

May 2022 Imaging Case of the Month: Asymmetric Apical Opacity–Diagnostic Considerations

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Clinical History: A 64-year-old woman presented to the emergency room with complaints of right arm pain for 2 months accompanied by subjective low-grade intermittent fevers.

The patient's past medical history was unremarkable and she had never had surgery. She had been a smoker for most of her life, at least 25-pack-years. She denied allergies, admitted to moderate daily alcohol use, and denied illicit drug use.

The patient's physical examination showed no clear focal abnormalities and she was afebrile. She did have some right scapular tenderness to palpation, although there were no abnormal skin changes over this region. Her pulse rate and blood pressure were within normal limits, and her room air oxygen saturation was 96%. Basic laboratory data, including a complete blood count and electrolytes were largely within the normal range. The patient's white blood cell count was technically abnormal at 9.7×10^9 (normal, $3.4 - 9.6 \times 10^9$), but there was no left shift and the treating emergency room physician felt the mildly elevated white blood cell count was of no clinical significance.

Frontal and lateral chest radiography (Figure 1) was performed.

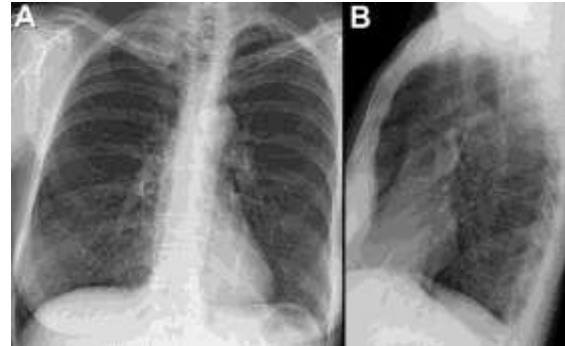


Figure 1. Frontal (A) and lateral (B) chest radiography.

Which of the following represents an appropriate interpretation of her frontal chest and lateral radiograph?

1. Frontal chest radiography shows multifocal consolidation
2. Frontal chest radiograph shows numerous small nodules
3. Frontal chest radiography shows a focal mass
4. Frontal chest radiography shows a destructive bone lesion
5. Frontal chest radiography shows pleural effusion

Correct!

3. Frontal chest radiography shows a focal mass

The frontal and lateral chest radiograph (Figure 1) shows normal heart size and no focal consolidation or evidence of pleural effusion. Lung volumes are normal. A focal opacity without air bronchograms is present

in the right apex, but no clear bone destruction in this region or elsewhere is seen (Figure 2). No nodules are present, nor is multifocal consolidation.

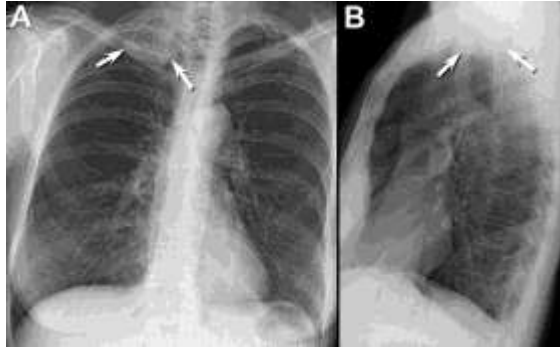


Figure 2. Frontal (A) and lateral (B) chest radiography shows a focal opacity (arrows) without air bronchograms is present in the right apex.

Which of the following represents *the least likely consideration* for the patient's imaging findings?

1. Bronchogenic malignancy
2. Bacterial pneumonia
3. Subclavian artery pseudoaneurysm
4. Neurogenic neoplasm
5. Plasmacytoma

Correct!

2. Bacterial pneumonia

Bacterial pneumonia can occasionally appear rounded and focal, a presentation commonly encountered in pediatric patients. However, as an air space filling process, bacterial pneumonias often show poorly defined margins and air bronchograms, and the latter are conspicuously lacking in this circumstance. The other listed conditions may have a very similar appearance to the patient's presenting frontal chest radiograph see Figure 2. Finally, the patient's presenting complaints are not suggestive of bacterial lung infection.

Which of the following represents *the most appropriate next step* for the patient's management?

1. Follow up / repeat chest radiography
2. Comparison to prior chest radiographs
3. Lateral decubitus chest radiography
4. ¹⁸F-DG-PET scan
5. Unenhanced chest CT

Correct!

2. Comparison to prior chest radiographs

The first course of action when many lesions are discovered at chest imaging is typically to compare the current study to older, prior examinations to assess for stability. While the lesion in the right upper thorax in this patient's chest radiograph could be aggressive, as shown in Figure 3C, indolent lesions may present quite similarly; in that figure (Figure 3C), the neurogenic neoplasm (a schwannoma) closely resembles the patient's presentation frontal chest radiographic finding, and many neurogenic neoplasms in adults, particularly schwannomas, are not cause for alarm in most circumstances.

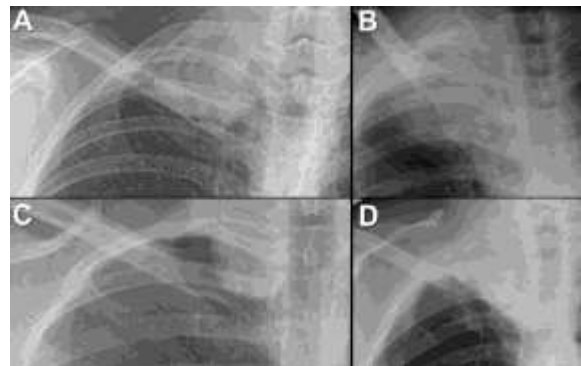


Figure 3. Focused frontal chest radiographs showing (A) The current patient (see Figure 1A); (B) a right subclavian artery pseudoaneurysm in an intravenous drug user;

(C) neurogenic neoplasm (schwannoma), and; (D) plasmacytoma.

Should the right apical lesion be stable for several years, the further diagnostic approach would be altered.

An older chest radiograph from 7 years earlier was located for comparison (Figure 4).



Figure 4. The current frontal chest radiograph (A) compared with a prior frontal chest radiograph performed 7 years earlier (B).

Which of the following represents an appropriate next step for the patient's management?

1. Perform enhanced chest CT
2. Perform CT pulmonary angiography
3. Repeat chest radiography
4. Perform ¹⁸FDG-PET scan
5. Perform contrast-enhanced cardiac MRI

Correct!

1. Perform enhanced chest CT

The previous frontal chest radiograph from 7 years earlier is of good quality and shows no abnormality; the abnormal chest radiographic findings are new since that prior study.

Although the patient does complain of some arm pain, there are no features that suggest either risk factors or clinical features suggestive of acute pulmonary embolism.

Enhanced chest CT is a good choice for the next step in this patient's evaluation, but that study should be performed with appropriate timing for the evaluation of the right-sided chest mass, and a CT pulmonary angiogram typically employs contrast injection timing optimized for pulmonary arterial enhancement, which results in suboptimal assessment of other aspects of chest anatomy, such as the mediastinum and pericardial and pleural surfaces; therefore, CT pulmonary angiography technique should not be performed. Repeat chest radiography would be an appropriate choice for low-risk lesions in an imaging-clinical concordant situation, such a focal chest radiographic finding suggesting pneumonia in a patient with cough and fever. In such circumstances, repeat chest radiography to assure resolution of the chest radiographic finding is appropriate. Cardiac MRI would not be an appropriate examination for this patient as that examination restricts evaluation to the immediate area surrounding the heart, and would therefore not include the right apical opacity in the field of view. Chest MRI could prove useful for this patient, but typically is performed after chest CT assessment has been conducted and found to be indeterminate. Similarly, ¹⁸FDG-PET scan may be of value for this patient's evaluation, but is premature at this point and is typically employed in the context of previous chest CT assessment.

The patient underwent enhanced chest CT (Figure 5).

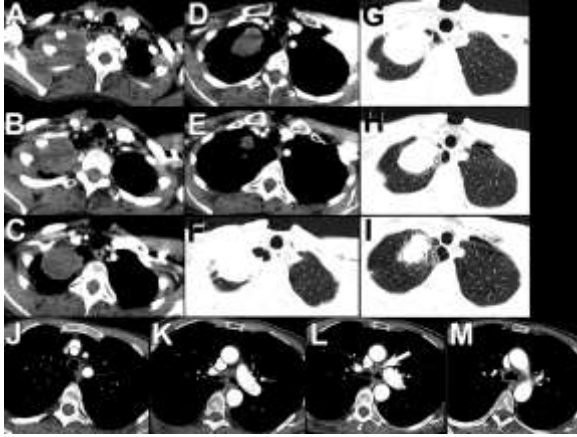


Figure 5. Axial enhanced chest CT displayed in soft tissue (A-E) and lung (F-I) windows. ([Click here to view Figure 5 in a new window.](#) [Click here to view video of CT scan in soft tissue windows.](#))

Which of the following represents an appropriate interpretation for this examination?

1. Chest CT shows findings suspicious for an extraparenchymal lesion
2. Chest CT shows findings suggestive of fungal pneumonia
3. Chest CT shows suggestive of bacterial pneumonia
4. Chest CT findings are suggestive of primary pulmonary neoplasia
5. Chest CT shows findings suggestive of lipoid pneumonia

Correct!

4. Chest CT findings are suggestive of primary pulmonary neoplasia

The enhanced chest CT shows a right apical mass in close contact with the chest wall over the right lung apex. The lesion shows central low attenuation but no air bronchograms. Unlike fungal pneumonias, such as coccidioidomycosis, no surrounding satellite nodularity is present. No fat within the lesion is evident to suggest lipoid pneumonia as a possible etiology. The lesion could arise from

the extraparenchymal soft tissues of the thorax, including the pleura (such as a solitary fibrous tumor of the pleura), intercostal neurovascular bundle (subclavian artery pseudoaneurysm and neurogenic lesion- see Figures 3B and C), or adjacent soft tissue or lymphoid tissue (see Figure 3D). However, the lesion in this circumstance appears centered in the apical lung parenchyma, as shown to advantage using multiplanar evaluation using sagittal and coronal planes (Figure 5)- these images show that the lesion makes relatively obtuse angles with the adjacent chest wall, rather than the more acute angles that would be expected for a lesion arising from an extraparenchymal location.

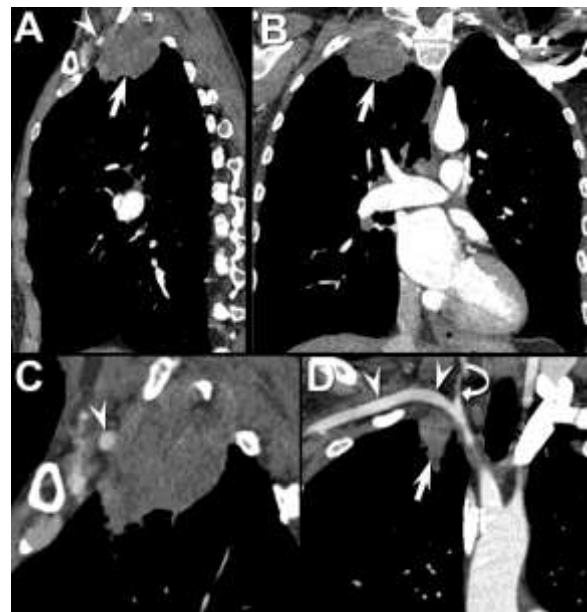


Figure 6. Sagittal (A and C) and coronal (B and D) enhanced chest CT images.

Based on the findings at enhanced chest CT, which of the following represents an appropriate next step for the evaluation of this patient?

1. CT-guided percutaneous lung biopsy of the right apical lesion
2. ¹⁸F-FDG-PET/CT scan

3. Pulmonary medicine consultation
4. Chest MRI
5. More than one of the above

Correct!

5. More than one of the above

All of the above choices are reasonable and more than one of the above could be chosen as the next step in the evaluation for this patient.

Testing for coccidioidomycosis was negative. The patient underwent ¹⁸F-FDG-PET/CT scanning (Figure 7).

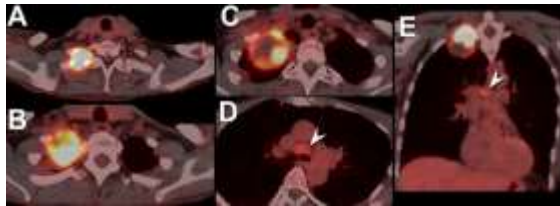


Figure 7. Axial (A-D) and coronal (E) ¹⁸F-FDG PET/CT.

Which of the following represents an appropriate interpretation for this examination?

1. The ¹⁸F-FDG-PET/CT scan shows the right apical lesion is *not* metabolically active
2. The ¹⁸F-FDG-PET/CT scan shows the right apical lesion is the *only* metabolically active abnormality
3. The ¹⁸F-FDG-PET/CT scan shows more than one site of metabolically active abnormality
4. The ¹⁸F-FDG-PET/CT scan is technically limited and does not provide diagnostically useful information
5. None of the one of the above

Correct!

3. The ¹⁸F-FDG-PET/CT scan shows more than one site of metabolically active abnormality

The ¹⁸F-FDG-PET/CT scan shows that the right apical lesion is metabolically active, with central areas that are relatively photopenic, correlating with the possibility of necrosis noted at enhanced chest CT. An additional site of metabolic activity is identified in the right paratracheal region, anterior to the carina, consistent with the enlarged lymph node in this region at enhanced chest CT.

Based on the information thus far, which of the following represents the most likely diagnosis for the patient's condition?

1. Lymphoproliferative disorder
2. Fungal infection
3. Inflammatory myofibroblastic tumor
4. Neuroendocrine neoplasm
5. Bronchogenic malignancy

Correct!

5. Bronchogenic malignancy

The presence of a metabolically active right apical lung mass with metabolically active right paratracheal lymphadenopathy in an older smoker is highly suspicious for primary bronchogenic malignancy.

Lymphoproliferative disorder is not entirely excluded, but in non-immunocompromised adults, lymphoproliferative disease arising from the lung is relatively rare, and when presenting in a primarily extranodal fashion, the presence of noncontiguous lymphadenopathy also is unusual. No imaging or clinical evidence points towards fungal infection. A neuroendocrine neoplasm, particularly large cell neuroendocrine malignancy, would appear very similar to this patient's lesion and remains a consideration, but is less common than primary bronchogenic malignancy. Similarly,

inflammatory myofibroblastic tumor could also present in this fashion, although the lymphadenopathy is not typical of that rare disorder.).

Based on the information available thus far, which of the following represents *the best choice* for establishing the diagnosis and furthering management in this patient?

1. CT-guided percutaneous lung biopsy of the right apical lesion
2. Pleuroscopy
3. Pulmonary medicine consultation for bronchoscopy
4. Chest MRI
5. Video-assisted thoracoscopic surgery

Correct!

3. Pulmonary medicine consultation for bronchoscopy

Several of the listed choices are appropriate steps for establishing the diagnosis for the right apical mass in this patient. However, given the suspicion for neoplasia, the *least* invasive method for establishing the diagnosis *and simultaneously* staging the suspected malignancy is bronchoscopy with endobronchial ultrasound directed towards sampling the enlarged, metabolically active right paratracheal lymph node. Video-assisted thoracoscopic surgery could also provide simultaneous sampling of both the right apical lesion and the enlarged right paratracheal lymph node, but is more invasive than bronchoscopy and thus may be avoided if bronchoscopic evaluation successfully establishes a diagnosis for the lung lesion and mediastinal lymphadenopathy. Pleuroscopy could not provide the diagnostic and potential staging information needed for this patient, and CT-guided transthoracic biopsy could establish the etiology of the right apical mass, but could not address the right paratracheal lymph node etiology. Chest MRI could

provide useful information regarding the behavior of the right apical lesion but would not obviate the need for a tissue diagnosis.

The patient was referred to pulmonary medicine for further evaluation and bronchoscopy was performed. No endobronchial abnormalities were present. The right paratracheal lymphadenopathy seen at chest CT and ¹⁸F-FDG-PET scan was identified at endobronchial ultrasound and was biopsied and the right apical lesion was also sampled. Squamous cell carcinoma was found in the right apical lesion, but sampling of the right paratracheal lymphadenopathy was negative for malignancy.

Which of the following represents *an appropriate next* step for the patient's management?

1. Perform rigid bronchoscopy
2. Perform mediastinoscopy
3. Perform video-assisted thoracoscopic surgery
4. Proceed to surgical resection via thoracotomy
5. Begin radiotherapy

Correct!

2. Perform mediastinoscopy

In the presence of a known metabolically active lung neoplasm, the metabolically active right paratracheal lymphadenopathy must be regarded as potentially metastatic despite the negative results at bronchoscopy with endobronchial ultrasound-guided sampling. In patients with primary lung malignancy, the prevalence of malignancy in metabolically active lymph nodes that are also enlarged at CT is very high and therefore the negative results at bronchoscopic sampling require confirmation with lymph node resection. Such resection can occur at the time of thoracotomy in properly selected patients, but this patient's right paratracheal

lymphadenopathy, if malignancy were proven at this site, would change her staging (tumor measuring 5.2 cm) from T3N0 (stage IIB) to T3N2 (Stage IIIB)- i.e., from potential surgical resection to either no surgery or initial chemoradiation followed by re-staging and reconsideration for surgical resection. Proper staging is required before initiating definitive therapy, including surgery, radiotherapy, and/or chemotherapy. Cervical mediastinoscopy, given the location of the enlarged right paratracheal lymph node, is preferable to video-assisted thoracoscopic approach.

Thoracic surgery was consulted and performed cervical mediastinoscopy. Pathological analysis of the resected lymph nodes showed no evidence of malignancy.

What other *information / testing is required* before determining an appropriate course of therapy for this patient's malignancy?

1. Brain MRI
2. Bone scan
3. Pulmonary function testing
4. Brachial plexus MRI
5. All of the above

Correct!
5. All of the above

The completion of the patient's staging should include brain MRI and bone scan to assess for distant metastatic disease, although the bone scan could potentially be omitted in light of the ¹⁸F-DG-PET results showing no osseous metastatic disease. Pulmonary function testing would be required to assess the patient's ability to undergo pulmonary resection. Finally, brachial plexus MRI is required to determine if the right apical neoplasm is resectable, in light of the patient's right upper extremity complaints, because it is possible the tumor is invading and involving the brachial plexus-

involvement of the brachial plexus, (C8 or above), would increase the patient's T stage from T3 to T4.

The patient's brain MRI and bone scan were negative, and her pulmonary function testing showed moderate obstruction and mildly decreased diffusion capacity with normal resting oximetry, not precluding surgery. She underwent brachial plexus MRI (Figure 7), which showed that the right apical lesion was in close proximity to and displacing the inferior trunk of the plexus, but no encasement or clear evidence of nerve involvement was seen.

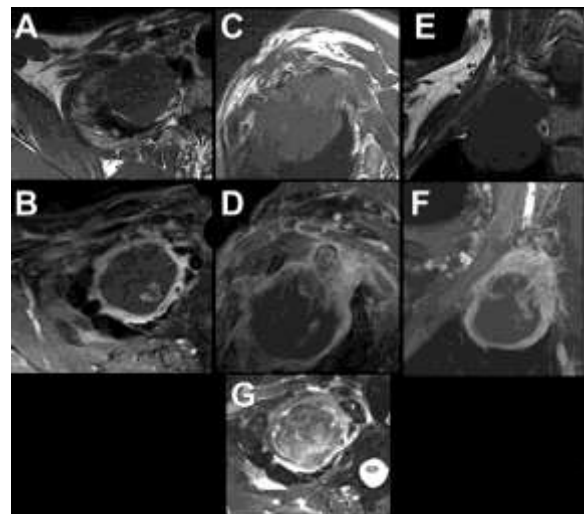


Figure 8. Brachial plexus MRI.

The patient successfully completed several rounds of chemoradiation (carboplatin/paxlitaxel and 60 Gy) and subsequently underwent surgical resection of the right apical squamous cell neoplasm; a chest wall resection involving the posterior ribs and transverse processes of T1-3 was performed with neurosurgical assistance as well. The patient recovered uneventfully and remains recurrence-free 1.5 years later.

Diagnosis: Superior sulcus (Pancoast) tumor

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