Thoracic Imaging:
A Case of Metastatic Adenocarcinoma of Unknown Primary

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Agenda

- Introduce Patient RS
- Discuss menu of tests and radiological findings in a patient with shortness of breath
- Chest findings in metastatic disease
- Role of diagnostic imaging in end of life care
RS is a 65-year-old-man with a 50-pack year smoking history, with recent pulmonary embolism with deep venous thrombosis, atrial fibrillation, chronic kidney disease, and hypertension, who presents to an outside hospital (OSH) with two weeks of cough productive of white-colored sputum and progressive shortness of breath.

- Cough acutely worse over past two days
- Worsening shortness of breath such that he can no longer lie flat or sleep
Our Patient RS: Exam and Labs

- **Exam Findings**
  - **Vitals:** BP 140/68 Pulse 92 Temp 97.3 RR 22 O2sat 95 on 2L
  - **Lungs:** Fine crackles on inspiration; visible retractions
  - **Heart:** Distant sounds; irregular rhythm
  - **ROS:** 38lb weight loss in 4 months
  - **FH:** many family members with cancer (lung, breast, ovarian)

- **Labs:** WBC 10.9 Hct 34.9 BNP: 300
DDx of shortness of breath (SOB)

- Cardiac: CHF, MI, tamponade
- Respiratory: COPD, asthma, PE, PNTX, ILD, malignancy
- Iatrogenic: medications, aspiration
- Systemic: Sarcoidosis, SLE, anemia
- Infectious: pneumonia, allergy/exposures, bronchiectasis, bronchitis
Radiological Tests to evaluate SOB

- **X-ray**
  - AP, PA, lateral and decubitus

- **Chest CT**
  - Usually not indicated in the initial evaluation of patients with dyspnea

- **Less common studies**
  - WBC scan, PET scan, gallium scan, ultrasound

Source: UptoDate
Our Patient RS: CXR Day 1

PA chest x-ray
Our Patient RS: CXR Day 1

Film Findings:

1. Increased interstitial markings
2. Lung base infiltrate
3. Uniformly enlarged heart
4. Old rib fracture

PA chest x-ray
No significant change following diuresis and antibiotic therapy
The Chest CT

Relevant Indications

- **Further workup of abnormality seen on plain x-ray**
- Evaluation of recurrent or persistent pneumonia
- Evaluation of patients status post trauma
- Evaluation of chest organs for abnormalities
- Diagnosis, staging and follow-up of neoplastic or metastatic disease in the chest
- Chronic cough and dyspnea

Patient Preparation

- 1. NPO 3 hours prior to contrast administration
- 2. Renal function
- 3. IV peripheral access for administration contrast

Procedure

- **Patient lies supine through scanner**
- Conventional axial scanning may last up to 30 minutes, while helical scanning takes 10-15 minutes.
- High resolution CT (HRCT) uses very thin image slices to obtain higher resolution of the lung parenchyma than imaging with thicker slices. The exam lasts about 30 minutes.
Our Patient RS: CT of mediastinal infiltrate

Axial CT w/contrast (soft tissue window)
Our Patient RS: CT of hilar adenopathy

Axial CT w/contrast (soft tissue window)
Our Patient RS: CT of pericardial effusion

Axial CT w/contrast (soft tissue window)
Our Patient RS: CT of bronchial wall thickening

Axial CT w/contrast (lung window)
Our Patient RS: CT of ground glass opacity

Axial CT w/contrast (lung window)
Patient RS: CT of lobar atelectasis

Axial CT w/contrast (lung window)
Initial Patient Management

- Large pericardial effusion confirmed by transthoracic echocardiogram as having tamponade physiology
- Flexible bronchoscopy and left thoracotomy pericardial window with drainage of pericardial effusion (sent to cytology)
- Placed a left-sided chest tube, though on POD 1 patient had increasing respiratory distress
Our Patient RS: CXR after pericardial window

Worsening bilateral pleural effusions and bibasilar opacity

Patient subsequently transferred to BIDMC
Film Findings:
1. Left subclavian catheter into SVC
2. Bilateral pleural effusions (right>left)
3. Increased interstitial markings
4. Enlarged heart silhouette
5. Bibasilar atelectasis
6. Resolved subcutaneous emphysema; no chest tube

OSH pericardial effusion cytology malignant cells
**Our Patient RS: CT at BIDMC**

**Image Findings:**

1. **Ground glass opacity** in periphery of left upper lobe periphery (18 x 12mm)
2. **Pleural effusions** bilaterally (right>left)
3. **Cather** terminating in SVC
4. No dominant lung lesions seen

Axial CT without contrast (lung window)
Our Patient RS: CT with lymphangitic carcinomatosis

Image Findings:
1. **Pleural effusions** bilaterally (right >> left)
2. Cather terminating in SVC
3. **Nodular septal thickening**, including major fissure suggestive of lymphangitic carcinomatosis
4. Thickening of airways, particularly in RUL and suspicious nodules

Axial CT without contrast (lung window)
Lymphangitic Carcinomatosis (LC)

- Diffuse infiltration and obstruction of pulmonary parenchymal lymphatic channels by tumor.
- 80% are adenocarcinomas
- Prognosis is poor → most patients survive only weeks or months
- Sensitivity of CXR in the detection of LC is approximately 25%
- Imaging modality of choice is HRCT

http://emedicine.medscape.com/article/359006-overview
Our Patient RS: CT of mediastinal abnormalities

Image Findings

1. **Infiltration** in anterior mediastinal fat with increased density and nodularity
2. Thickened pericardium
3. Thickened aortic wall
4. **Improved** pericardial effusion

Sagittal CT without contrast (soft tissue window)
Our Patient RS: CT of mediastinal infiltrate

Film Findings:

1. Nodular thickening, infiltrative process of mediastinal fat with increased density.
2. Pleural effusions bilaterally (right>left)
3. Pericardial effusion improved

Axial CT without contrast (soft tissue window)
Anatomy of mediastinal lymph nodes

Our Patient RS: CT of paratracheal node

Right lower paratracheal lymph node (14 x 10mm)

Axial CT without contrast (soft tissue window)
Mediastinal Metastasis

- CT best modality in detection mediastinal lymphadenopathy → discrete densities
- Right paratracheal LN: Most frequently involved when patients have metastatic disease from extrathoracic neoplasms.

Coronal CT without contrast (soft tissue window)
DDx of metastatic adenoCA to chest

- Lung (*RS had no primary lung nodules)
- Pancreatic
- Gastric
- Colonic
- HCC
- RCC
- Prostate (urothelial type)
Radiology and Palliative Care

- In a patient with metastatic disease of unknown primary, ethical issues about which tests are necessary (diagnostically or therapeutically)

- Role of multiple modalities:
  - X-ray
  - CT/MRI → to locate primary malignancy
  - US → evaluation of DVTs
  - Nuclear Medicine → bone scans to find metastasis
  - Interventional Radiology → stent or palliative chemotherapy ports placements
Sagittal US image showing predominantly heterogeneous, hypoechoic lumen (blood) expanding non-compressible left axillary vein (site of previous contrast injection). RS had been on maximal anticoagulation therapy.
Anatomy of upper extremity veins
Our Patient RS: US of axillary vein DVT

Sagittal US Doppler showing absence of wall to wall flow (red) in left axillary vein, consistent with occlusion
Film Findings:
1. Tracer uptake in both scapula (DJD vs metastasis)
2. Increased uptake in left femur

How does one further evaluate an abnormal area of tracer uptake?
Our Patient RS: X-ray left femur

- Follow up X-ray shows normal bone morphology.
- However, up to 40% bone loss may be present before metastasis appear on plain film.
- Interventions on a potential pathologic fracture when x-ray is normal?
**Mirel’s Criteria for pathological fracture scoring**

Useful for evaluating plain films of metastatic lesions. Radiograph is scored based on factors in table below, assessing need for orthopedic intervention.

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<th>Points</th>
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<tr>
<td>Location</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Perrtrochanteric</td>
<td>Lower extremity</td>
<td>Upper extremity</td>
<td></td>
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<tr>
<td>Type of lesion</td>
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<td></td>
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</tr>
<tr>
<td>Lytic</td>
<td>Mixed</td>
<td>Blastic</td>
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<tr>
<td>Cortical extent</td>
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<tr>
<td>&gt;2/3</td>
<td>1/3- 2/3</td>
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<td>Pain</td>
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<th>9</th>
<th>10</th>
<th>11</th>
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<td>Fracture (%)</td>
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<td>4</td>
<td>15</td>
<td>33</td>
<td>72</td>
<td>96</td>
<td>100</td>
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<7 no internal fixation; =8 consider CT; >9 internal fixation

Our Patient RS: Follow up

- Orthopedics deemed left femoral fracture not a good candidate for internal fixation
- Patient discharged to home hospice care, ambulating
- Follow up arranged with medical oncology for palliative chemotherapy
Summary

- Work up of shortness of breath with radiological correlations
- Abnormal chest findings (tamponade and metastatic cancer)
- Role of radiology in palliative care decision making
  - Menu of tests
  - Anatomy review
  - Patient RS as an example
Acknowledgements

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UptoDate