Pneumocystis Pneumonia: The radiology of an AIDS-defining illness

Jennifer Stevens, Harvard Medical School Year III
Gillian Lieberman, MD
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

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

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

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Race/ethnicity</strong></td>
<td></td>
</tr>
<tr>
<td>African-American</td>
<td>109 (49)</td>
</tr>
<tr>
<td>White</td>
<td>27 (12)</td>
</tr>
<tr>
<td>Hispanic</td>
<td>28 (13)</td>
</tr>
<tr>
<td>Haitian/African</td>
<td>50 (23)</td>
</tr>
<tr>
<td>Other</td>
<td>7 (3)</td>
</tr>
<tr>
<td><strong>Age (years)</strong></td>
<td></td>
</tr>
<tr>
<td>18 to 24</td>
<td>10 (5)</td>
</tr>
<tr>
<td>25 to 34</td>
<td>68 (31)</td>
</tr>
<tr>
<td>35 to 44</td>
<td>96 (43)</td>
</tr>
<tr>
<td>45 to 54</td>
<td>36 (16)</td>
</tr>
<tr>
<td>&gt;55</td>
<td>10 (5)</td>
</tr>
<tr>
<td><strong>Sex</strong></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>146 (66)</td>
</tr>
<tr>
<td>Female</td>
<td>75 (34)</td>
</tr>
<tr>
<td><em><em>CD4</em> (cells/µl)</em>*</td>
<td></td>
</tr>
<tr>
<td>≥200</td>
<td>124 (56)</td>
</tr>
<tr>
<td>&lt;200</td>
<td>96 (44)</td>
</tr>
</tbody>
</table>

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

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

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

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

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

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
Note the basilar reticular pattern R>L
FC – CT 10/31

Ground glass opacity, primarily in upper zones

Thickening of intralobular septae
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
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
Companion patient 1 – AP CXR

• Typical findings of PCP on CXR

• Reticular and nodular pattern, right > left
Companion patient 1 – AP CXR

- Reticular and nodular pattern, right > left
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
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
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
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
Companion patient 3 - CT

- Ground glass opacity
- Note atypical CT findings, including centrilobular nodules in upper fields and reticular opacities in lower lung zones bilaterally
- Air trapping also present
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
The patient is noted to have atypical radiographic features of PCP, including:

- Mediastinal and hilar lymphadenopathy
- Small b/l pleural effusion
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 lymphoproliferative disorder given patient’s high CD4 count and rapid progression of disease.
Companion patient 4 - CT

The nodules are also visible on this reformation.
• 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
Companion patient 5 - CT

- The patient presented with an unusual new nodular peripheral opacity of about 16 mm in the right middle lobe.
- A mass found on biopsy was determined to be both PCP and CMV co-infected.
- The patient also had more common PCP features, including ground glass opacification, interlobular septal thickening, and nodular opacities.
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
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
Consider a DDx: CD4 count and disease

- CD4 > 500 cells/mm³
  - Bacterial pneumonia
  - TB
  - Lung CA
- CD4 200 - 499 cells/mm³
  - Recurrent bacterial pneumonia
  - TB
  - Lymphoma and lymphoproliferative disorder
Consider a DDx:
CD4 count and disease

- CD4 > 500 cells/mm³
  - Bacterial pneumonia
  - TB
  - Lung CA

- CD4 200 - 499 cells/mm³
  - Recurrent bacterial pneumonia
  - TB
  - Lymphoma and lymphoproliferative disorder
Infectious Bronchiolitis

This CT may be confused with PCP

Consider a DDx: 
CD4 count and disease

- CD4 > 500 cells/mm³
  - Bacterial pneumonia
  - TB
  - Lung CA

- CD4 200 - 499 cells/mm³
  - Recurrent bacterial pneumonia
  - TB
  - Lymphoma and lymphoproliferative disorder
Note the apical granuloma here
Note the apical granuloma here.
Miliary TB

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

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
This CT may also be confused with PCP

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
Aspergilloma

Note the aspergilloma here
Pulmonary disease in immunocompromised adults

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

Pulmonary disease in immunocompromised adults

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

Pulmonary disease in immunocompromised adults

• Common
  – Pulmonary thromboembolism and infarction
  – Tuberculosis and atypical mycobacterial infections

Pulmonary disease in immunocompromised adults

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

Pulmonary disease in immunocompromised adults

• Uncommon
  – Primary pulmonary hypertension
  – Cardiogenic pulmonary edema
  – Noncardiogenic pulmonary edema
  – Pulmonary hemorrhage
  – Radiation injury

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
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References


