

## January 2014 Imaging Case of the Month

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### *Clinical History*

A 77-year-old man presented for an executive health physical. His past medical history was significant for coronary artery disease, renal stones, gout, and a left nephrectomy for clear cell renal carcinoma 17 years earlier. Chest radiography (Figure 1) was performed. Prior chest radiographs from the previous year (Figure 2) and 7 years earlier (Figure 3) are shown for comparison.

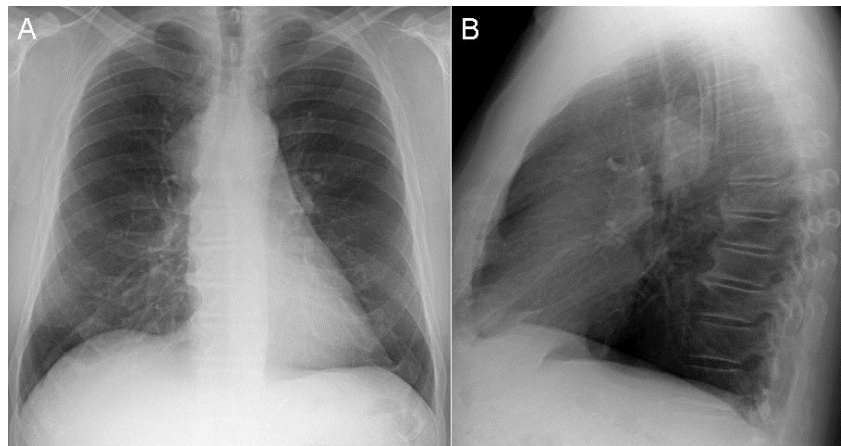


Figure 1. Frontal (A) and lateral (B) chest radiography.

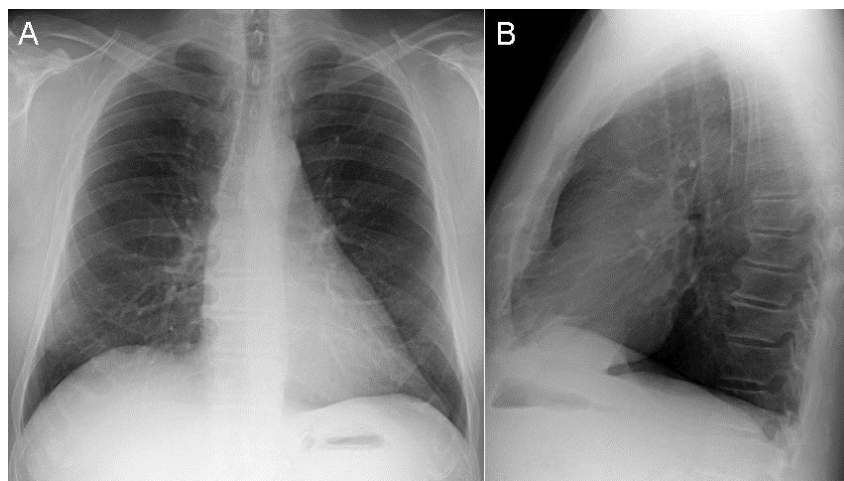


Figure 2. Frontal (A) and lateral (B) chest radiography performed one year prior to presentation.

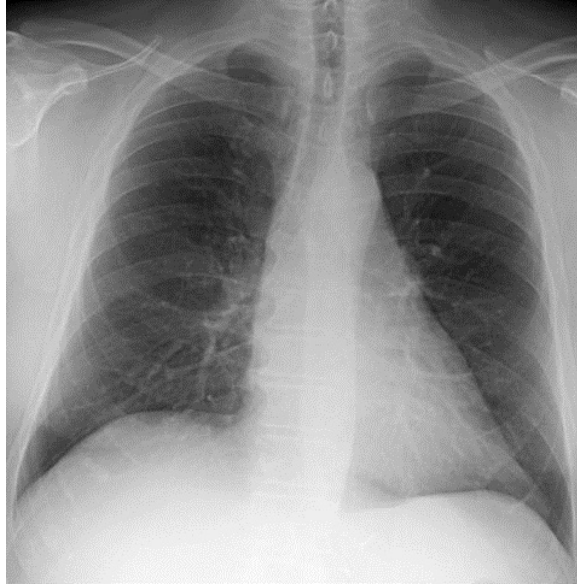


Figure 3. Frontal chest radiography performed 7 years prior to presentation.

Which of the following statements regarding the chest radiograph is **most accurate**?

1. The chest radiograph shows a mass
2. The chest radiograph shows an unusual cardiac configuration
3. The chest radiograph shows basal predominant linear opacities suggesting fibrosis
4. The chest radiograph shows multifocal ground-glass opacity and consolidation associated with linear and reticular abnormalities
5. The chest radiograph shows multiple nodules

**Correct!**

**1. The chest x-ray shows a mass**

The chest radiograph shows a mass along the right mediastinum at the level of the thoracic aortic arch (Figure 4).

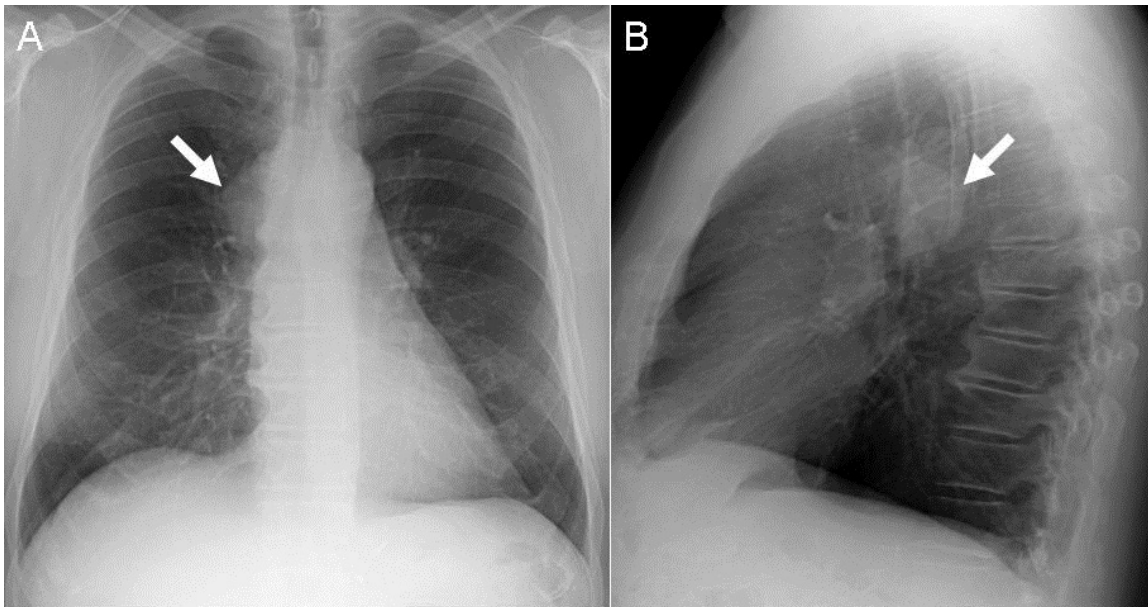


Figure 4. Frontal (A) and lateral (B) chest radiography shows a smoothly contoured, finely lobulated mass along the right paratracheal region (arrow, A), overlying the posterior aortic arch in the lateral projection (arrow, B). On the lateral radiograph, the mass projects over the posterior aortic arch, suggesting a middle mediastinal location. The lesion is new from the remote prior chest radiograph (Figure 3) and new or at least increasing from one year previously (Figure 2). The lungs appear clear- no nodules, areas of ground-glass opacity, or consolidation are evident, nor are there linear or reticular abnormalities or features to suggest fibrotic lung disease. The heart size and configuration appear normal.

Which of the following is the **least appropriate consideration** among the differential diagnostic possibilities for the appearance of the patient's chest radiograph?

1. Aneurysm
2. Lymphoma
3. Neurogenic tumor
4. Solitary fibrous tumor of the pleura
5. Thymic malignancy

**Correct!**  
**5. Thymic malignancy**

The chest radiographic characteristics of the lesion are consistent with an extraparenchymal process- the lesion is fairly smoothly margined, with a broad contact with the mediastinal pleura and mediastinum, and if one “extrapolates” into a circle the right lateral convex margin of the lesion, the center of the extrapolated circle projects within the mediastinum. Pleural lesions, however, because they are also extraparenchymal, may appear similar, and therefore, a solitary fibrous tumor of the pleura originating from the mediastinal pleural surface is possible. The lesion overlies the thoracic aortic arch on the lateral study, placing it in the middle mediastinum- therefore, lymphoma and aneurysm are both reasonable considerations. While neurogenic tumors most commonly are found in the posterior mediastinum, such a lesion arising along the course of the vagus nerve could present in this fashion, and therefore choice 3. Neurogenic tumor- remains a possibility. Thymic lesions arise from the anterior mediastinum and therefore a thymic malignancy is the least likely among the considerations presented.

The patient underwent thoracic CT (Figure 5) for further characterization of the chest radiographic findings.

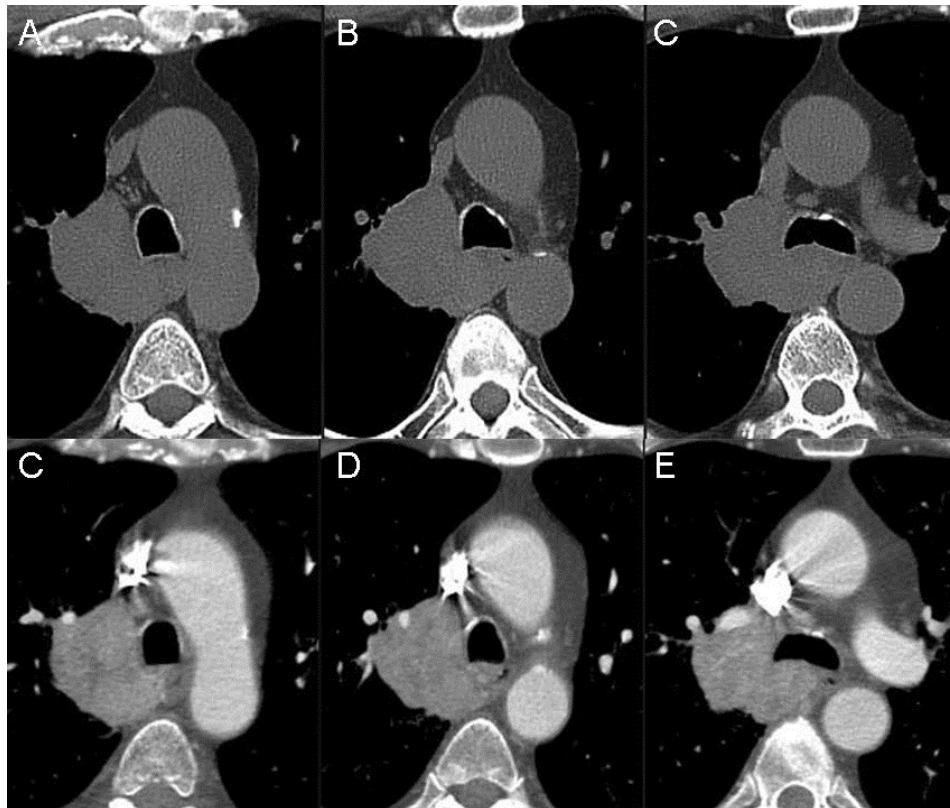


Figure 5. Axial thoracic CT images displayed in soft tissue windows prior to (A-C) and following (D-F) intravenous contrast administration.

Which of the following statements regarding this CT examination is **most accurate**?

1. The thoracic CT shows that the lesion does not enhance and is therefore non-vascular in nature
2. The thoracic CT shows that the right thoracic lesion seen at chest radiography is located entirely within the lung
3. The thoracic CT shows that the right thoracic lesion seen at chest radiography is related to a vascular structure
4. The thoracic CT shows that the right thoracic lesion seen at chest radiography is cystic in nature
5. The thoracic CT shows that the right thoracic lesion seen at chest radiography is solid and enhancing



**Correct!**

**5. The thoracic CT shows that the right thoracic lesion seen at chest radiography is solid and enhancing**

The lesion first seen at chest radiography is enhancing- note the attenuation of the lesion prior to contrast administration (Figure 5A-C) compared with the images following contrast administration (Figure 5D-F) - a clear attenuation increase is present. The lesion is solid, showing soft tissue attenuation; no low attenuation within the lesion to suggest cystic change or necrosis is present. The lesion clearly resides within the mediastinum, at least in part- note the close contact with the right lateral wall of the trachea and obliteration of the fat usually present in this area. However, the lateral aspect of the lesion shows features suggesting some extension into lung- note how the lesion approaches and contacts right upper lobe segmental vasculature (see Figure 5D). The lesion therefore is closely related to the right mediastinal pleura as well. The lesion does not enhance to the same degree of mediastinal arteries or veins, nor is any connection to such structures present.

The patient then underwent 18FDG-PET scanning (Figure 6), which showed significant hypermetabolism within the lesion.

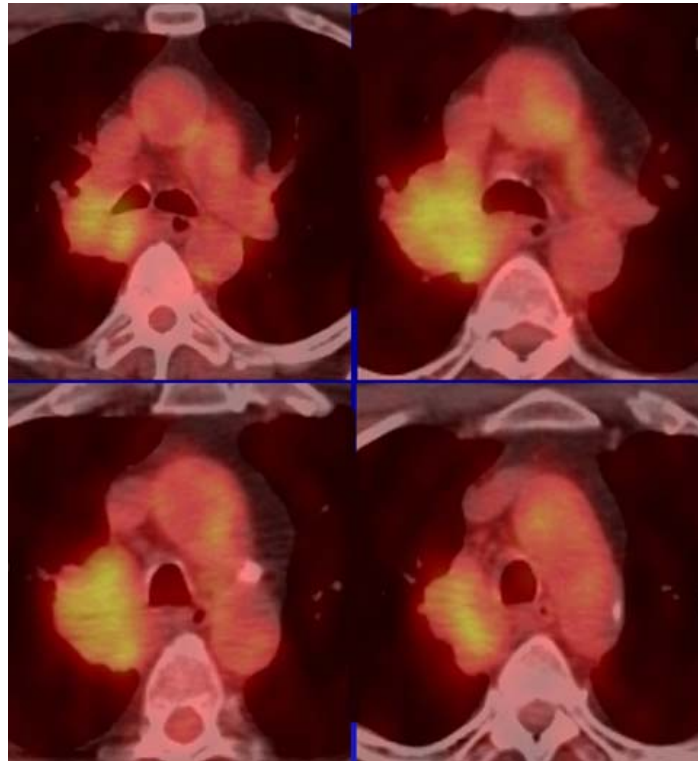


Figure 6. Axial 18FDG-PET images show that the right thoracic lesion is hypermetabolic (compare activity within the lesion to mediastinal blood pool activity).

What is the **appropriate next step** for the evaluation / management of this patient?

1. Cervical mediastinoscopy
2. Left anterior mediastinotomy (Chamberlain procedure)
3. Open surgical lung biopsy
4. Serial imaging to assess for change
5. Transthoracic fine needle aspiration biopsy

**Correct!**

### **1. Cervical mediastinoscopy**

The lesion could be approached through bronchoscopy with transbronchial biopsy, although cervical mediastinoscopy is probably the single best procedure for obtaining material sufficient for diagnosis. Open surgical biopsy certainly could also obtain the tissue required for diagnosis, but is needlessly invasive. The lesion is not readily accessible to transthoracic fine needle aspiration biopsy. A left anterior mediastinotomy procedure (Chamberlain procedure) provides access to the left mediastinum and subaortic region, but would not be appropriate for obtaining tissue from this lesion. Serial imaging to assess for change plays no role in the management for this patient, given the size of the lesion and the fact that it is potentially new or has shown growth over the previous year.

Cervical mediastinoscopy was performed. What is the **most likely diagnosis**?

1. Castleman disease (angiofollicular hyperplasia)
2. Lymphadenopathy
3. Lymphoma
4. Metastatic melanoma
5. Metastatic renal cell carcinoma



**Correct!**

## **5. Metastatic renal cell carcinoma**

All of the provided choices are reasonable possibilities for the diagnosis in this patient, although lymphoma typically does not display such extensive vascularity. Given the patient's prior history, metastatic renal cell malignancy is the most likely diagnosis among the choices provided.

Diagnosis: Metastatic renal cell carcinoma to mediastinum with medial right lung invasion

### ***Discussion***

Renal cell carcinoma may metastasize widely, and the potential thoracic manifestations of metastatic renal cell carcinoma are protean. Typical thoracic manifestations of renal cell malignancy include lymphadenopathy, lung nodules, pleural nodules and effusion, and lytic foci within the osseous structures of the thorax. Renal cell carcinoma has a recognized propensity for metastasizing to mediastinal lymph nodes, which may occur in the absence of metastatic disease to the lungs, hilar lymph nodes, pleura, or osseous structures of the thorax (Figure 7).

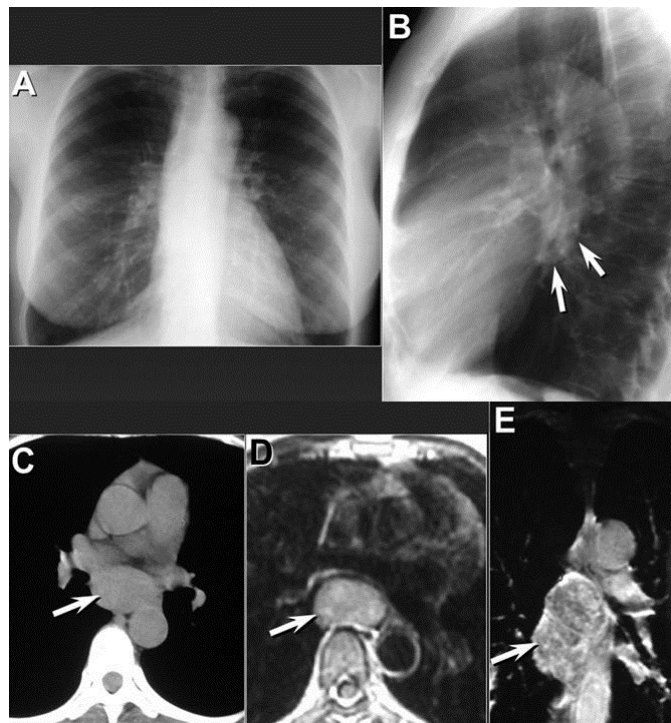


Figure 7. Thoracic manifestations of renal cell carcinoma: subcarinal without other mediastinal or hilar lymph node enlargement, lung nodules, pleural abnormality, or osseous disease in a 61-year-old woman who provided a history of resection of a “benign” renal lesion in Russia 15 years prior to presentation.

Frontal (A) and lateral (B) chest radiography shows a subtle contour abnormality (arrows) only faintly visible on the lateral projection. Unenhanced axial CT (C) and axial T1-weighted (D) and coronal dynamic contrast enhanced MRI (E) images show a solid, enhancing lesion (arrow) in the subcarinal space corresponding to the radiographic abnormality. Bronchoscopic transbronchial biopsy was attempted but did not provide diagnostic tissue. Subsequently, surgical biopsy proved renal cell carcinoma.

Similarly, metastatic renal cell carcinoma may spread to hilar lymph nodes without affecting mediastinal lymph nodes, the lungs, pleura, or osseous structures of the thorax (Figure 8), possibly through retrograde lymphatic flow from the thoracic duct or through the lymphatics within the inferior pulmonary ligament.

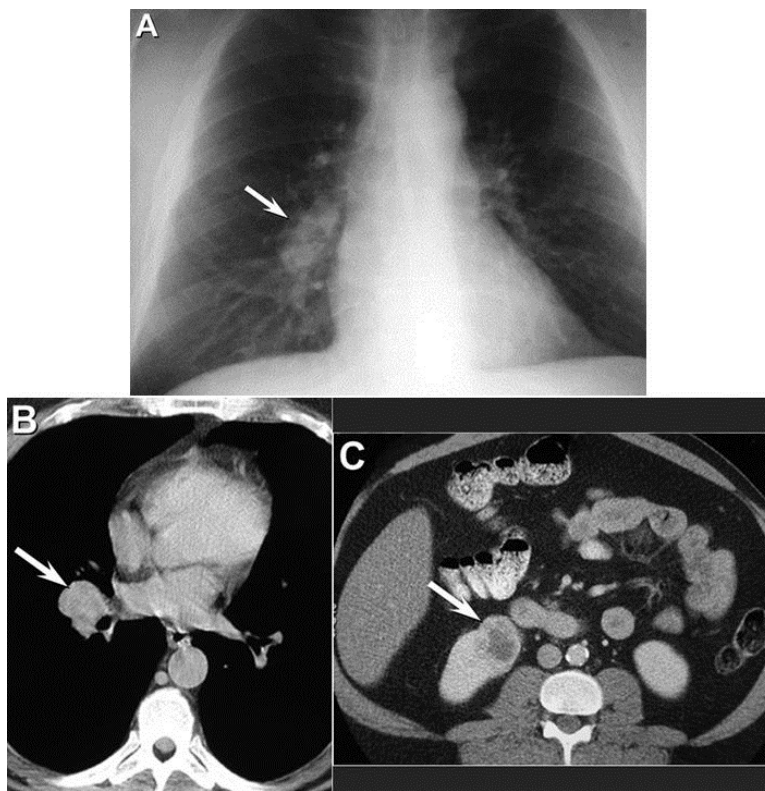


Figure 8. Thoracic manifestations of renal cell carcinoma: right hilar without mediastinal lymph node enlargement, lung nodules, pleural abnormality, or osseous disease in a 63-year-old man with a brain lesion thought to represent primary intracranial malignancy. During craniotomy, the surgeon noted a densely hemorrhagic mass thought to be unusual for the presumed glioblastoma and the operation was halted. Frontal chest radiography (A), a pre-operative study whose results were not reviewed prior to surgery, shows enlargement of the right hilum (arrow), suggesting lymphadenopathy. Axial contrast-enhanced thoracic CT (B) confirms right hilar lymphadenopathy (arrow). CT of the abdomen (C) shows a solid, centrally necrotic mass (arrow) representing renal cell carcinoma.

Thoracic metastatic lymphadenopathy due to renal cell carcinoma often results in lymph nodes showing soft tissue attenuation, but occasionally metastatic lymphadenopathy from renal cell carcinoma may show significant hypervascularity (Figure 9A-D). Occasionally internal necrosis within lymph nodes or lung nodules (Figure 9E and F) may be seen.

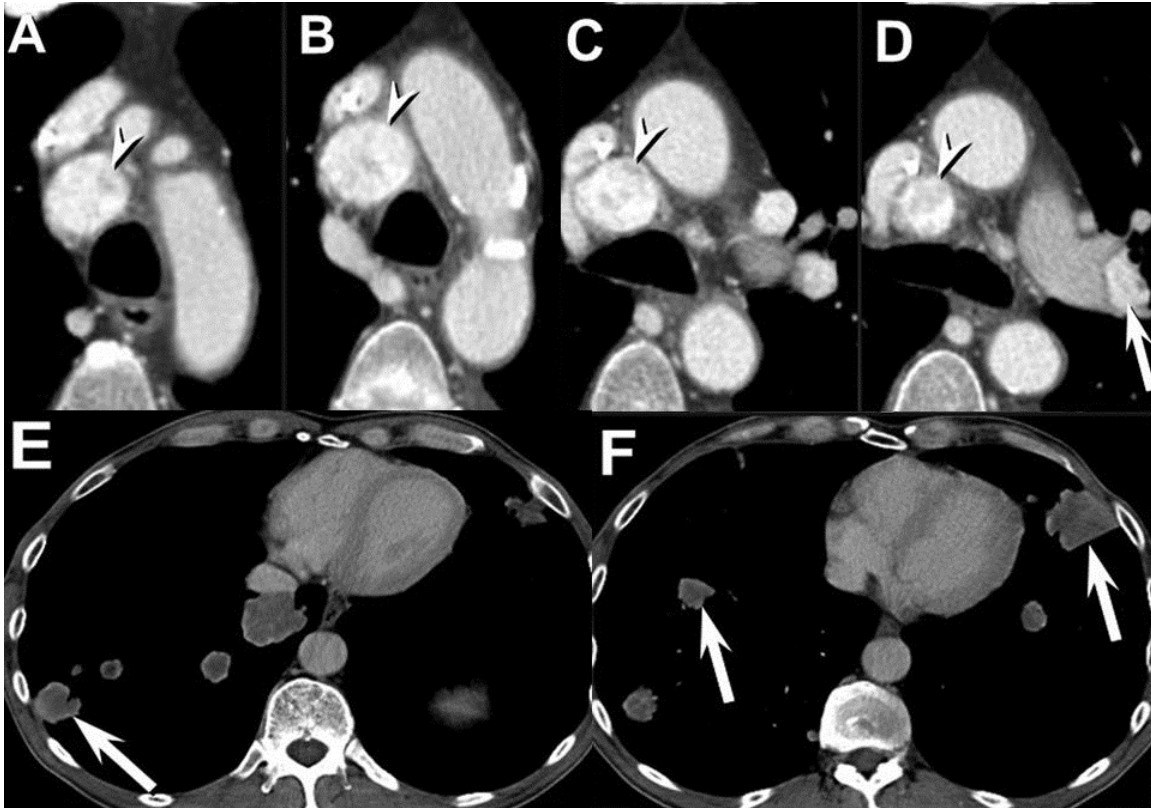


Figure 9. Thoracic manifestations of renal cell carcinoma: variable vascular patterns. Axial contrast-enhanced thoracic CT (A-D) shows extremely hypervascular mediastinal (arrowhead) and left peribronchial (arrow) lymphadenopathy. Axial contrast-enhanced thoracic CT (E and F) in another patient shows necrotic metastatic lung nodules (arrowheads).

Renal cell carcinoma also has a recognized tendency to cause endobronchial metastases (Figure 10).

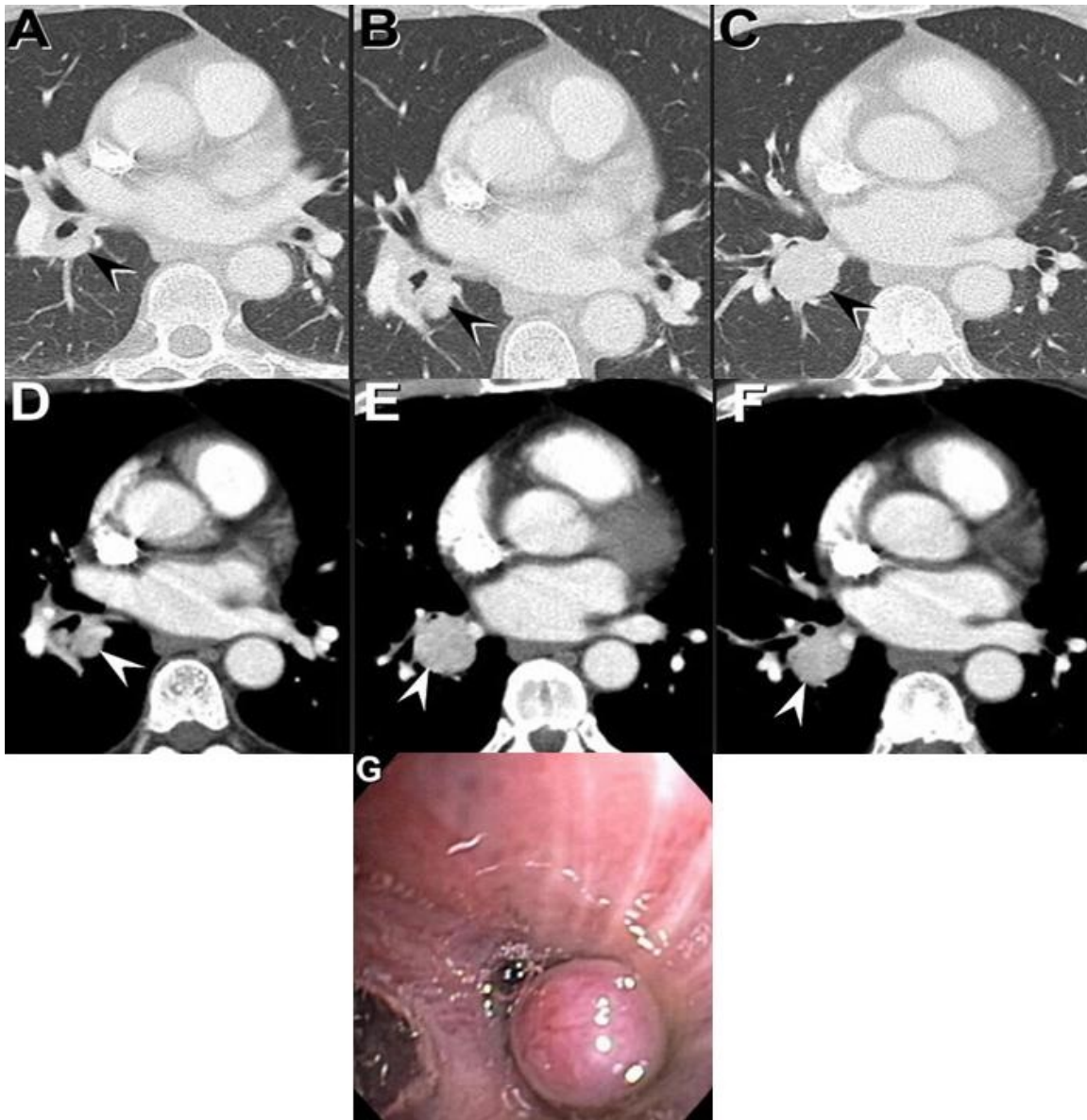


Figure 10. Thoracic manifestations of renal cell carcinoma: endobronchial metastases. Axial contrast-enhanced thoracic CT displayed in lung (A-C) and soft tissue (D-F) windows shows a hypervascular endobronchial lesion (arrowheads) arising from the proximal right lower lobe bronchus. Bronchoscopic image (G) shows the metastatic endobronchial lesion.

Metastatic lung nodules are a common manifestation of thoracic metastatic disease from renal cell carcinoma, and occasionally the nodules may be quite large or very small, the latter possibly producing a “miliary” appearance (Figure 11).



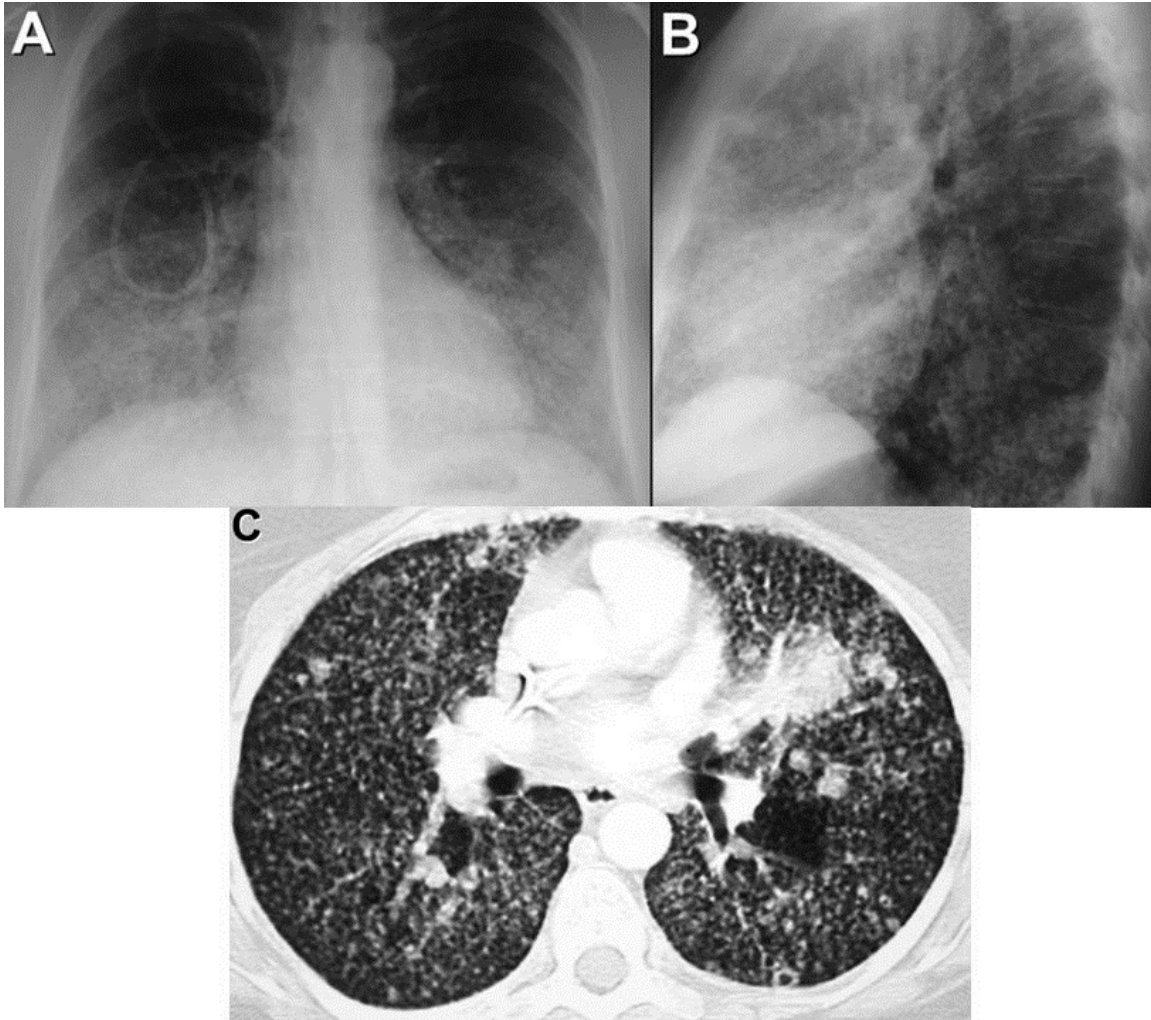


Figure 11. Thoracic manifestations of renal cell carcinoma: miliary metastases. Frontal (A) and lateral (B) chest radiography in a patient with metastatic renal cell malignancy shows numerous small circumscribed nodules, consistent with a miliary pattern, found to represent miliary renal cell carcinoma metastases. Axial thoracic CT displayed in lung windows (C) shows numerous small nodules consistent with a miliary pattern. The appearance is relatively non-specific and could be seen with disseminated infection, although the larger nodules, particularly the lingular lesion, are more suggestive of a malignant process.

Finally, renal cell malignancy may cause tumor emboli, possibly as a result of renal vein invasion (Figure 12).

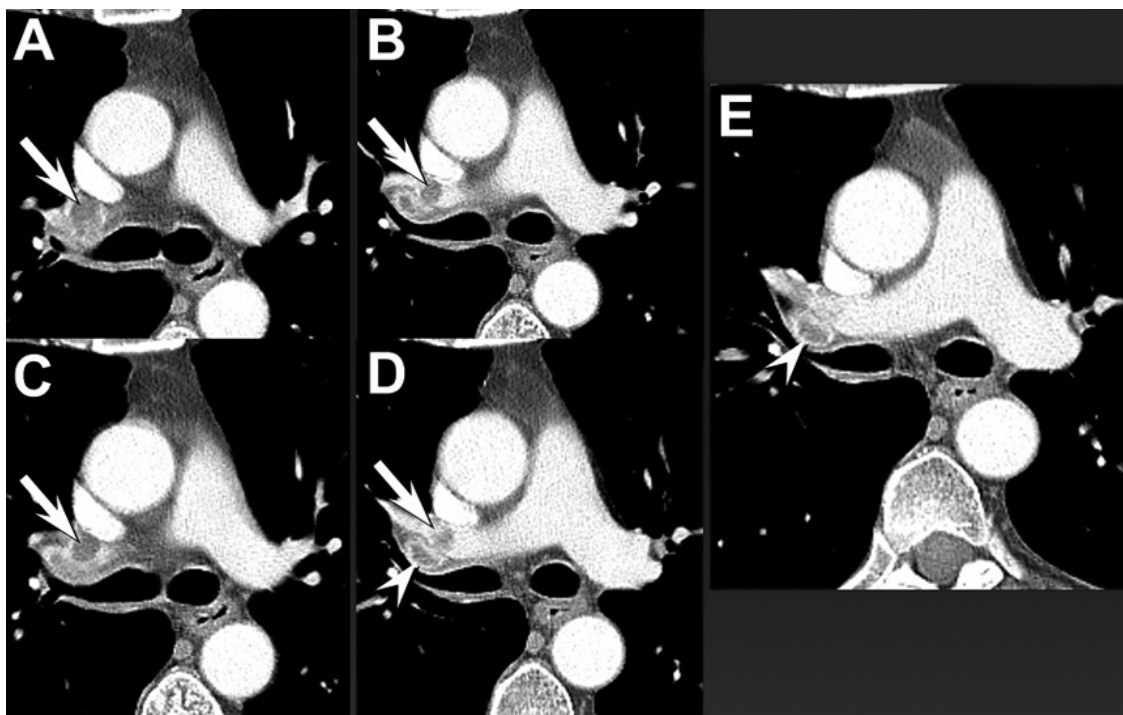


Figure 12. Thoracic manifestations of renal cell carcinoma: endovascular metastases. Axial contrast-enhanced thoracic CT (A-D) in a patient with metastatic renal cell carcinoma shows tumor emboli (arrows) in the right upper lobe artery. A centrally necrotic, peripherally enhancing right hilar metastatic lymph node (arrowheads) is present also.

Metastatic disease developing years following apparent curative resection of a renal malignancy is also a recognized phenomenon in patients with renal cell malignancy.

### References

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