March 2015 Imaging Case of the Month

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Clinical History: A 35-year-old man presented with a history of Von Hippel-Lindau syndrome, including prior right-sided renal cell carcinomas, cerebellar hemangioblastomas, and retinal hemangiomas. The patient's renal malignancies were treated with laparoscopic radiofrequency ablations 6 and 8 years prior to presentation, and subsequently with percutaneous microwave ablations in the interim between 2008 and presentation. The latest percutaneous microwave ablation procedure (Figure 1) was performed to address two nodular enhancing foci in the posterior superior pole of the right kidney and one interpolar enhancing, septated lesion that were noted to have enlarged slightly on a recent MRI examination (Figure 2) of the abdomen compared with one year earlier.

Figure 1. Percutaneous microwave of three right-sided renal lesions, 2 posterior-superior pole, the other lateral interpolar in location, shows two NeuWave microwave antennas inserted into suspicious lesions in the right kidney.

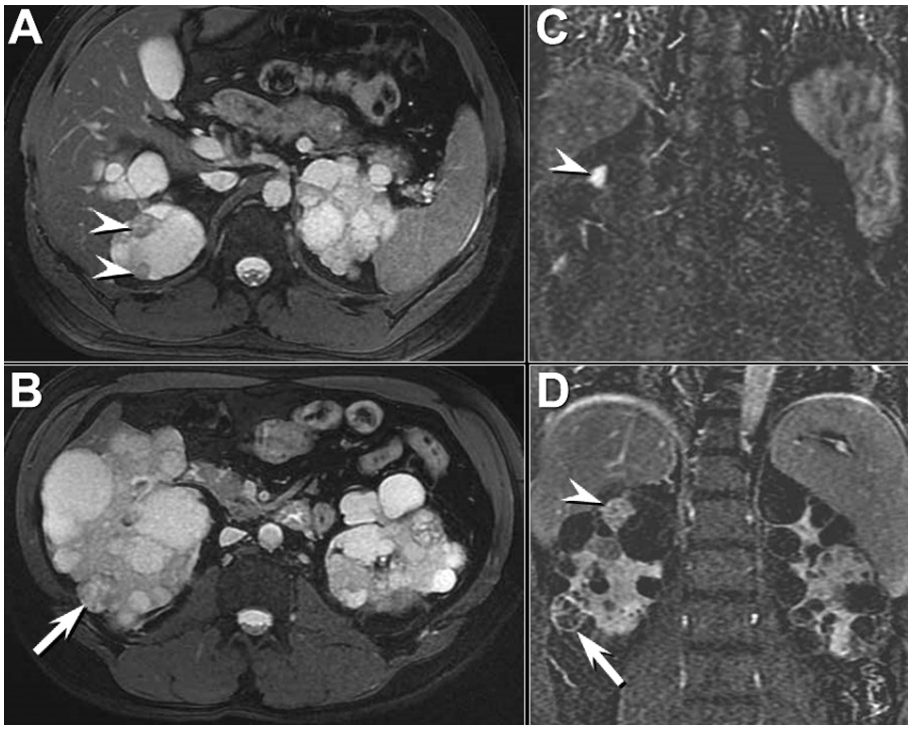

Figure 2. MRI of abdomen (A and B, axial steady-state free precession fat saturation images and, C and D, coronal subtraction contrast-enhanced images) shows three potentially solid, enhancing foci, two in the posterior and superior pole of the right kidney (arrowheads), and one in the lateral interpolar kidney, the latter with thick septations (arrow) that have shown slight enlargement from MR. performed one year previously.

A CT of the abdomen (Figure 3), performed 2 years earlier, is shown as a baseline comparison.

Figure 3. Selected image from the CT of the abdomen performed 2 years prior to presentation shows enlargement of the bilateral kidneys with numerous, bilateral renal cystic lesions. No pleural or lung base abnormality is evident.

Several days following the percutaneous microwave ablation procedure, the patient complained of right-sided chest pain, and frontal chest radiography was performed (Figure 4).

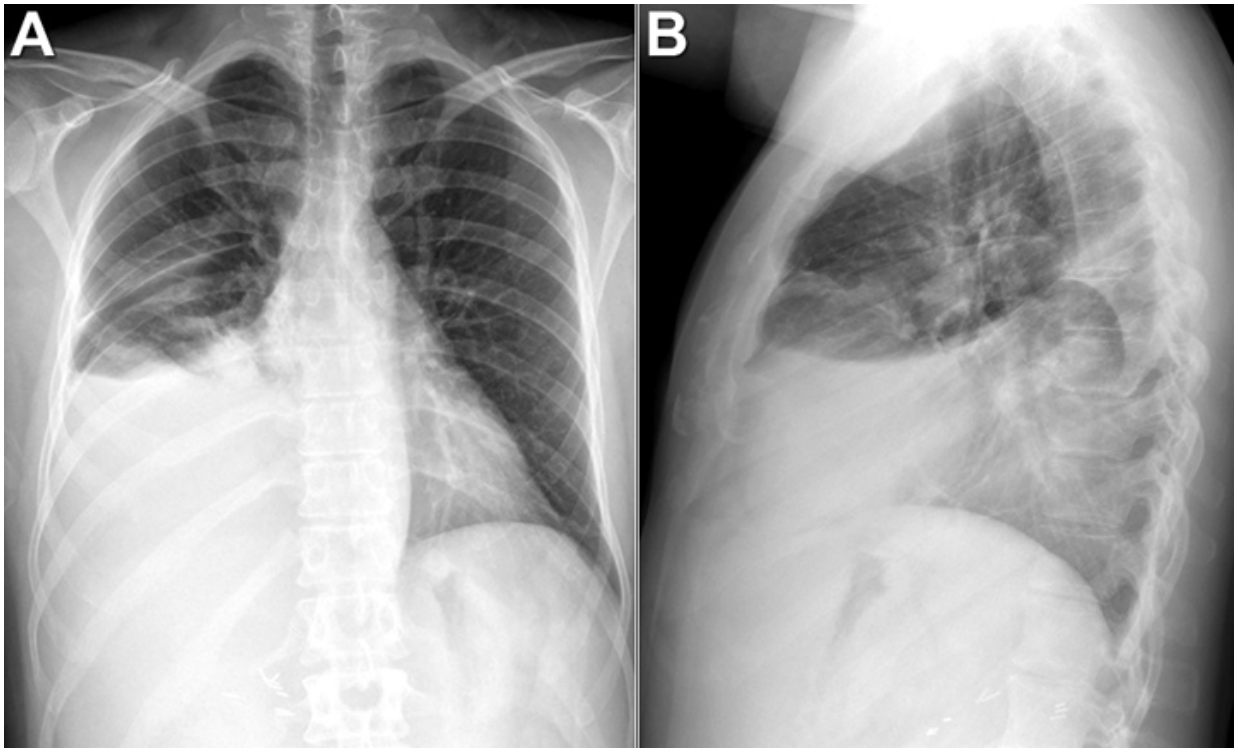

Figure 4. Frontal and lateral chest radiography performed several days following the right-sided percutaneous microwave ablation procedure.

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

1. The frontal chest radiograph shows a large right pleural effusion
2. The frontal chest radiograph shows diffuse lung opacities suggesting diffuse alveolar damage
3. The frontal chest radiograph shows mediastinal widening
4. The frontal chest radiograph shows pneumomediastinum
5. The frontal chest radiograph shows pneumothorax

Correct!
1. The frontal chest radiograph shows a large right pleural effusion

The frontal chest radiograph shows homogeneous opacity in the inferior and lateral right thorax with a meniscoid shape characteristic of pleural effusion; the pleural fluid collection appears large. There is no evidence of either pneumothorax or pneumomediastinum. The mediastinal contours, as far as they can be visualized, appear normal. The left lung and right upper lobe remain clear- no evidence of developing diffuse alveolar damage is present.

Clinical Course: Following the percutaneous microwave ablation procedure, the patient developed acute renal failure (serum creatinine increased from 1.9 mg/dL at baseline to a peak of 4.5 mg/dL), as well as a drop in hemoglobin (from 13.1 mg/dl at baseline to a low of 10 mg/dL).

Which of the following represents an ***appropriate step*** for the evaluation of this patient?

1. Unenhanced abdominal CT
2. Abdominal ultrasound
3. Unenhanced abdominal MRI
4. ^{18}FDG-PET
5. Ga-citrate scanning
6. 1 and 2
7. 1 or 3
8. 1 or 2

Correct!
6. 1 and 2

Given the acute renal failure and dropping hemoglobin value (the latter raising the possibility of hemorrhage), abdominal imaging for this patient is indicated. Generally, abdominal imaging in the acute care setting may be performed using either CT of the abdomen (with or without intravenous contrast) or abdominal ultrasound. Abdominal ultrasound has the benefits of rapid performance, which can be accomplished portably at the bedside if needed, lack of use of ionizing radiation, and excellent depiction of hydronephrosis, which is a leading consideration in a patient with acute renal failure and suspected bleeding. CT of the abdomen is also quite capable of showing hydronephrosis in this setting and is probably a better choice than ultrasound for disclosing retroperitoneal hemorrhage, although ultrasound does remain an appropriate starting point in this context. Therefore, choice 6-both unenhanced CT of the abdomen and abdominal ultrasound- are appropriate choices for evaluating this patient. Abdominal MRI may be capable of showing hydronephrosis and retroperitoneal hemorrhage, and has the additional benefit of the lack of use of ionizing radiation, but MRI is more time consuming than either CT or ultrasound and is therefore not favored in the acute setting. Neither ^{18}FDG-PET nor ^{68}Ga-citrate scanning play a role in the evaluation of suspected acute urinary obstruction and / or post-procedural hemorrhage following a percutaneous ablation procedure and are not appropriate choices for this patient's evaluation.

Clinical course: Both retroperitoneal ultrasound and unenhanced abdominal CT (Figure 5) were performed.

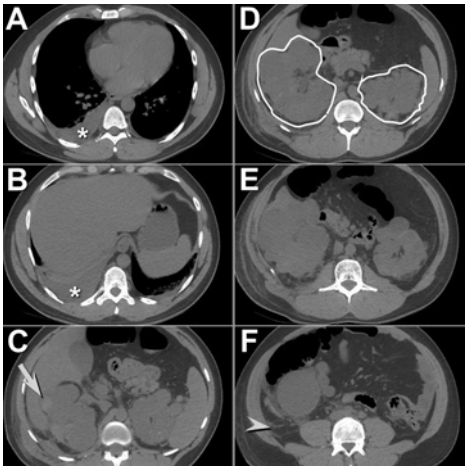

Figure 5. Unenhanced abdominal CT performed after development of acute renal failure following the percutaneous microwave ablation procedure shows cystic bilateral enlargement of both kidneys (shapes in D). Some of the cysts are hyperdense (arrow in C), consistent with hemorrhage or proteinaceous material. Mild perinephric fat stranding is present (arrowhead in F), which can be seen with retroperitoneal hemorrhage, but the mild nature of this finding is entirely consistent with the recent percutaneous microwave ablation procedure. Right pleural effusion (*) is again present.

The CT examination showed a right pleural effusion, confirming the findings at recent chest radiography, and bilateral cystic renal enlargement, consistent with Von Hippel-Lindau syndrome. Mild perinephric fat stranding consistent with the recent percutaneous microwave ablation procedure was visible, but no findings suggesting either hydronephrosis or retroperitoneal hemorrhage were seen at either ultrasound or CT. The patient complained of persistent chest and abdominal pain, lethargy, intermittent fevers (patient indicated as high as 102°F), and general “unwellness.” At re-presentation 3 weeks later, the patient was afebrile with a normal white blood cell and platelet counts and normal electrolyte panels and liver function tests. The serum creatinine was 3.38 mg/dL and the hemoglobin and hematocrit had been stable at 10 mg/dL and 28%, respectively, over the previous few weeks. Repeat frontal chest radiography (Figure 6) was performed.

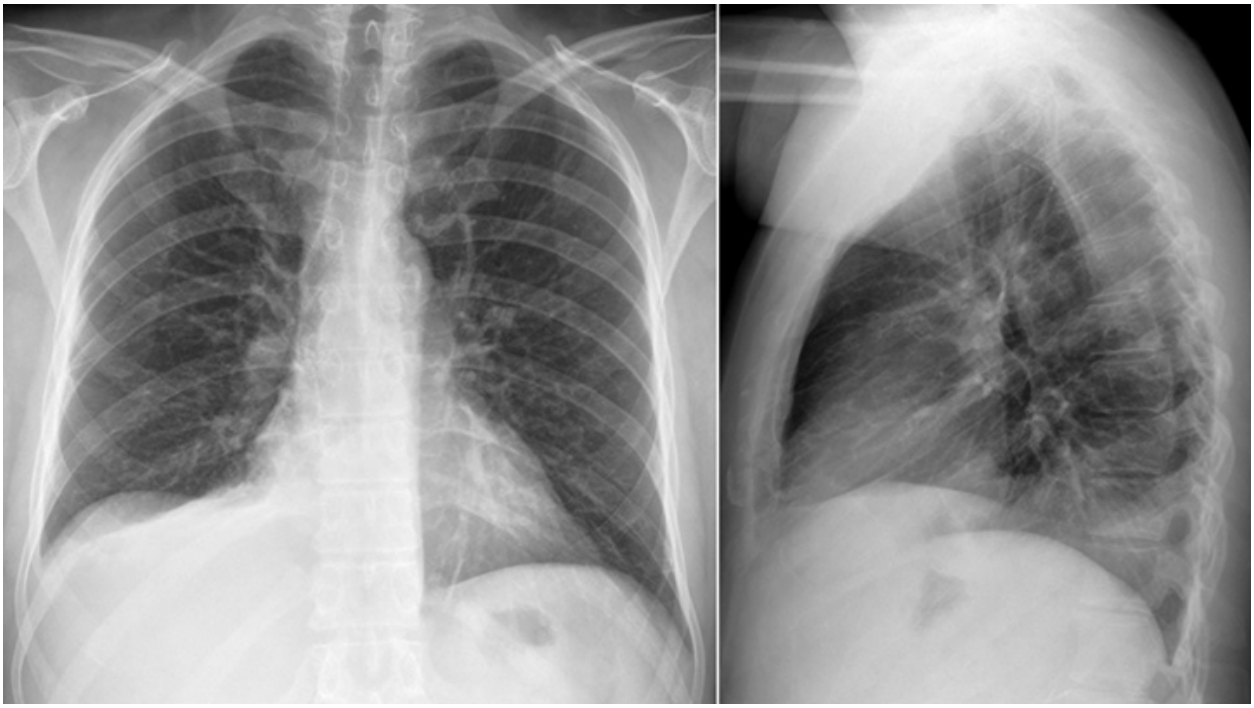

Figure 6. Frontal and lateral chest radiography performed just over 3 weeks following the right-sided percutaneous microwave ablation procedure.

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

1. The frontal chest radiograph shows continued right pleural effusion and right lower lobe volume loss
2. The frontal chest radiograph shows development of new nodules and foci of air-space consolidation
3. The frontal chest radiograph shows increased pressure pulmonary edema
4. The frontal chest radiograph shows new cardiomegaly
5. The frontal chest radiograph shows pneumoretroperitoneum

Correct!

1. The frontal chest radiograph shows continued right pleural effusion and right lower lobe volume loss.

Frontal chest radiograph shows continued right pleural effusion and right lower lobe volume loss. The right pleural effusion has decreased in size compared with the previous chest radiograph (Figure 4), but it persists nonetheless. The heart size is normal, and features that suggest hydrostatic pulmonary edema, such as interlobular septal thickening, airway thickening, cardiomegaly, and vascular enlargement and indistinctness, are absent. There is no evidence of pneumoretroperitoneum, and no pulmonary nodules or new air-space opacities have developed.

Which of the following represents the ***next most appropriate step*** for the evaluation of this patient?

1. ^{68}Ga-citrate scintigraphy
2. ^{99m}Tc-MAA ventilation-perfusion scintigraphy
3. Abdominal MRI
4. Left decubitus chest radiography
5. Thoracentesis

Correct!
5. Thoracentesis

Thoracentesis is the most appropriate next step among the choices listed. While pleural effusion can occur in the setting of thromboembolic disease, fluid in the pleural space is a non-specific finding, and if pulmonary embolism is suspected in this setting, CT pulmonary angiography would probably be a better choice for assessment of suspected thromboembolic disease than ^{99m}Tc-MAA ventilation-perfusion scintigraphy given that the chest radiograph is abnormal (which often results in a higher likelihood of indeterminate results at ^{99m}Tc-MAA ventilation-perfusion scintigraphy compared with patients who have normal chest radiographs). Abdominal MRI has little role in the assessment of a pleural effusion of unknown etiology (although it was performed in this patient and showed the bilateral cystic renal disease and expected post-procedural changes, but with no evidence of hydronephrosis, hemorrhage, or undrained fluid collection). ^{99m}Tc-Ga-citrate scintigraphy is sometimes useful when thoracic infection or inflammation is suspected in the setting of diffuse lung opacities, but would be unrewarding in this circumstance. Decubitus chest radiography is useful for detection of pleural effusion and quantification of fluid to determine if enough fluid is present to perform thoracentesis successfully. However, for this patient, decubitus chest radiography should be performed in the *right* lateral decubitus position, not the *left*, for pleural fluid quantification.

Further clinical course: Thoracentesis was performed and showed hazy, straw-colored fluid with an increased cell count (chronic inflammatory and mesothelial cells) but no cytological evidence of malignancy. The total pleural fluid protein and LDH were 4.4 and 200, respectively, with these values interpreted as representing an exudative effusion. Chest radiography (Figure 7) obtained less than one week following thoracentesis, performed for shortness of breath, showed re-accumulation of the right pleural effusion.

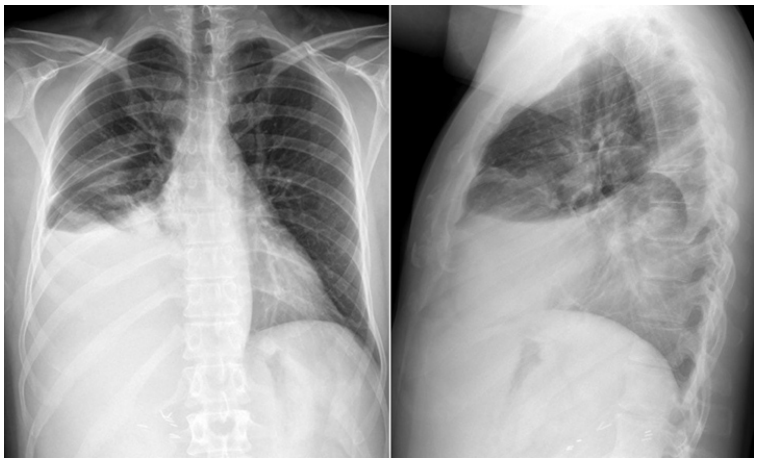

Figure 7. Frontal and lateral chest radiography performed less than one week following right-sided thoracentesis and just under one month following the percutaneous microwave renal ablation procedure shows right pleural effusion re-accumulation. The right pleural effusion is now large.

Repeat right-sided thoracentesis was performed and yielded nearly 2000 cc of fluid with biochemical analysis suggesting a transudate. Unenhanced thoracic CT (Figure 8) was then performed.

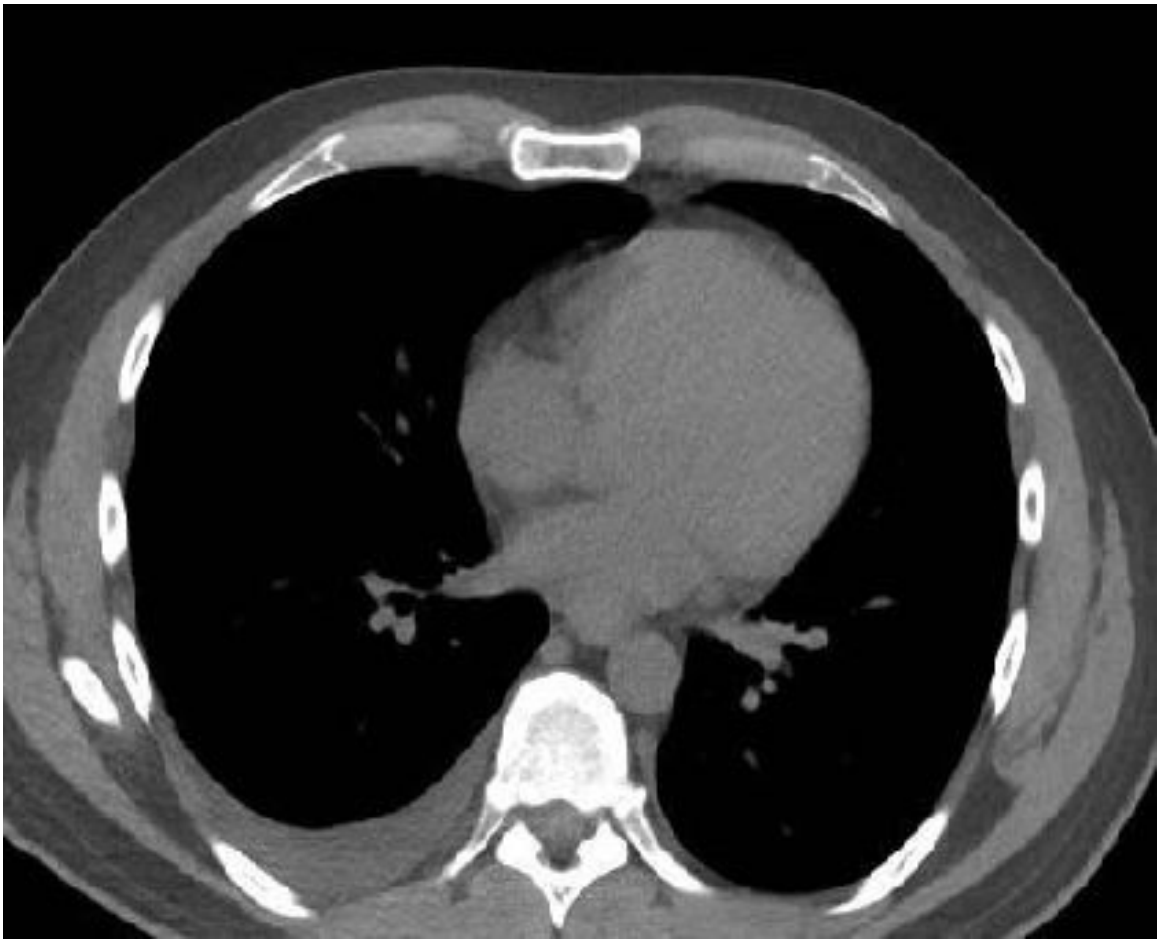

Figure 8. Selected view of unenhanced thoracic CT performed following right-sided thoracentesis.

Which of the following statements regarding the unenhanced thoracic CT study is ***most accurate***?

1. Thoracic CT shows eccentric thickening of the esophagus near the gastroesophageal junction
2. Unenhanced thoracic CT shows a posterior mediastinal mass obstructing the thoracic duct
3. Unenhanced thoracic CT shows a small right pleural effusion without pleural thickening
4. Unenhanced thoracic CT shows mediastinal and peribronchial lymphadenopathy
5. Unenhanced thoracic CT shows pneumomediastinum

Correct!

3. Unenhanced thoracic CT shows a small right pleural effusion without pleural thickening

Unenhanced thoracic CT shows a small right pleural effusion, with no clear evidence of pleural thickening. No gas is present in the right pleural space. The imaging features are non-specific. No definite evidence of peribronchial or mediastinal lymph node enlargement is present. No mediastinal gas foci are seen. No mediastinal mass is evident and no abnormality is present along the expected course of thoracic duct. A small hiatal hernia is present near the gastroesophageal junction, but the distal esophagus does not appear abnormally thickened when accounting for the relative under-distension of this structure.

Further clinical course: The patient underwent repeat chest radiography (Figure 9) for recurrent shortness of breath which showed re-accumulation of the right pleural fluid collection yet again.

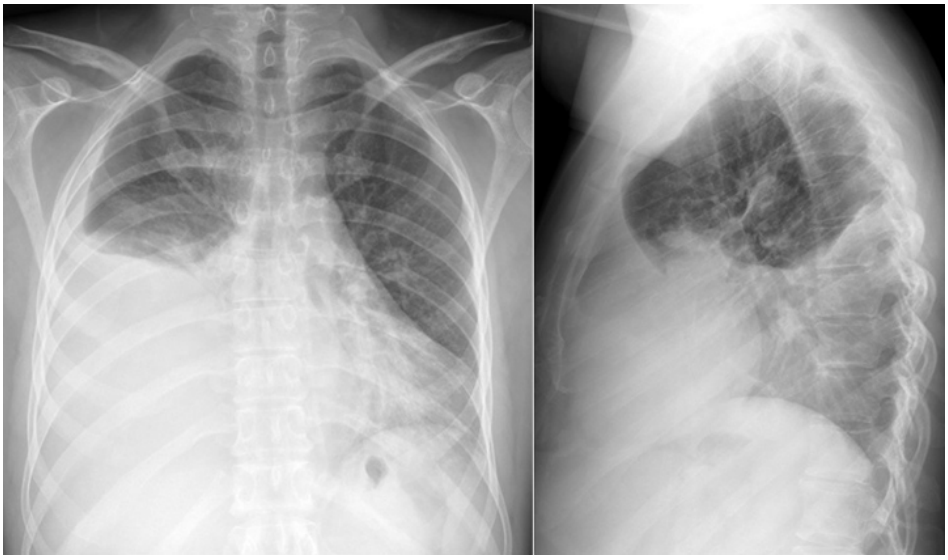

Figure 9. Repeat frontal and lateral chest radiography several days following the unenhanced thoracic CT and nearly 35 days following the percutaneous microwave renal ablation procedure shows right pleural effusion re-accumulation. The right pleural effusion is again large.

The patient underwent several repeated thoracentesis over the ensuing month, always followed by rapid re-accumulation of a large, transudative, right pleural effusion. During this time frame, the patient also complained of abdominal bloating and was seen in the emergency room with dehydration and vomiting as well. His renal function had initially improved following the acute renal injury that occurred immediately after the percutaneous microwave ablation procedure, but then had worsened, with serum creatinine values remaining in the range of 3.5 – 4.5 mg/dL. Nephrology was consulted, and recommended a ^{99m}Tc-Mercaptoacetyltriglycine (MAG-3) renal scan (Figure 10) to assess for renal cortical infarction and viability of the right kidney.

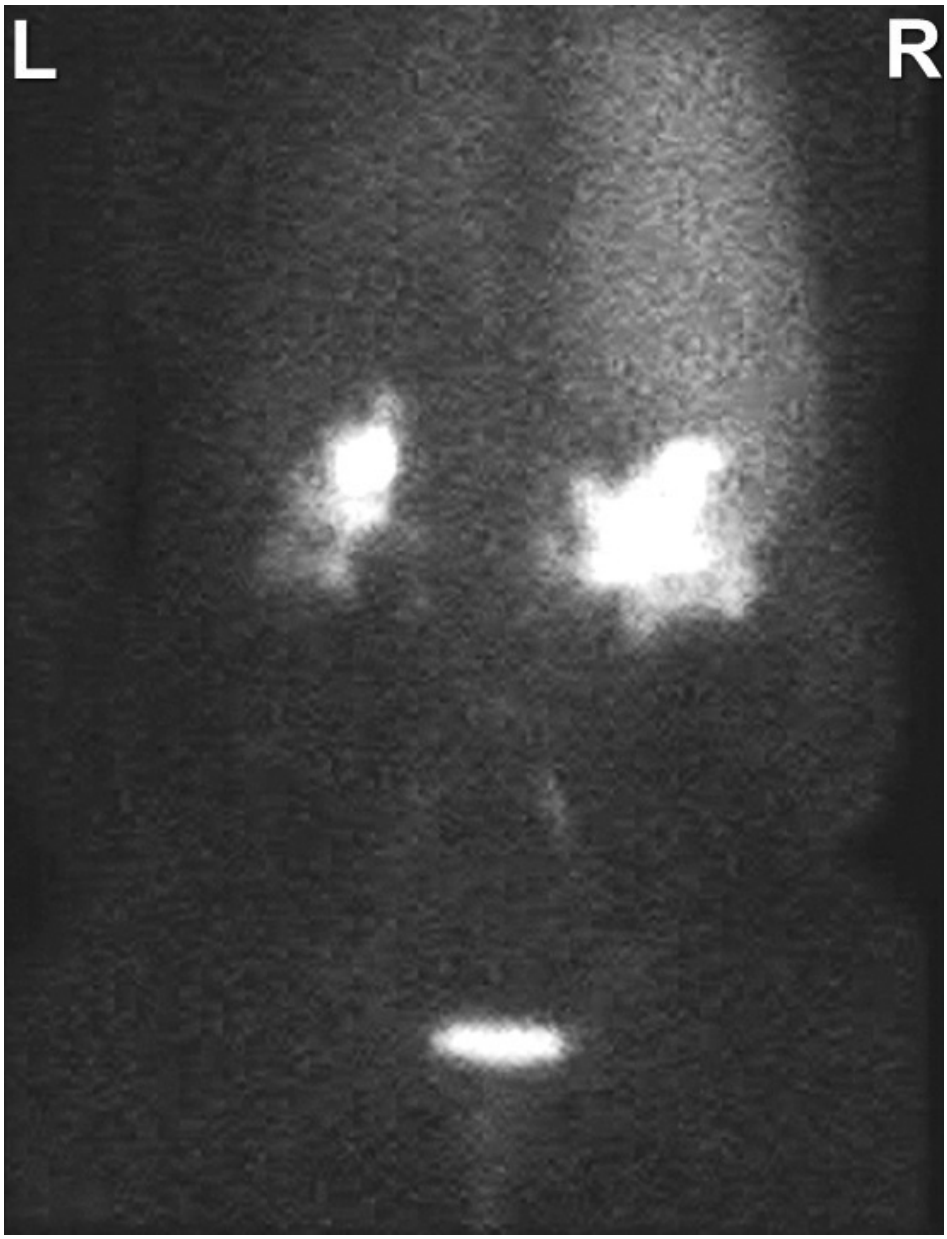

Figure 10. ^{99m}Tc-Mercaptoacetyltriglycine (MAG-3) renal scan (posterior view; L = patient left, R= patient right).

Based on the findings at this examination, which of the following would be the ***most likely*** to establish the etiology for the patient's right pleural effusion?

1. Endovascular renal artery embolization
2. Measurement of right pleural liquid creatinine level
3. Measurement of right pleural liquid glucose level
4. Measurement of right pleural liquid triglyceride level
5. Thoracoscopic biopsy of the right pleura

Correct!
2. Measurement of right pleural liquid creatinine level

^{99m}TcMAG-3 provides a measure of effective renal blood flow and renal function and is capable of detecting obstructive uropathy. This study shows no evidence of urinary tract obstruction. Dynamic images (not displayed here) showed significant prolonged bilateral renal cortical tracer uptake and bilaterally delayed tracer excretion. Areas of decreased tracer uptake / hypofunction are consistent with the extensive renal cysts bilaterally. Increased tracer accumulation is seen overlying the right thorax, indicating movement of radiopharmaceutical from the renal collecting system into the right pleural space (note the relative “brightness” of the right thorax compared with the left), establishing the presence of nephro-pleural fistula with urinothorax.

Measurement of pleural liquid fat, such as triglyceride levels, can be useful when chylothorax is suspected, but the clinical history and course as well as the imaging findings do not suggest this diagnosis. Thoracoscopic pleural biopsy is performed with infiltrative disorders of the pleura, particularly malignancy, are suspected as a cause of recurrent pleural effusion. The patient does have malignancy, but the malignancy has been controlled locally and both the lack of pleural thickening at imaging and the transudative nature of the right pleural effusion suggest that malignancy is probably not the cause of the recurrent with pleural effusion, Measurement of pleural fluid glucose can provide useful information in some infectious and inflammatory disorders that may affect the pleura, but such conditions are unlikely in this patient, Endovascular renal artery embolization has no role in this patient, and is typically employed to control hemorrhage (often due to trauma, microaneurysms, or persistently bleeding neoplasms).

Further clinical course: The right pleural fluid was sent for measurement of its creatinine content, and was found to be markedly elevated at 7.7 mg/dL, establishing the diagnosis of nephro-pleural fistula and right-sided urinothorax.

Diagnosis: Nephro-pleural fistula and right-sided urinothorax.

References

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