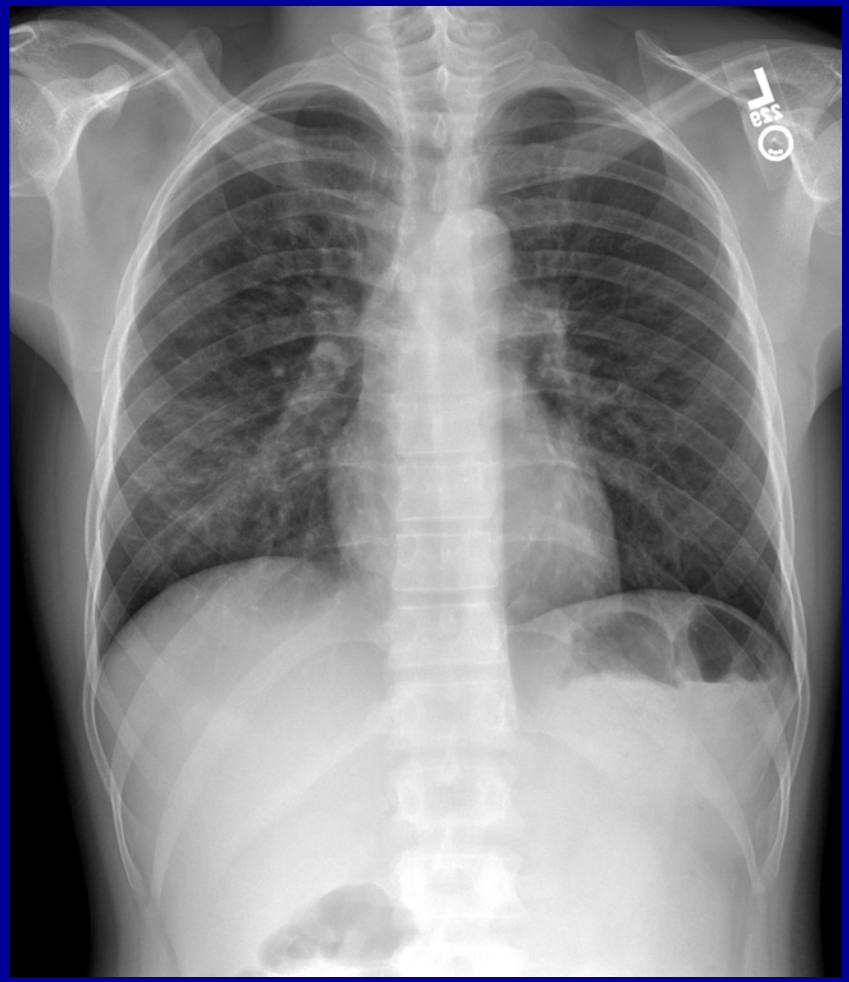
Companion patient 1 – AP CXR



- Typical findings of PCP on CXR
- Reticular and nodular pattern, right>left

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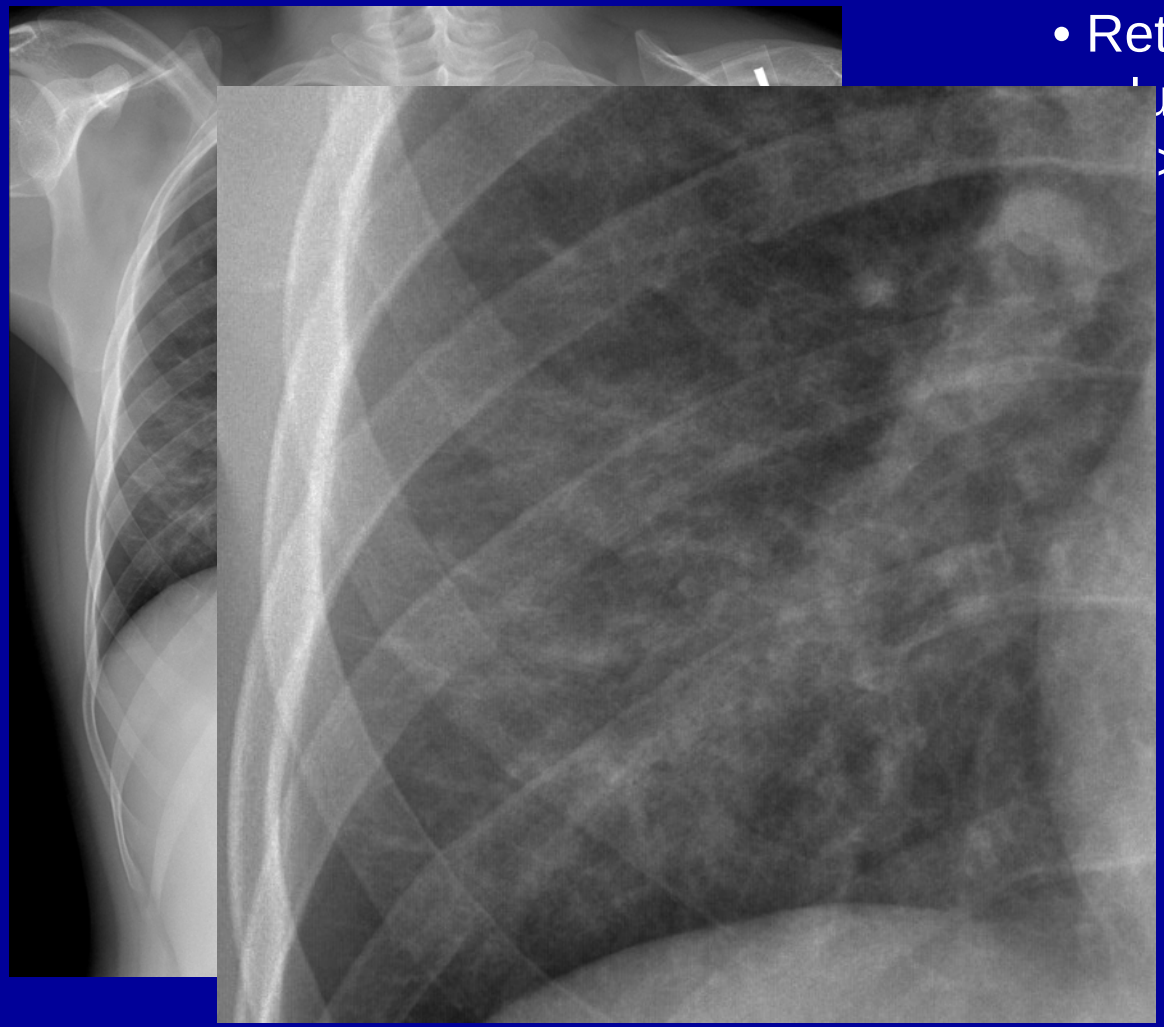
Companion patient 1 – AP CXR



- Reticular and
  ular pattern,
  >left

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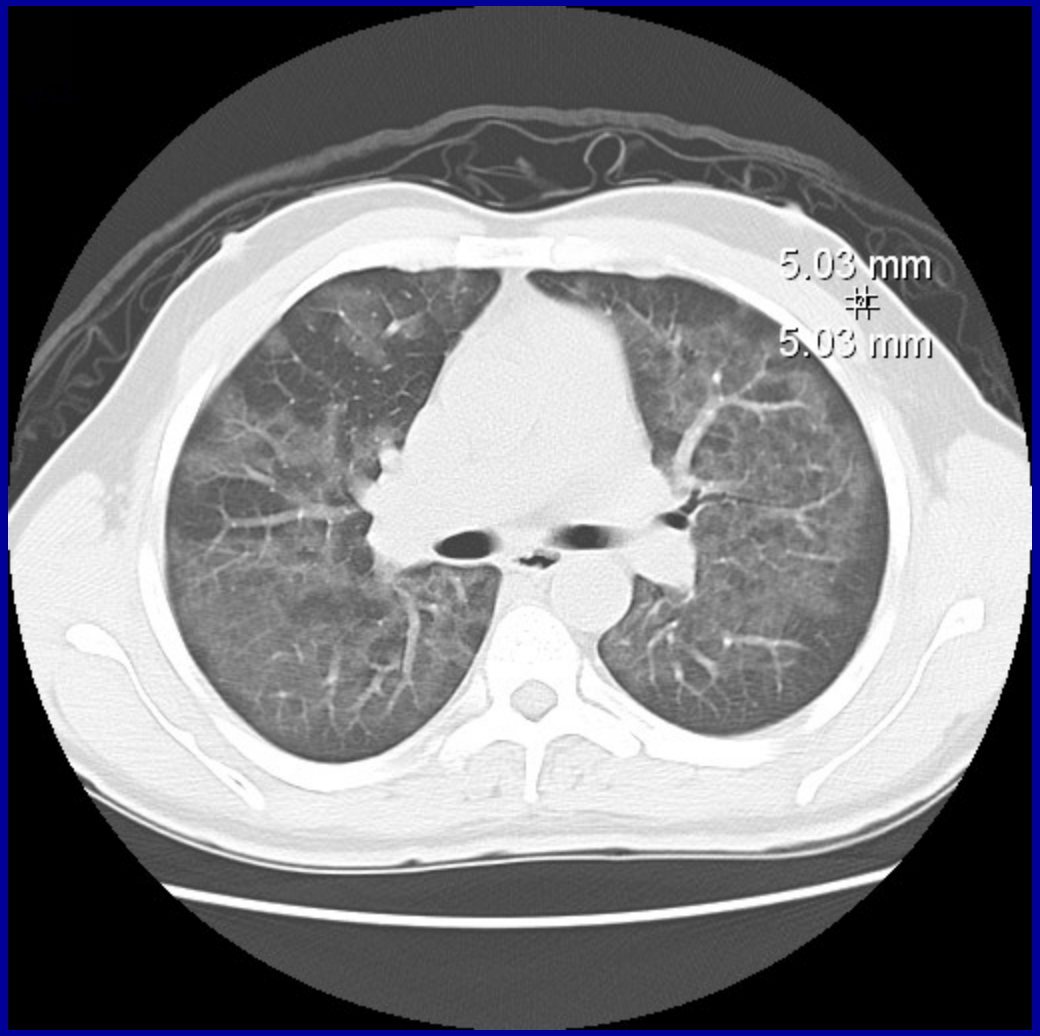
Companion patient 1 - CT



- Typical features of PCP on CT
- Diffuse ground glass opacities
- Note mosaic pattern
- No cysts or nodules
- Found to have PCP on induced sputum

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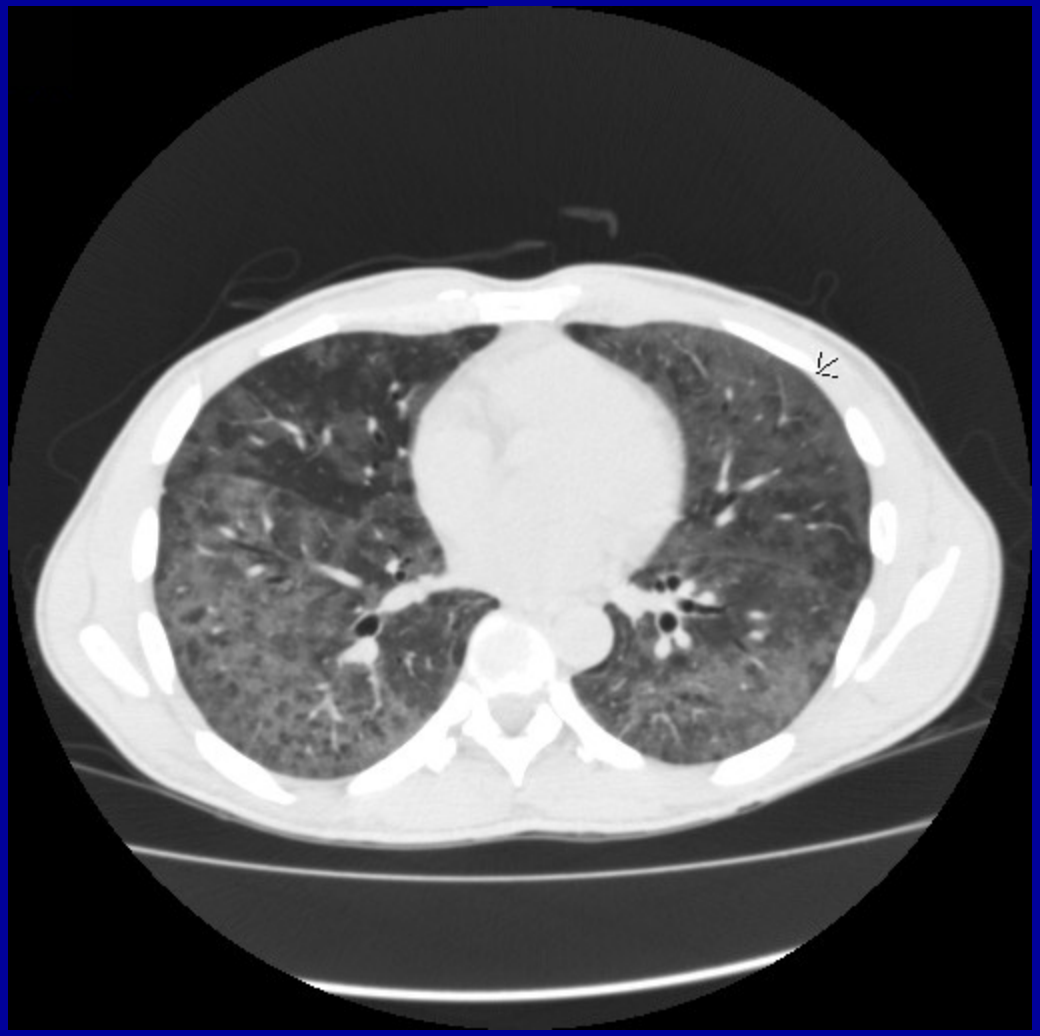
Companion patient 2 - CT



- Pt NG, 38 y/o male previously healthy p/w 30 lbs weight loss, SOB, and prior syncopal episode
- T 99.6, O2 sat 90% RA, Lactate 1.4
- Found to be HIV+ with CD4 of 25.
- Found to have PCP by induced sputum

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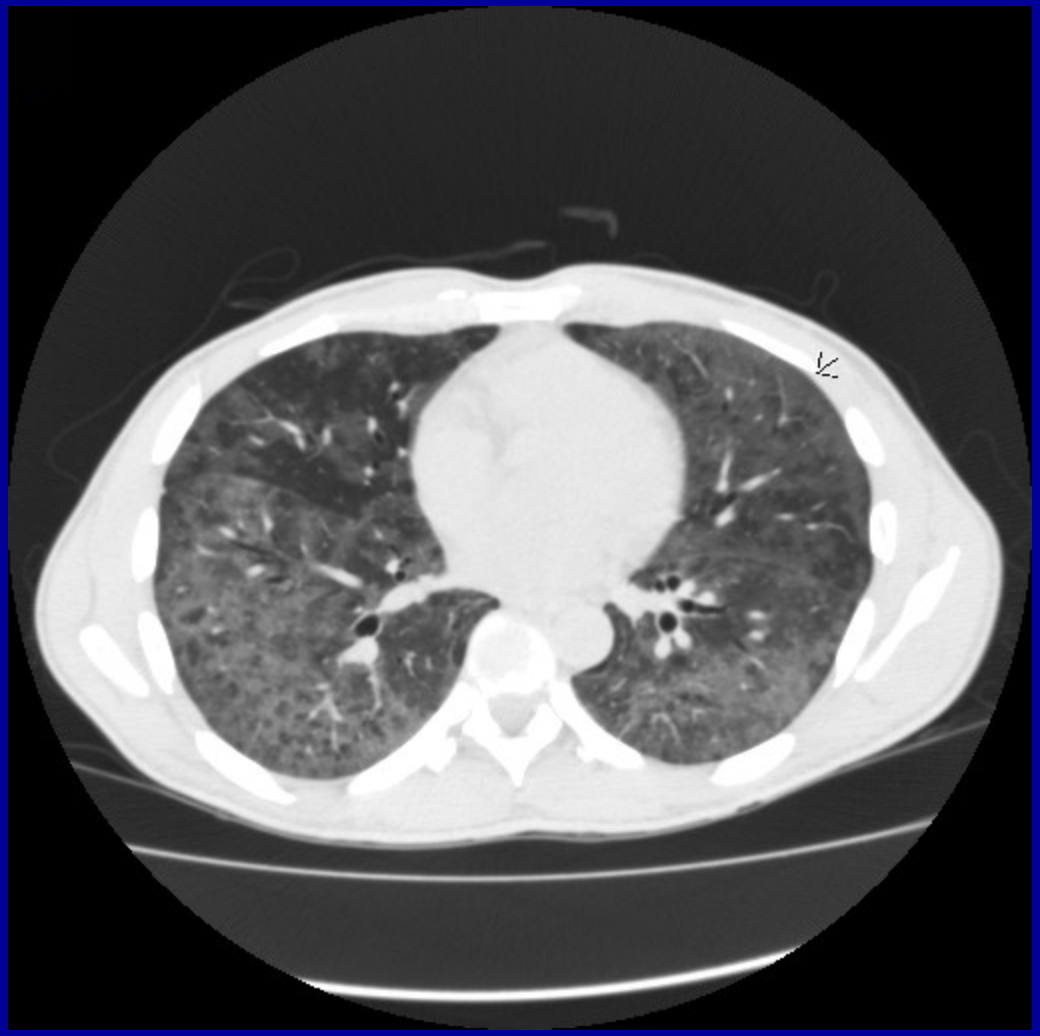
Companion patient 2 - CT



- Note again the peripheral and basilar ground glass opacities
- Multicystic changes in R middle lobe, read as chronic

Atypical radiographic features

- Atypical findings: dense consolidation, nodules, miliary opacities, pleural effusions
- Masses typically represent superinfection
- Necrotizing vasculitis
- Granulomatous response, including calcified granulomata

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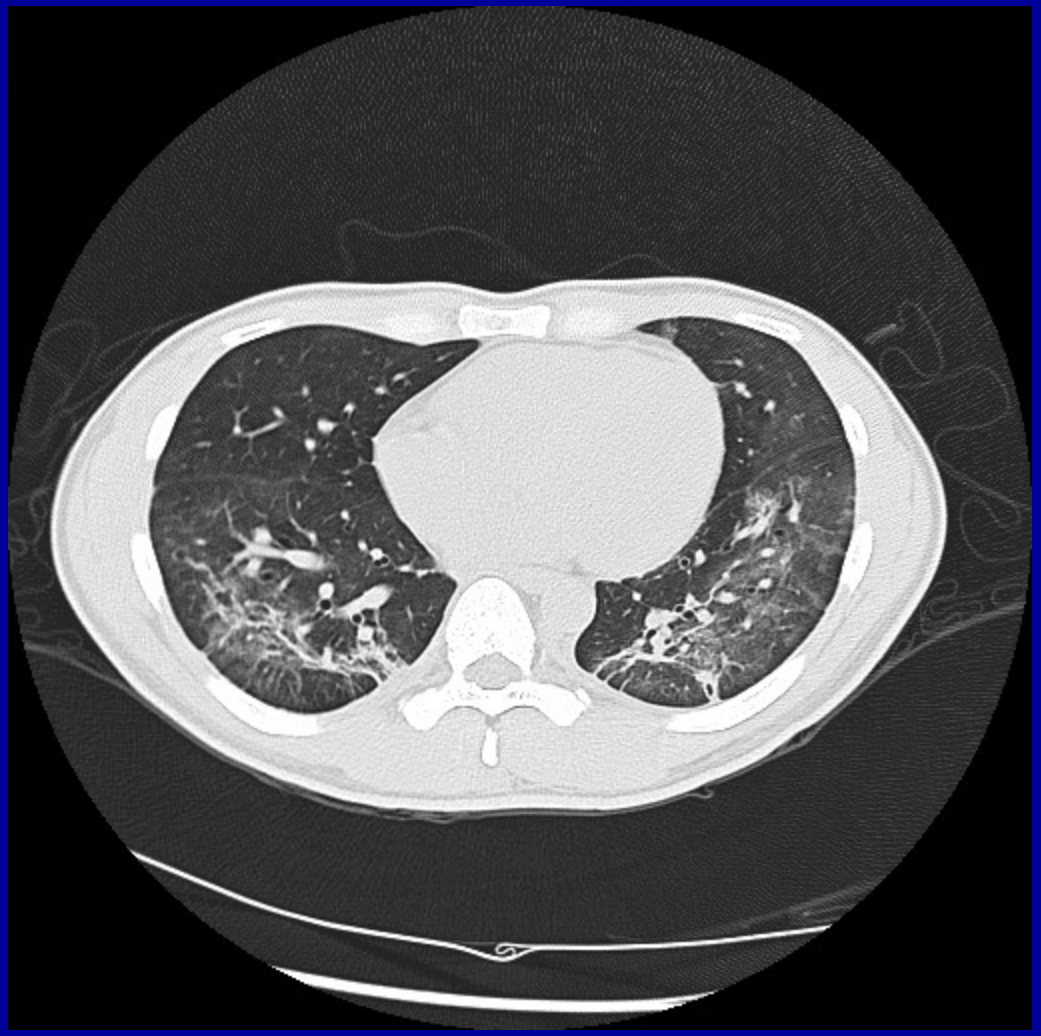
Companion patient 3 - CT



- Pt DC, 32 y/o male health care worker c/o 10 days SOB/DOE
- Found to be HIV+ after workplace needlestick, CD4 count of 16
- T 104, O2 sat 98% 3L, LDH 211
- Found on bronch to have PCP

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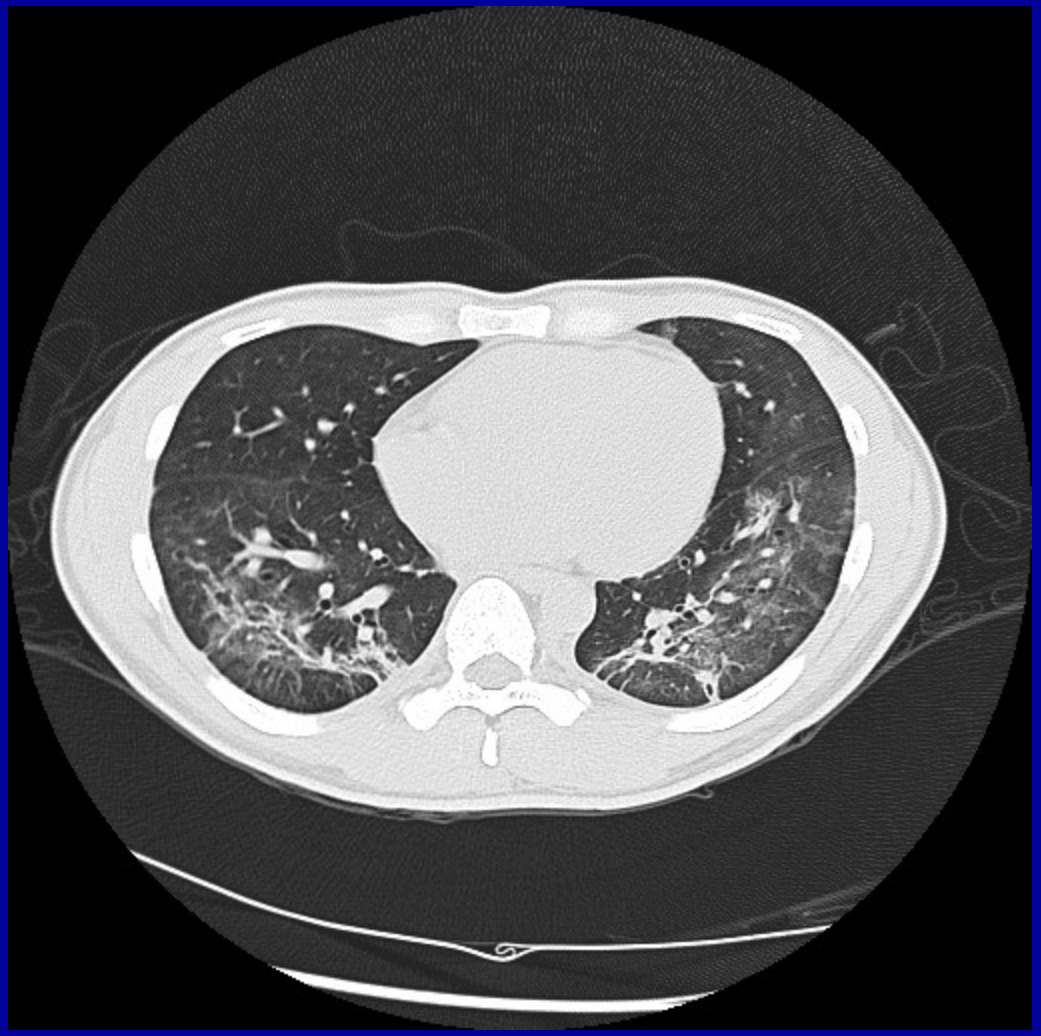
Companion patient 3 - CT



- Ground glass opacity
- Note atypical CT findings, including centriolobular nodules in upper fields and reticular opacities in lower lung zones bilaterally
- Air trapping also present

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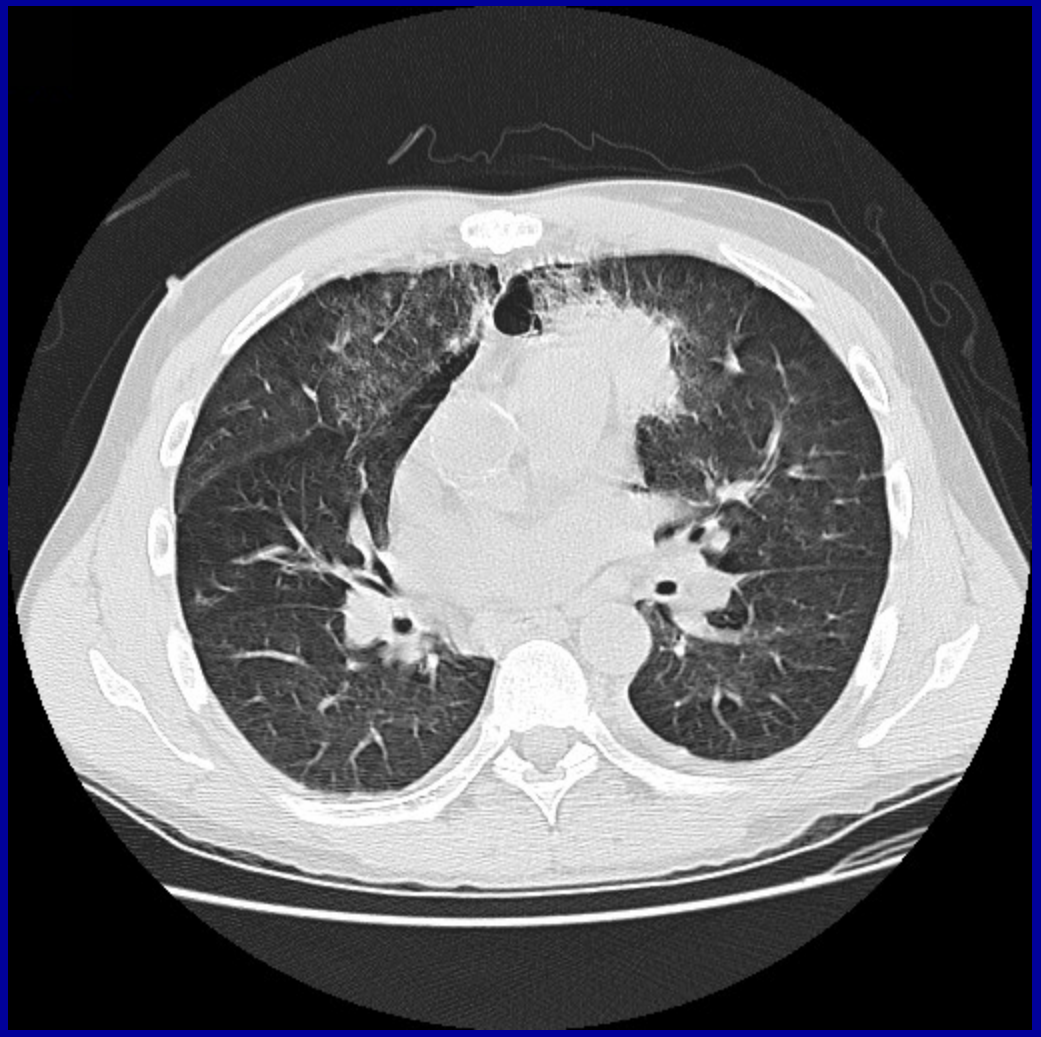
Companion patient 4 - CT



- Pt RZ, 36 y/o HIV+ man, s/p heart transplant c/o 2 days high fever and headache
- Previous CXR showed apical infiltrates
- T 101, O2 sat 97% on 50% face mask, LDH 177
- Found on bronch to have PCP

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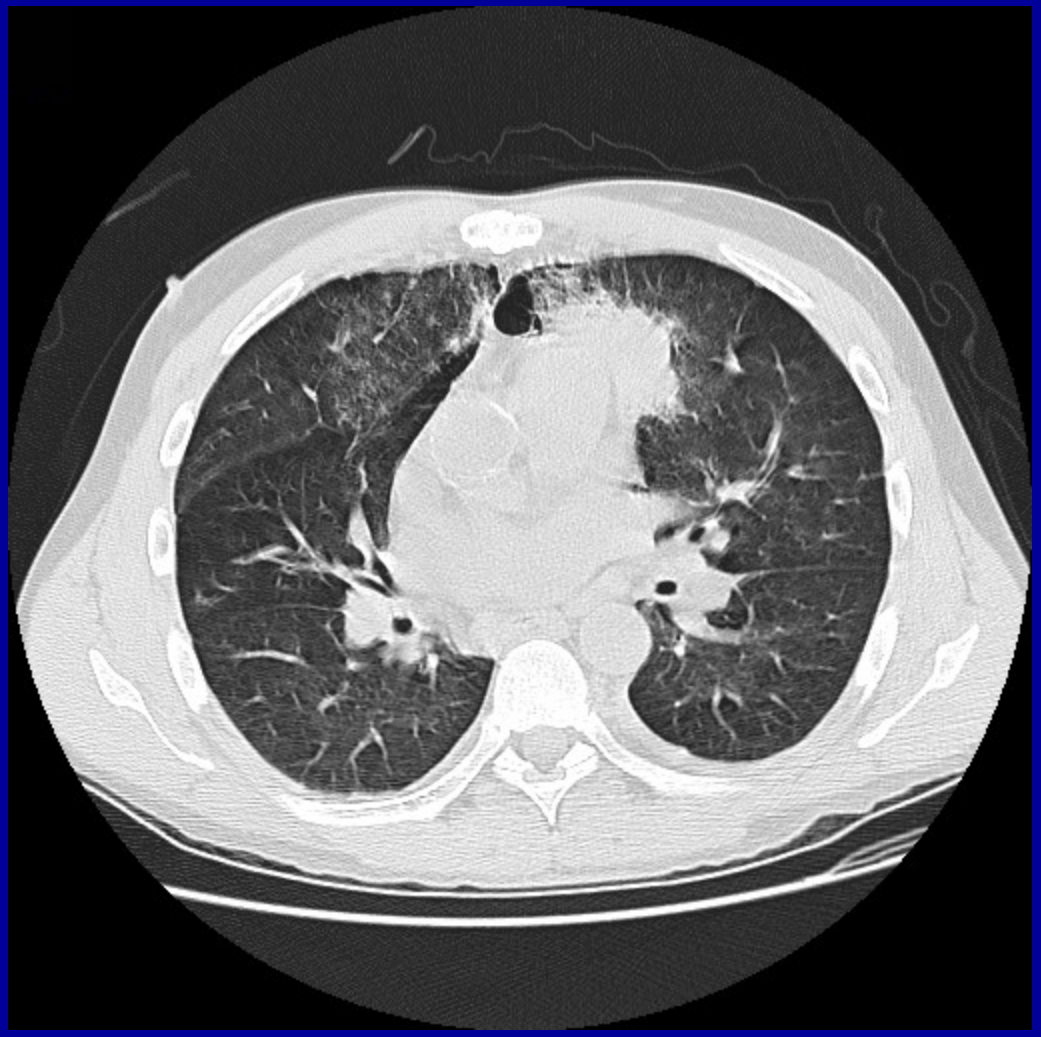
Companion patient 4 - CT



- The patient is noted to have atypical radiographic features of PCP, including:
- Mediastinal and hilar lymphadenopathy
- Small b/l pleural effusion

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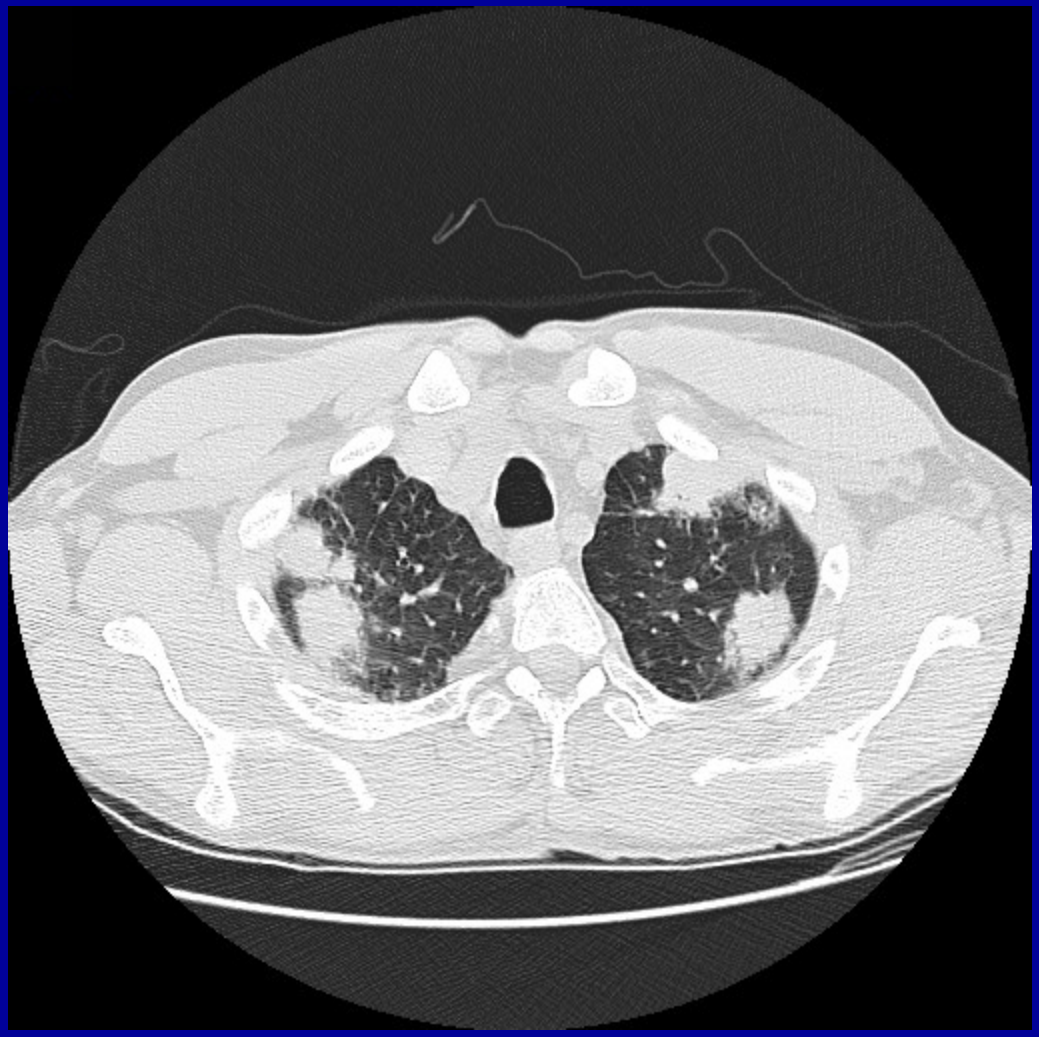
Companion patient 4 - CT



- Also unusual are the ill-defined nodular opacities from 1 cm to 4 cm
- This was so unusual that the radiologists read these findings as likely fungal infection vs lympho-proliferative disorder given patient's high CD4 count and rapid progression of disease

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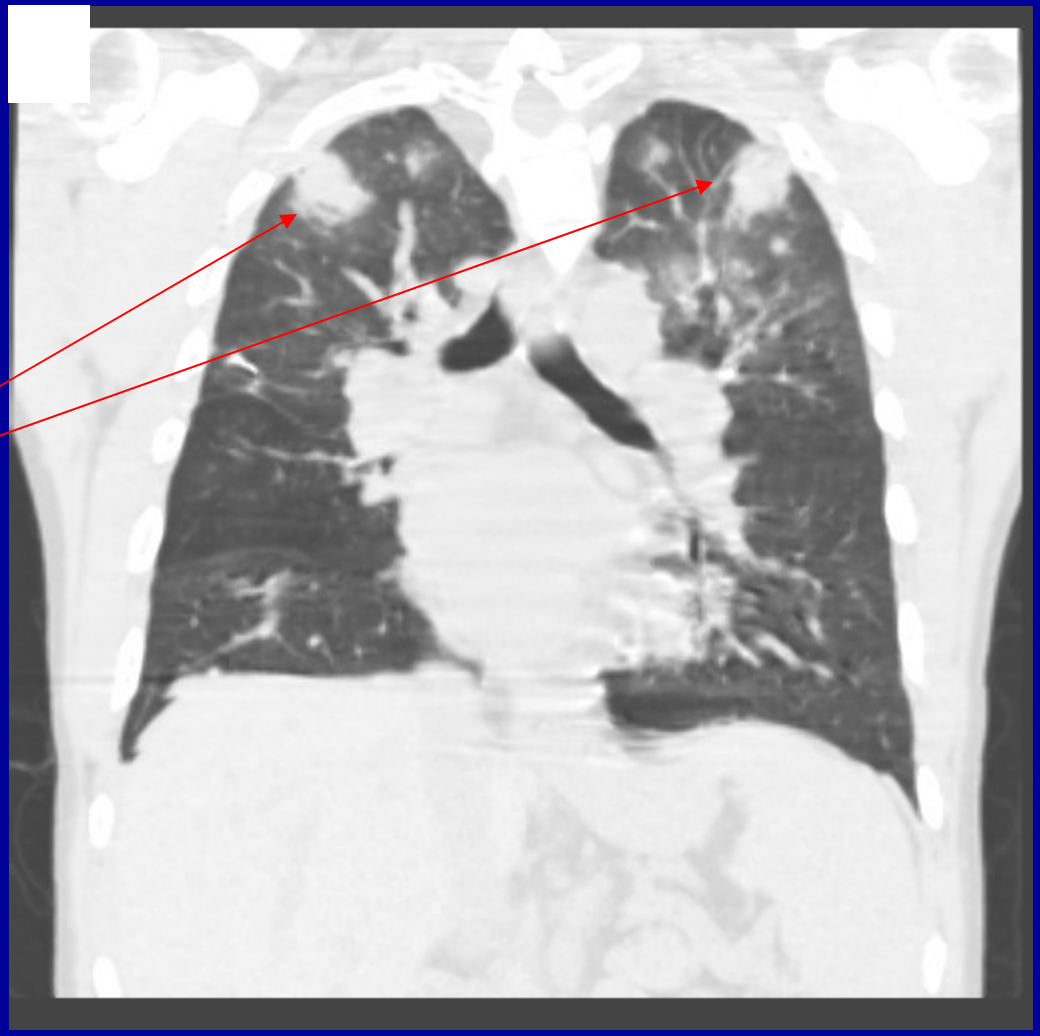
Companion patient 4 - CT

The nodules are also visible on this reformation



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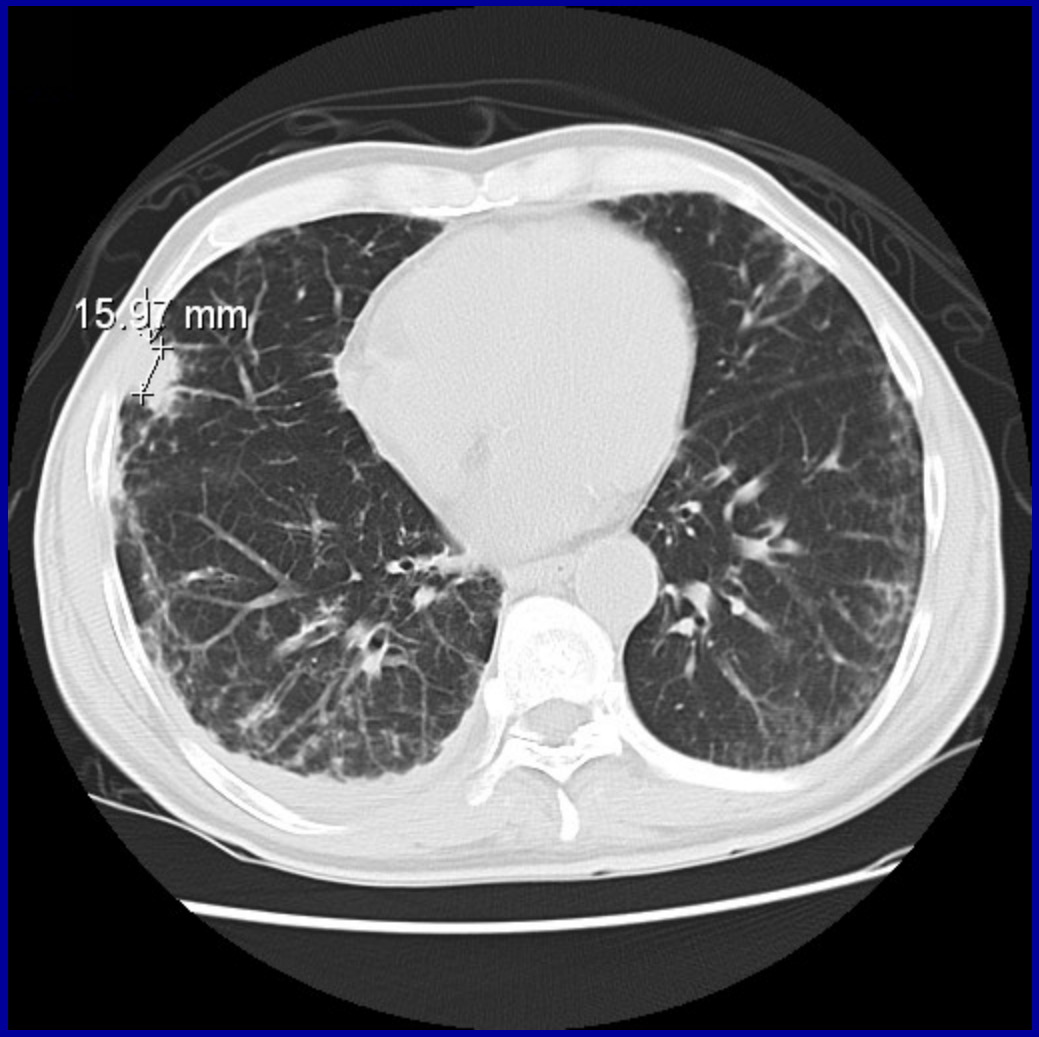
Companion patient 5 - CT



- Pt DE, 51 y/o HIV+ man, recent CD4 count of 15 and h/o PCP infection p/w 5 months SOB, low grade fevers and sputum production
- T 103, O2 sat 93% RA, Lactate 2.3
- Found on bronch to have both PCP and CMV pna

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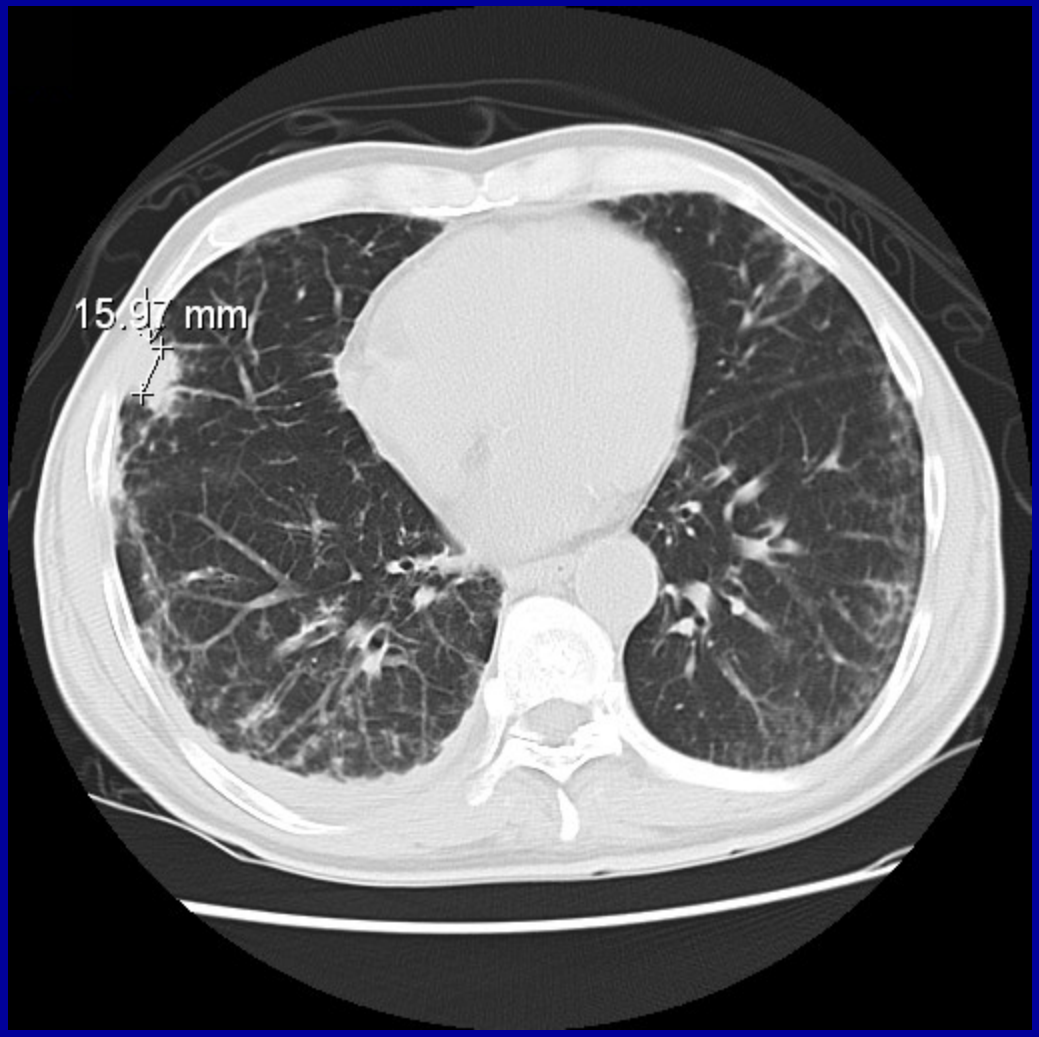
Companion patient 5 - CT



- The patient p/w this unusual new nodular peripheral opacity of about 16 mm in R middle lobe
- Mass found on bx to be both PCP and CMV co-infected
- The pt also has more common PCP features, including ground glass opacification, interlobular septal thickening, nodular opacities

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Companion patient 6 - CT

- Pt FB, 55 y/o HIV+ woman, recent CD4 count of 1 p/w 1 week of N/V and a bitter taste in her mouth
- Tmax 101.2, O2 sat 97% 2L NC, Lactate 1.8

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Companion patient 6 - CT

- This patient has typical features such as diffuse ground glass opacities
- She also is noted to have defined nodules, a thick-walled cavity, and small cysts within ground glass opacities
- Found to have cystic PCP and to have MAC bacteremia

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Consider a DDx: CD4 count and disease

- CD4 > 500 cells/mm3
  - Bacterial pna
  - TB
  - Lung CA
- CD4 200 - 499 cells/mm3
  - Recurrent bacterial pna
  - TB
  - Lymphoma and lymphoproliferative disorder

Consider a DDx: CD4 count and disease

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  - Bacterial pna
  - TB
  - Lung CA
- CD4 200 - 499 cells/mm3
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  - TB
  - Lymphoma and lymphoproliferative disorder

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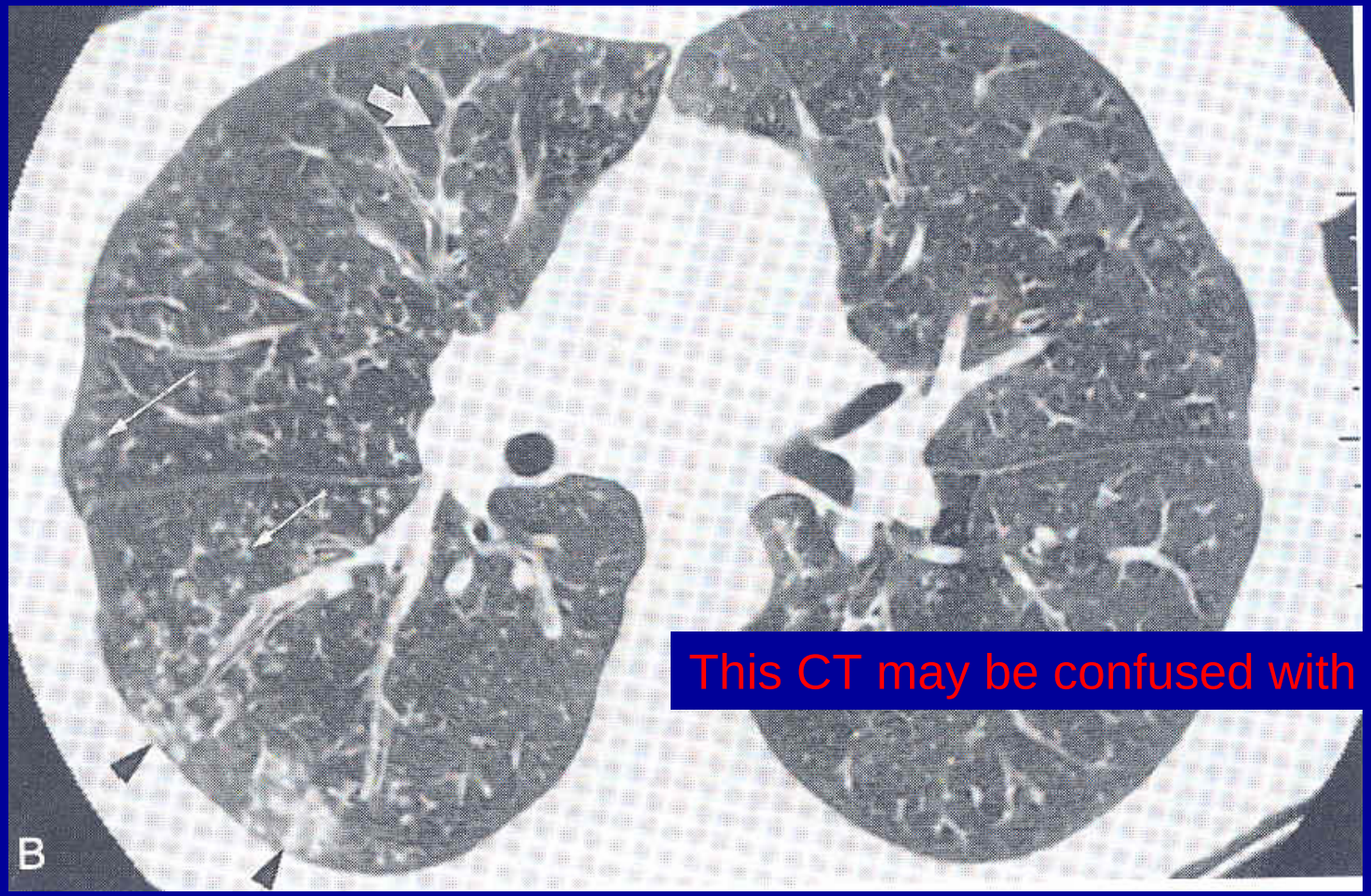
Infectious Bronchiolitis



This CT may be confused with PCP

McGuinness, G. Changing trends in the pulmonary manifestations of AIDS. Imaging of the patient with AIDS. Radiologic Clinics of North America. 1997; 35:1029-1083

Consider a DDx: CD4 count and disease

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- CD4 200 - 499 cells/mm3
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  - TB
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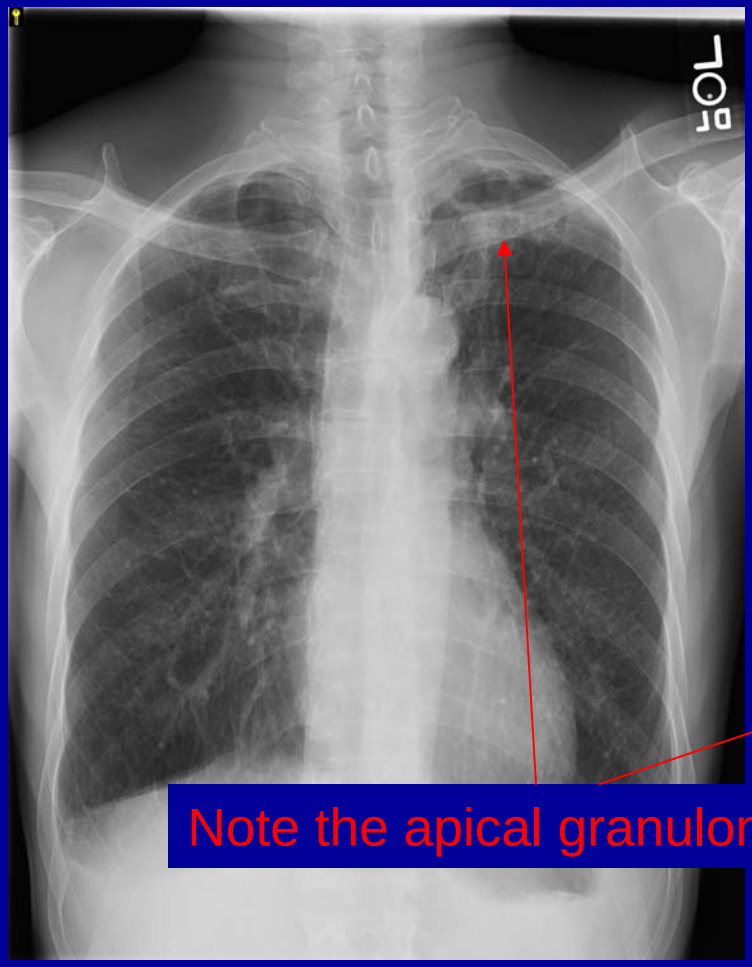
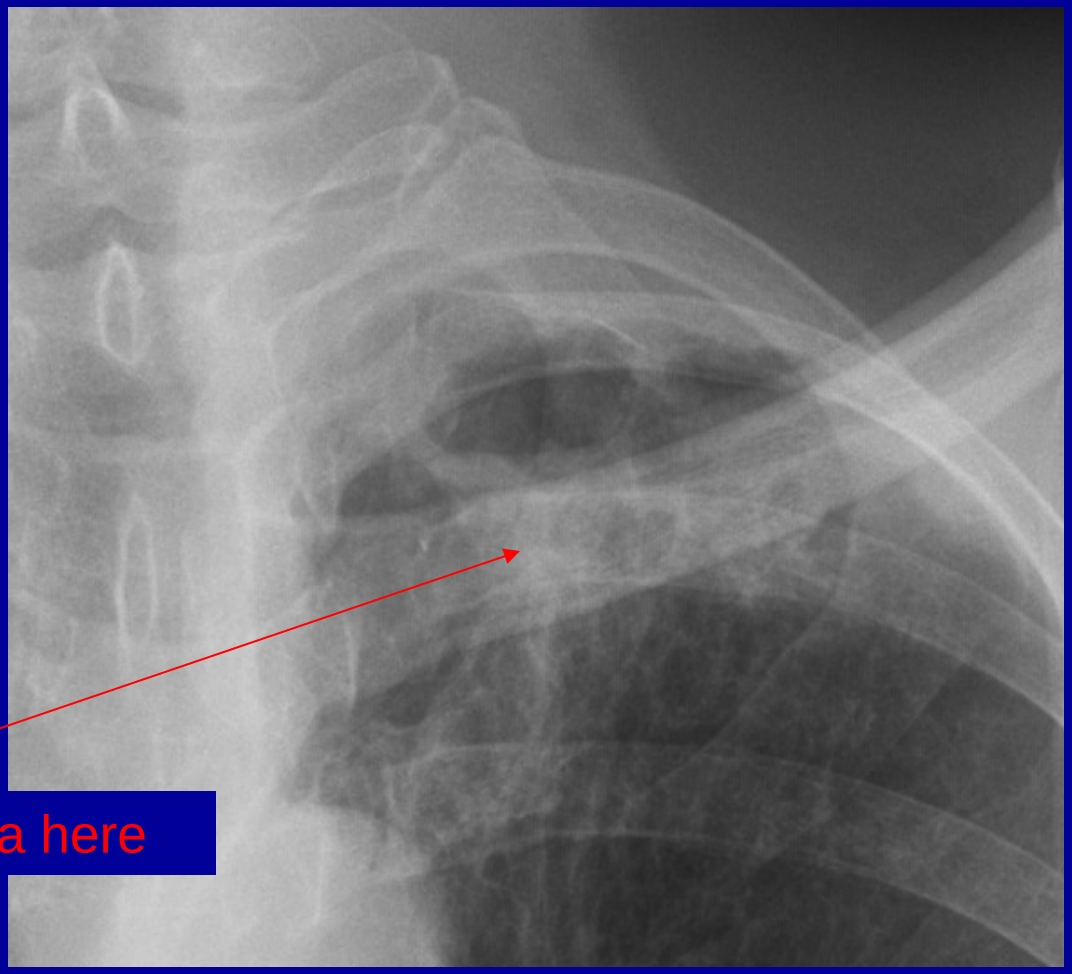
TB





Note the apical granuloma here

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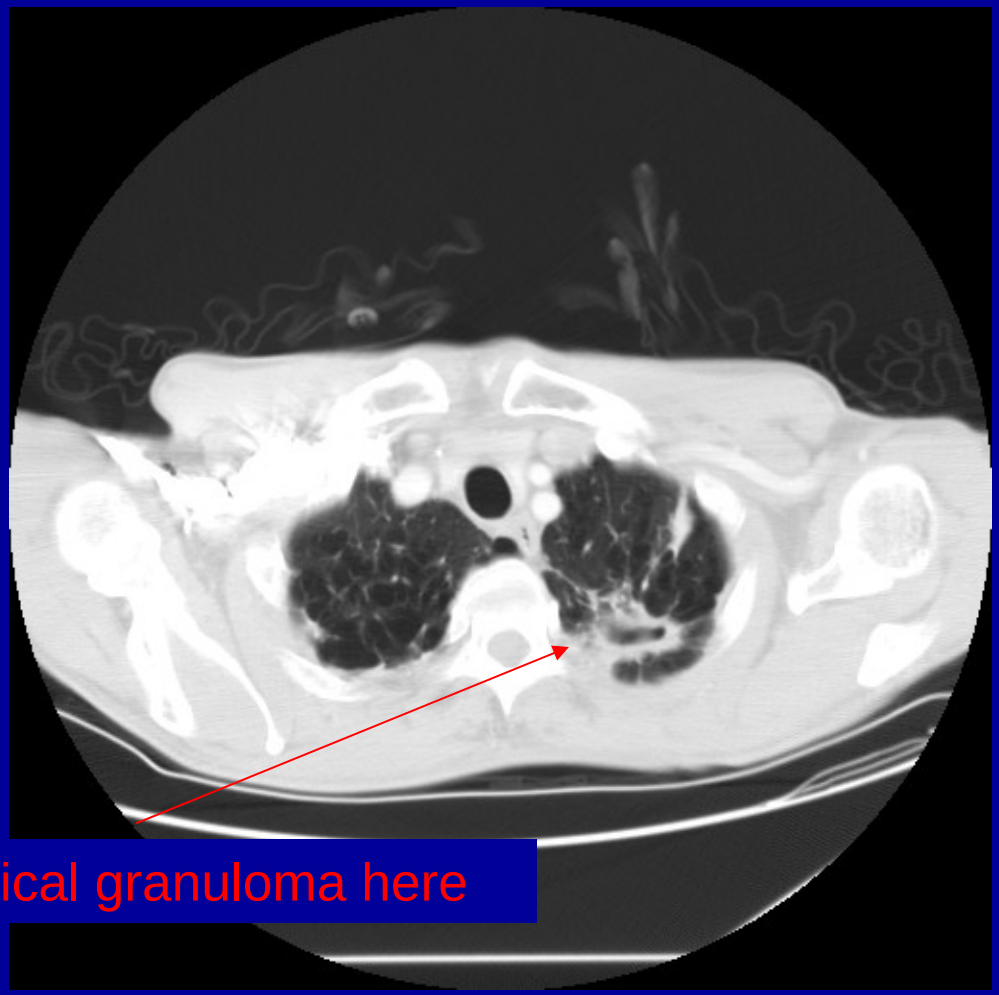
TB



Note the apical granuloma here

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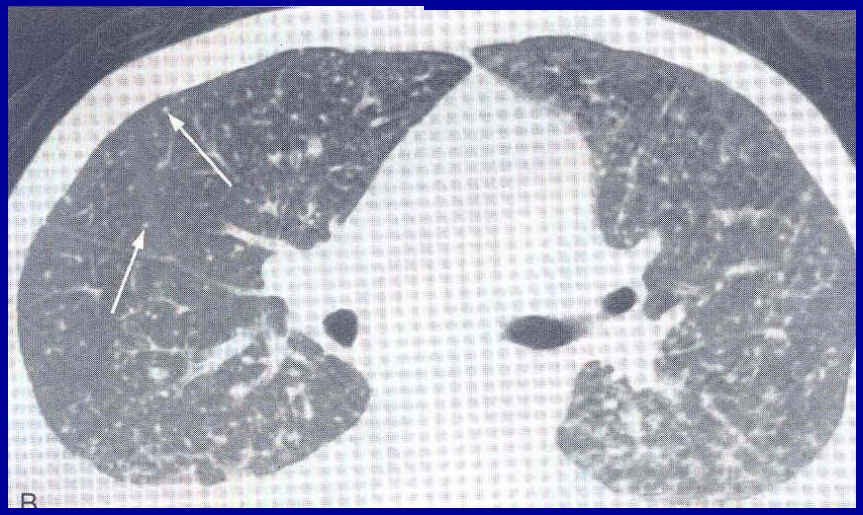
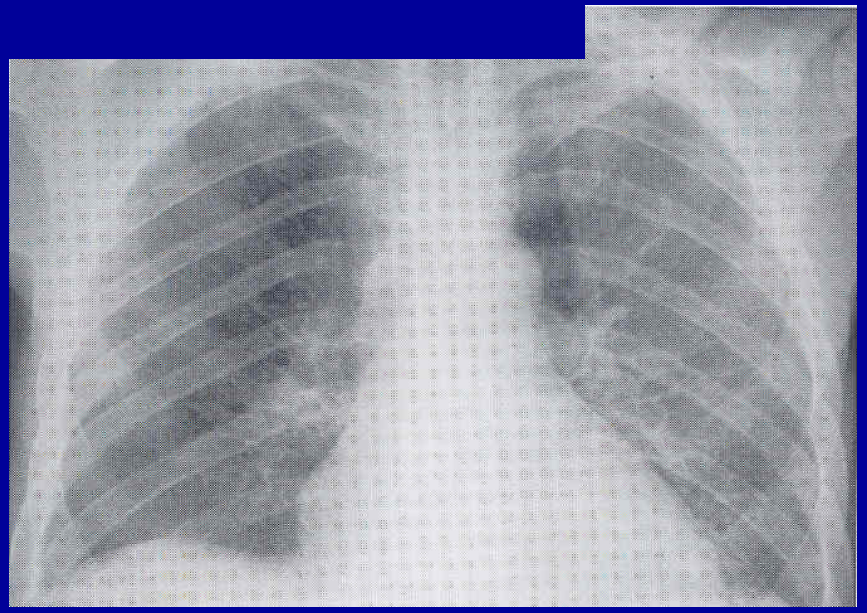
Miliary TB

In the severely immunocompromised host, however, miliary TB becomes a major concern.





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Consider a DDx: CD4 count and disease

- CD4 < 200 cells/mm3
  - PCP
  - Disseminated TB
- CD4 < 100 cells/mm3
  - PCP
  - Kaposi's Sarcoma
  - CMV disease
  - MAC
  - Disseminated fungal infection

Consider a DDx: CD4 count and disease

- CD4 < 200 cells/mm3
  - PCP
  - Disseminated TB
- CD4 < 100 cells/mm3
  - PCP
  - Kaposi's Sarcoma
  - CMV disease
  - MAC
  - Disseminated fungal infection

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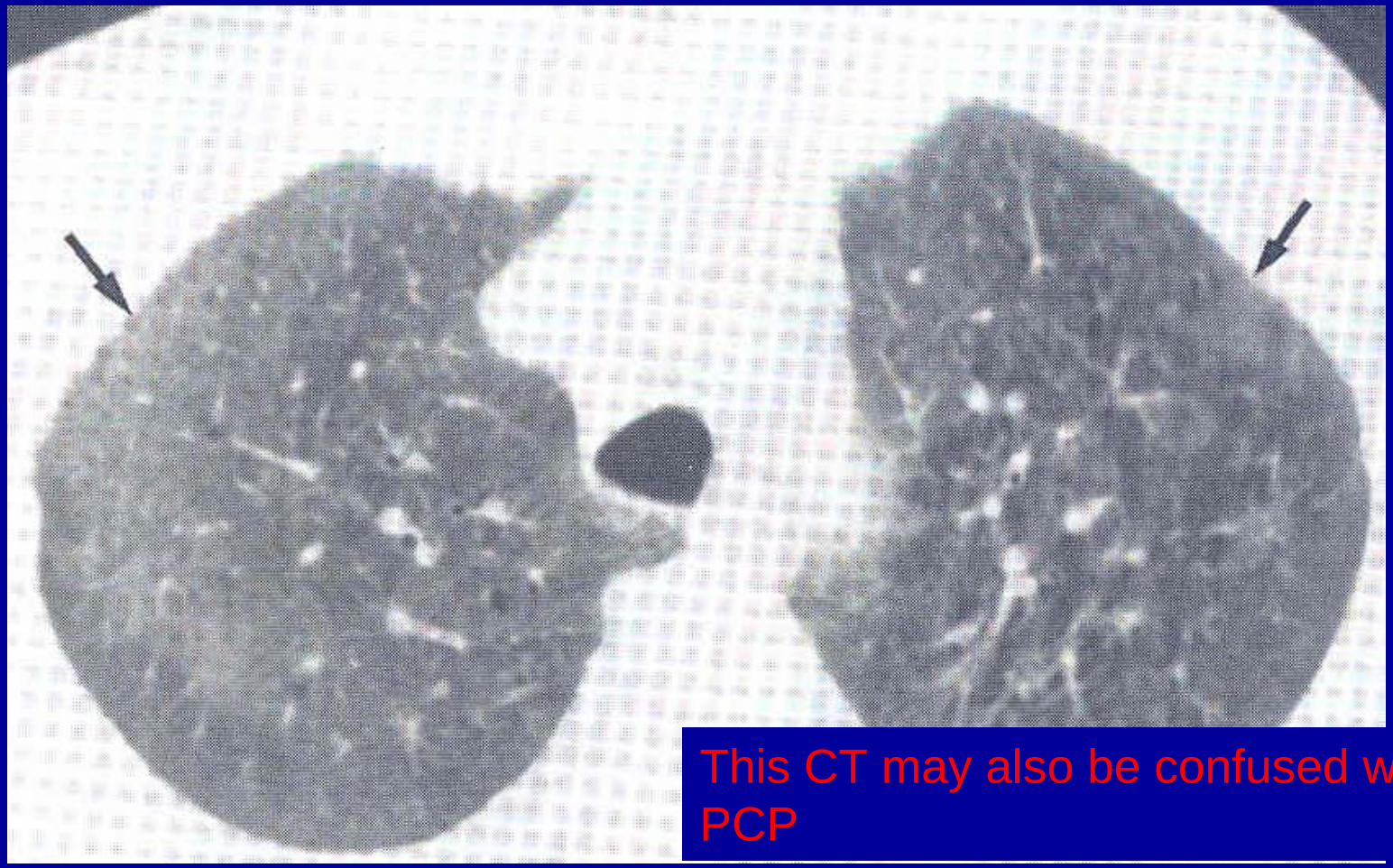
CMV



This CT may also be confused with PCP

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Consider a DDx: CD4 count and disease

- CD4 < 200 cells/mm3
  - PCP
  - Disseminated TB
- CD4 < 100 cells/mm3
  - PCP
  - Kaposi's Sarcoma
  - CMV disease
  - MAC
  - Disseminated fungal infection

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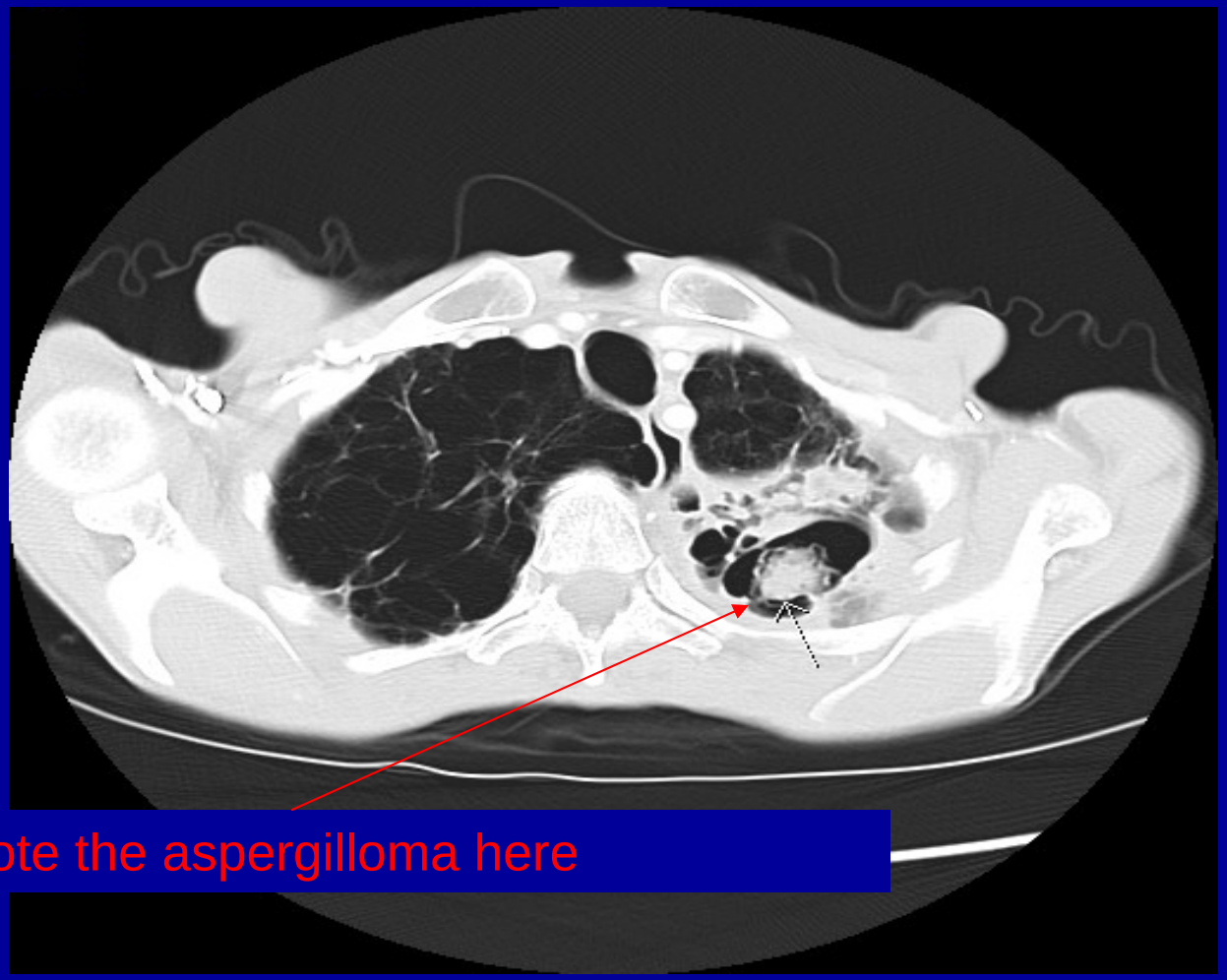
Aspergilloma



Pulmonary disease in immunocompromised adults

- Common
  - ARDS
  - Drug-induced disease
  - Malignant neoplasm
    - Bronchogenic carcinoma
    - Mets
    - Kaposi sarcoma
    - Lymphoma

Reeder MM. Gamuts in Radiology: Comprehensive lists of Roetgen differential diagnosis. 4th edition. Springer: New York, 2003

Pulmonary disease in immunocompromised adults

- Common
  - Opportunistic infections
    - PCP
    - Strongyloidiasis
    - Toxoplasmosis
    - CMV infection
    - Fungus disease
    - Rhodococcus equi
    - Bacillary angiomatosis

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Pulmonary disease in immunocompromised adults

- Common
  - Pulmonary thromboembolism and infarction
  - Tuberculosis and atypical mycobacterial infections

Reeder MM. Gamuts in Radiology: Comprehensive lists of Roetgen differential diagnosis. 4th edition. Springer: New York, 2003

Pulmonary disease in immunocompromised adults

- Uncommon
  - Alveolar proteinosis
  - Aspiration pneumonia
  - Graft-versus-host disease
  - Lymphangiography reaction
  - Lymphocytic interstitial pneumonitis
  - Nonspecific interstitial pneumonitis

Reeder MM. Gamuts in Radiology: Comprehensive lists of Roetgen differential diagnosis. 4th edition. Springer: New York, 2003

Pulmonary disease in immunocompromised adults

- Uncommon
  - Primary pulmonary hypertension
  - Cardiogenic pulmonary edema
  - Noncardiogenic pulmonary edema
  - Pulmonary hemorrhage
  - Radiation injury

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Definitive diagnosis

- Induced sputum
- If negative → bronchoscopy with bronchoalveolar lavage
- Stains, monoclonal antibodies, PCR
- Elevated serum LDH has low specificity

Summary

- Why radiology of PCP is important.
- Several patients without a known diagnosis of HIV who present with typical radiographic features of PCP.
- Atypical radiographic features of PCP.
- A differential diagnosis

Acknowledgements

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- Phillip Boiselle, MD
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- Pamela Lepkowski

References

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