Self-Assessment Module

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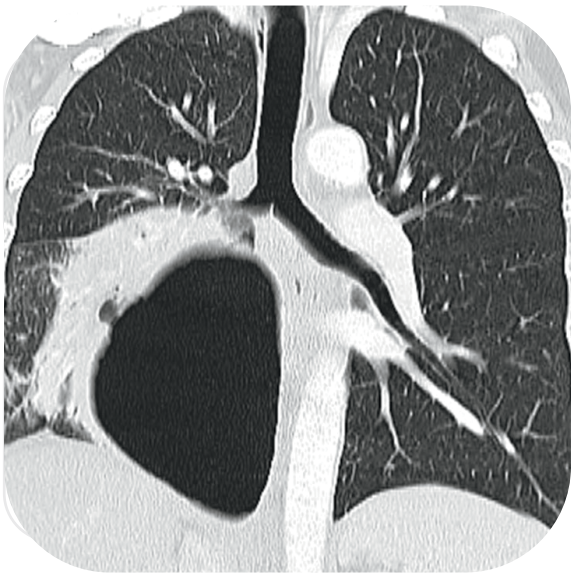
Chest Radiology



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CPI Chest Radiology Module 2022

Answer Sheet

Use this Answer Sheet to record your answers. Refer to the Answer Key to score your questions. You must receive an overall score of 80% to earn CME/SA-CME credit for this activity.

Questions 1 through 50

1. _____	14. _____	27. _____	40. _____
2. _____	15. _____	28. _____	41. _____
3. _____	16. _____	29. _____	42. _____
4. _____	17. _____	30. _____	43. _____
5. _____	18. _____	31. _____	44. _____
6. _____	19. _____	32. _____	45. _____
7. _____	20. _____	33. _____	46. _____
8. _____	21. _____	34. _____	47. _____
9. _____	22. _____	35. _____	48. _____
10. _____	23. _____	36. _____	49. _____
11. _____	24. _____	37. _____	50. _____
12. _____	25. _____	38. _____	
13. _____	26. _____	39. _____	

This is a self-scored test. Please do not send your answer sheet to the ACR.

Self-Assessment Module

CPI Chest Radiology Module 2022

Image-Related Questions

1. What is the *next* **BEST** step in the management of the anterior mediastinal lesion (arrow) present on the computed tomography (CT) image (Figure 1-1)?

A. CT

B. Positron emission tomography/computed tomography (PET/CT)

C. Magnetic resonance imaging (MRI)

D. Surgical resection

Fig 1-1. Chest. Computed tomography (CT). No contrast enhancement. Axial plane. Soft-tissue window. Level of the main pulmonary artery. Arrow points to lesion.

2. A 19-mm subsolid nodule in the left upper lobe (arrow) is detected incidentally on initial chest CT (Figure 2-1). What is the *next* **BEST** step in management?

A. Follow-up CT in 6 months

B. No follow-up

C. PET/CT

D. Surgical resection

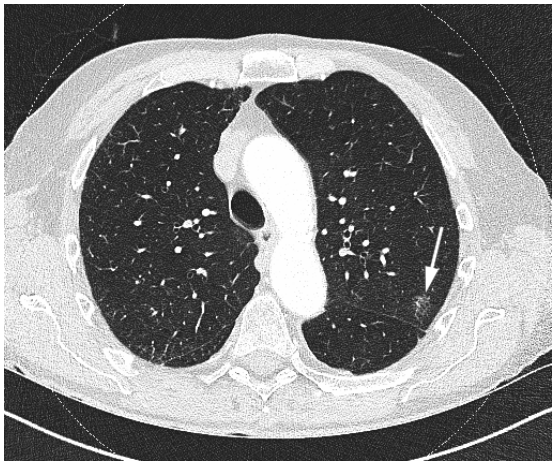

Fig 2-1. Chest. CT. Contrast enhancement. Axial plane. Lung window. Level of the aortic arch. Arrow points to a 19-mm subsolid nodule in the left upper lobe.

3. A 59-year-old woman with a history of dyspnea and pulmonary hypertension is evaluated for possible pulmonary embolism. A CT angiogram (Figures 3-1, 3-3, and 3-5) is obtained. The corresponding pulmonary blood volume images from dual-energy acquisition (Figures 3-2 and 3-4) are shown. What is the *next* **BEST** step in management?

A. Anticoagulation

B. Catheter-directed thrombolysis

C. Embolectomy

D. Thromboendarterectomy

Nonimage-Related Questions

31. Which *one* of the following chest radiographic findings in COVID-19 pneumonia has been linked to an **INCREASED** risk for mortality?

A. Mediastinal widening

B. Barotrauma

C. Pulmonary artery dilation

D. Pleural effusion

32. A 20-year-old man presents with right-sided arm swelling and pain. Which of the following imaging findings would be **MOST** diagnostic of thoracic outlet syndrome in this patient?

A. Axillosubclavian vascular narrowing with arm abduction

B. Large-vessel thickening suggesting vasculitis

C. Axillosubclavian vessel thrombus

D. Cervical rib

33. Which of the CT imaging sign choices raises the **MOST** concern for a neoplastic pleural process?

A. Loculated pleural fluid

B. Calcified pleural plaque

C. Linear pleural calcification

D. Unilateral nodular pleural thickening

34. According to the Fleischner Society guidelines, which **ONE** of the following CT imaging features distinguishes the "typical UIP [usual interstitial pneumonia] pattern" of fibrosis from the "probable UIP pattern?"

A. Honeycombing

B. Peribronchovascular distribution with subpleural sparing

C. Mosaic attenuation/air trapping

D. Reticulation

Rationales and References

Answer 1 is C.

Figure 1-1, a noncontrast chest CT image, demonstrates a small, well-circumscribed ovoid anterior mediastinal nodule, which on visual assessment appears greater than simple fluid in attenuation. Leading differential considerations for an anterior mediastinal lesion of this morphology and intermediate attenuation include thymoma, cystic thymoma, thymic cyst, and lymph node or nodal lesion.

Contrast-enhanced magnetic resonance imaging (MRI) can provide a more definitive tissue characterization. In this case, MRI showed the lesion to be T1 hyperintense (Figure 1-2), compatible with proteinaceous or hemorrhagic content, and without any soft-tissue–enhancing components (Figure 1-3), making the abnormality a thymic cyst, which was proven by pathology. The recently updated American College of Radiology (ACR) Appropriateness Criteria for the imaging assessment of mediastinal masses gives "MRI of the chest with and without contrast" a rating of usually appropriate as discussed in Imaging of Mediastinal Masses.

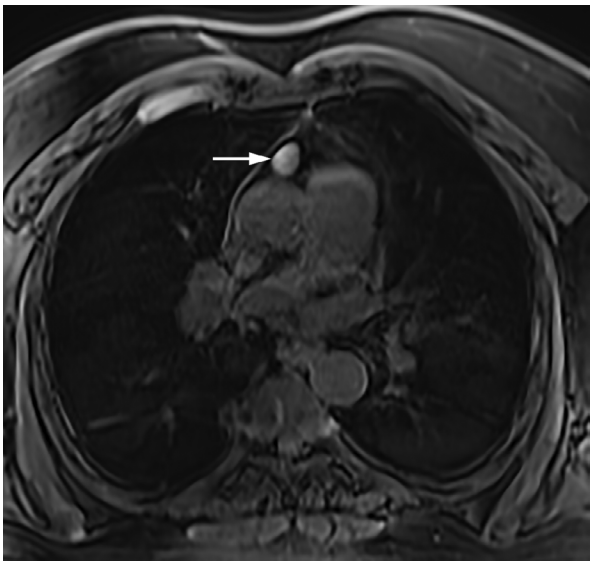

Fig 1-2. Thymic cyst. Chest. Magnetic resonance (MR). No contrast enhancement. T1 weighted. Axial plane. Level of the right main pulmonary artery. The lesion (arrow) is T1 hyperintense and consistent with a thymic cyst.

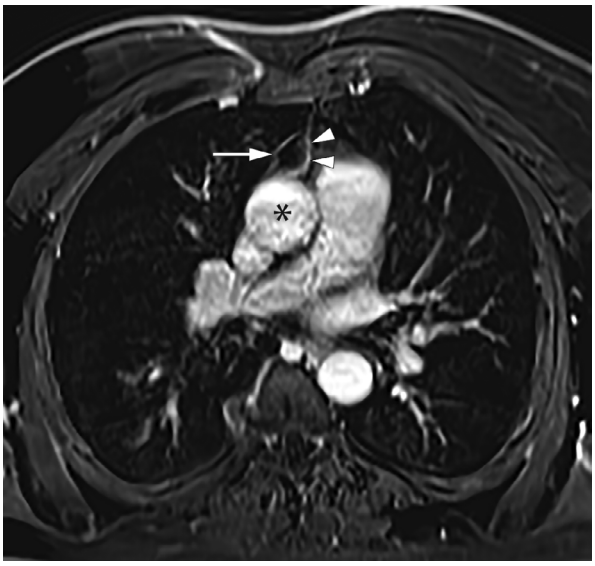

Fig 1-3. Thymic cyst. Chest. MR. Contrast enhancement. Subtraction image. Axial plane. Level of the right main pulmonary artery. The lesion (arrow), which is anterior to the aorta (asterisk) is smooth with thin wall enhancement (arrowheads) without irregularity, mural nodularity, or internal soft-tissue enhancement or septation. These imaging findings are compatible with a thymic cyst.

Option A is not correct.

Contrast-enhanced CT does not provide definitive tissue characterization (Figure 1-2). It cannot distinguish proteinaceous or hemorrhagic cyst content from soft-tissue components or exclude the possibility of septations or small mural or internal nodularity. All of these findings could be seen in patients with thymoma or thymic neoplasm.

Option B is not correct.

Thymic lesions may demonstrate a range of fluorodeoxyglucose (FDG) avidity. Positron emission tomography/computed tomography (PET/CT) would be of limited utility for distinguishing cystic thymoma from thymic cyst, or thymoma from lymphoma. Although the ACR Appropriateness Criteria does state that FDG-PET/CT may be appropriate in the test case scenario, the best answer is contrast-enhanced MRI of the chest.

Option D is not correct.

The reported rates of unnecessary thymectomy are high, ranging from 22% to 68%, and are often the result of resection of thymic hyperplasia, thymic cysts, or lymphomas. Although thymic cysts may be resected in symptomatic patients, surgical resection would be a more appropriate next step for a resectable thymoma and not a thymic cyst.

Thymic cysts are benign rare mediastinal masses. The majority of thymic cysts are believed to be congenital in origin. Approximately 60% of patients with a thymic cyst are asymptomatic. The most common symptoms are cough, dyspnea, and chest pain. None of these symptoms are specific for thymic cysts.

Reference(s):

Ackman JB, Verzosa S, Kovach AE, et al. High rate of unnecessary thymectomy and its cause. Can computed tomography distinguish thymoma, lymphoma, thymic hyperplasia, and thymic cysts? *Eur J Radiol.* 2015;84(3):524-533. doi:10.1016/j.ejrad.2014.11.042

Expert Panel on Thoracic Imaging, Ackman JB, Chung JH, Walker CM, et al. ACR Appropriateness Criteria Imaging of Mediastinal Masses. *J Am Coll Radiol.* 2021;18(5S):S37-S51. doi:10.1016/j.jacr.2021.01.007

Wang J, Zhang XM, Zhang J, et al. Clinical experience with thymic cystectomy: a single-institution study of 117 cases from 2013 to 2019. *Med Sci Monit.* 2020;26:e923967-1.

Wang X, Chen K, Li X, et al. Clinical features, diagnosis and thoracoscopic surgical treatment of thymic cysts. *J Thorac Dis.* 2017;9(12):5203-5211. doi:10.21037/jtd.2017.10.148

Answer 2 is A.

The CT image (Figure 2-1) demonstrates a subsolid nodule on the left upper lobe greater than 6 mm in size. The nodule subsequently resolved on follow-up CT examination.

Subsolid nodules are defined as nodules that are less than solid in density. These can be further broken down into pure ground glass (defined as increased density through which underlying lung architecture can be seen) and part solid (which have both ground-glass densities and variably sized solid components). Because a large proportion of subsolid nodules may be transient and resolve on follow-up examinations, the initial management for incidentally detected subsolid nodules greater than 6 mm in size is to establish persistence. After this step, the size of the solid component as well as other features may guide management. A ground-glass nodule equal to or greater than 6 mm will warrant a follow-up in 6 to 12 months. A part-solid nodule equal to or greater than 6 mm will warrant a follow-up in 3 to 6 months. Multiple subsolid nodules of any size also warrant an initial short-interval follow-up in 3 to 6 months. A small subsolid nodule less than 6 mm in size does not mandate follow-up according to the Fleischer guidelines. However, other societies, such as the American College of Chest Physicians (CHEST), British Thoracic Society (BTS), and CHEST consensus guidelines for Asia recommend follow-up for even these small (ie, less than 6 mm) subsolid nodules.

Option B is not correct.

In some cases of subsolid nodules that are less than 6 mm in size, no follow-up imaging is recommended. In the test case, however, the subsolid nodule is 19 mm. Thus, follow-up is recommended according to the Fleischer guidelines. Some societies, including CHEST and BTS, recommend follow-up of ground-glass nodules even when less than 6 mm in size. The rationale for this follow-up is related to the high incidence of malignancy in persistent subsolid nodules.

Option C is not correct.

PET/CT would not be the best initial examination. If obtained at a short interval, it may not provide meaningful information about the persistence of subsolid nodules. Furthermore, subsolid nodules of this size are likely to be PET negative regardless of their pathology.

Option D is not correct.

Surgical resection is not the best next step because newly detected subsolid nodules may be transient and have non-neoplastic causes. Importantly, reported rates of resolution of subsolid nodules vary from 20% to 68%. Thus, proceeding to surgical resection would be inappropriate in this test case.

Reference(s):

Azour L, Ko JP, Naidich DP, Moore WH. Shades of gray: subsolid nodule considerations and management. *Chest.* 2021;159(5):2072-2089. doi:10.1016/j.chest.2020.09.252

MacMahon H, Naidich DP, Goo JM, et al. Guidelines for management of incidental pulmonary nodules detected on CT images: from the Fleischner Society 2017. *Radiology.* 2017;284(1):228-243. doi:10.1148/radiol.2017161659

Answer 3 is D.

Figure 3-1 demonstrates severe narrowing of a pulmonary artery branch in the right middle lower lobe. Figure 3-3 shows similar narrowing of the right lower lobe pulmonary arteries. In patients with chronic pulmonary emboli where the origin of a vessel can be covered by a clot, the clot will resorb over time, but the vessel will have remodeled, resulting in an extremely small size. A corresponding wedge-shaped perfusion defect (Figures 3-2 and 3-4) is seen on the pulmonary blood volume image in the right middle and right lower lobes.

These types of defect can be seen in patients with chronic thromboembolic pulmonary hypertension (CTEPH). Imaging signs of CTEPH include narrowed, atretic, or absent pulmonary artery branches (Figure 3-6); pulmonary artery bands and webs (Figure 3-7); and eccentric filling defects (Figure 3-8).

For a diagnosis of CTEPH to be made, the patient must have pulmonary hypertension and multiple defects (not shown in this case). Pulmonary thromboendarterectomy (endarterectomy of the pulmonary artery intimal layer and portions of the medial layer) can be curative for symptomatic patients with pulmonary hypertension as a result of CTEPH.

to a solid nodule in the same time frame. This combination of changes requires histological sampling as was performed in this test case.

Reference(s):

Azour L, Ko JP, Naidich DP, Moore WH. Shades of gray: subsolid nodule considerations and management. *Chest.* 2021;159(5):2072-2089. doi:10.1016/j.chest.2020.09.252

de Hoop B, Gietema H, van de Vorst S, Murphy K, van Klaveren RJ, Prokop M. Pulmonary ground-glass nodules: increase in mass as an early indicator of growth. *Radiology.* 2010;255(1):199-206. doi:10.1148/radiol.09090571

Answer 31 is B.

Barotrauma includes findings such as pneumothorax, pneumomediastinum, pneumopericardium, and subcutaneous emphysema. Increased incidence of barotrauma has been reported in patients with COVID-19 receiving mechanical ventilation and has been found to be associated with longer hospital stay and to be an independent risk factor for death.

The radiograph (Figure 31-1) demonstrates airspace opacities bilaterally as well as increased curvilinear lucency along the left-heart border, compatible with pneumopericardium. Subcutaneous emphysema is also noted in the neck and chest wall bilaterally.

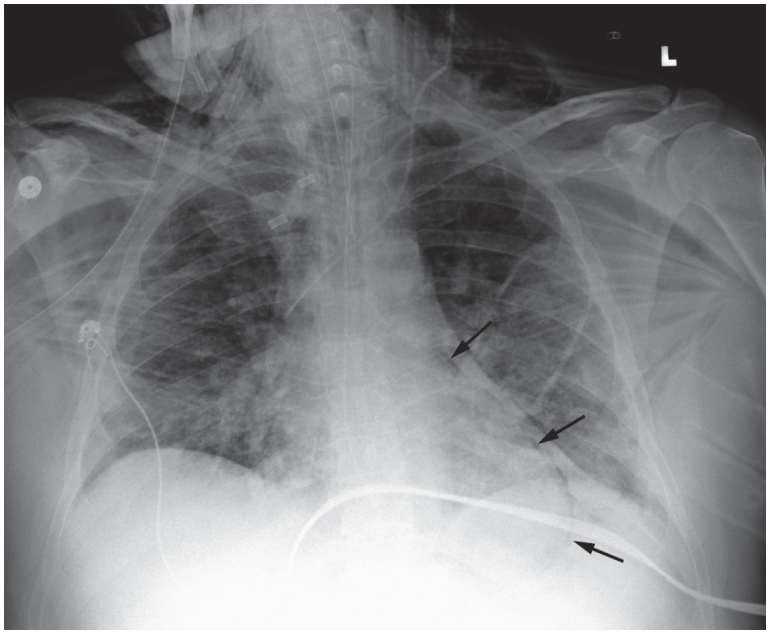

Fig 31-1. Pneumopericardium. Chest. Radiograph. Frontal view. Lucency (arrows) is seen along the left-heart border. Also noted are increased airspace opacities in the mid to lower lungs bilaterally, as well as subcutaneous emphysema in the supraclavicular regions bilaterally. Subcutaneous emphysema in the chest wall outlines the pectoralis muscles bilaterally.

Option A is not correct.

Increased mediastinal width on chest radiography is not associated with increased risk for mortality in patients with COVID-19.

Option C is not correct.

Pulmonary artery dilation, which is the Fleischner sign on radiography, may suggest underlying pathology including pulmonary embolism. Thromboembolic complications occur with greater incidence in COVID-19 than in other viral infections. Although there is a higher rate of mortality in patients with thrombotic complications associated with COVID-19, this specific sign has not been associated with higher mortality rates.

Option D is not correct.

Although pleural effusion may at times be seen in COVID-19, it has not been associated with an increased risk for mortality.

Reference(s):

McGuinness G, Zhan C, Rosenberg N, et al. High incidence of barotrauma in patients with COVID-19 infection on invasive mechanical ventilation. *Radiology.* 2020:202352. doi:10.1148/radiol.2020202352

Stals M, Grootenboers M, van Guldener C, et al. Risk of thrombotic complications in influenza versus COVID-19 hospitalized patients [published online ahead of print, 2021 Feb 17]. *Res Pract Thromb Haemost.* 2021;5(3):412-420. doi:10.1002/rth2.12496

Answer 32 is C.

Thoracic outlet syndrome (TOS) occurs as the result of compression of the neurovascular bundle (brachial plexus, subclavian vein, and subclavian artery). TOS may be neurogenic, venous, or arterial. Radiographs may be an initial step in evaluating a patient with suspected TOS, because compression of these structures may have a musculoskeletal (cervical rib, transverse vertebral process, clavicle abnormalities or anterior first rib) or soft-tissue (apical mass) cause. MR angiography allows for dynamic imaging assessment of the neurovascular bundle with the arms in abduction (Figure 32-1) and adduction (Figure 32-2), yet without the need for radiation.

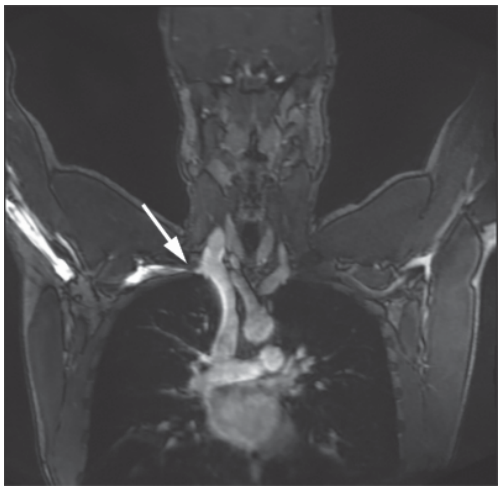

Fig 32-1. Venous thoracic outlet syndrome occurring with arm abduction. Chest. MR angiogram. Contrast enhancement. Coronal plane. Arms abducted. There is narrowing in the right subclavian vein with arm abduction (arrow).

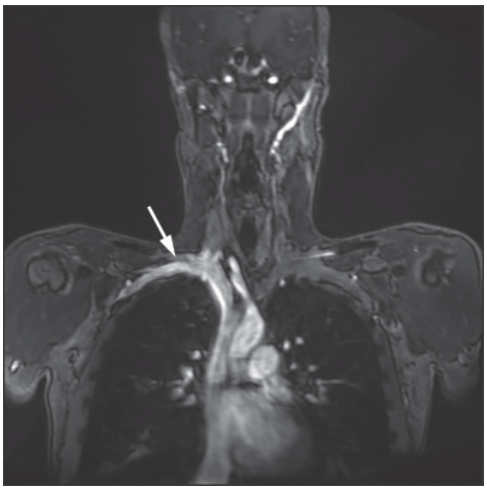

Fig 32-2. Venous thoracic outlet syndrome occurring with arm adduction. Chest. MR angiogram. Contrast enhancement. Coronal plane. Arms adducted. Subclavian vein narrowing resolved. Arrow points to the area of right subclavian vein narrowing that was seen in Figure 32-1, obtained when arms were abducted.

The ability to image patients in multiple planes allows for careful characterization of any potential area of narrowing. However, narrowing of the venous system in abduction (Figure 32-1) can be a normal finding and can be seen in up to 50% of healthy patients and that resolves with arm adduction (Figure 32-2). TOS is suggested when the venous narrowing persists with arm adduction.

Venous TOS is more common than arterial TOS, and patients may present with axillosubclavian thrombosis. Effort-induced upper-extremity thrombosis, as can be seen in pitching athletes, is also known as *Paget-Schroetter syndrome.*

Option A is not correct.

Dynamic changes in axillosubclavian artery or vein caliber may be seen in asymptomatic patients, and positional compression is not diagnostic of TOS.

Option B is not correct.

Although large-vessel vasculitis such as Takayasu vasculitis can mimic symptoms of TOS, vasculitis is a separate diagnostic entity. Typically, vasculitis will present with thickening of the arterial walls, which is not seen in the test case.

Option D is not correct.

Cervical ribs are seen in 0.2% to 1% of the general population and are typically found incidentally. Most patients are asymptomatic. Symptomatic patients will often have larger cervical ribs or a cervical rib fused with the first rib. None of these findings are present on the test case. Chest radiographs or CT may be necessary to detect a cervical rib.

Reference(s):

Raptis CA, Sridhar S, Thompson RW, Fowler KJ, Bhalla S. Imaging of the patient with thoracic outlet syndrome. *RadioGraphics.* 2016;36(4):984-1000. doi:10.1148/rg.2016150221

Answer 33 is D.

Pleural nodularity (Figure 33-1) is more commonly associated with pleural neoplastic processes, especially compared with the other choices in the test question.

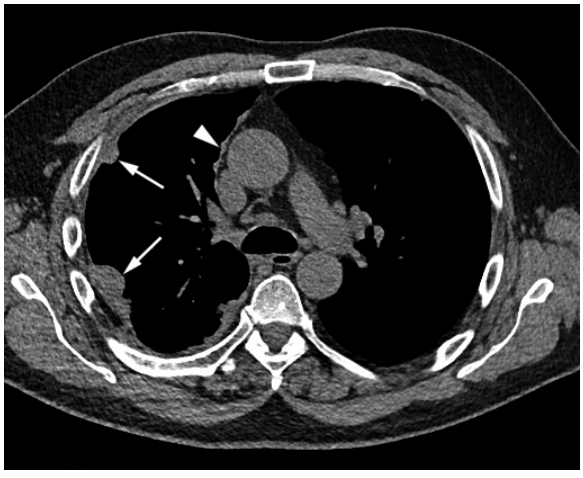

Fig 33-1. Pleural neoplastic disease, metastatic gastric adenocarcinoma to the pleura. Chest. CT. No contrast enhancement. Axial plane. Soft-tissue window. Level of the tracheal carina. Unilateral right pleural-based nodularity (arrows). Nodularity is also seen involving the mediastinal pleura (arrowhead).

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