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Seminars in
ROENTGENOLOGY

Pitfalls in Oncologic Imaging: Pericardial Recesses Mimicking Adenopathy

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Introduction

The pericardium is a thin, avascular sac that envelops the heart. It is made up of an outer fibrosa (the fibrous pericardium) and a double-layered inner serosa (the serous pericardium).

The serosa forms a complete sac (the pericardial cavity) which is filled with up to 50 mL of plasmatic ultrafiltrate and is separated from the heart by loose epicardial connective tissue and a single layer of mesothelial cells.[1] The pericardial cavity contains 2 major pericardial sinuses, the transverse and oblique sinuses, which, in turn, are composed of different recesses (Fig. 1).[2]

Advances in multidetector computed tomography (MDCT) technology have improved detection of pericardial recesses. Ozmen et al[3] have shown that visualization rates of pericardial recesses are higher with 4-, 16-, and 64-slice MDCT than with 2-slice MDCT. Additionally, thin-section computed tomography (CT) has improved the detection of pericardial recesses and sinuses.[4,5] Kodama et al assessed the prevalence of pericardial sinuses and recesses on thin section (2.5 or 3 mm) and thick section (5 or 7 mm) CT scans. Thin-section CT improved the depiction rate of every pericardial sinus and recess: 44.7% compared with 30.4% for the superior aortic recess, 16.7% compared with 3.4% for the inferior aortic recess, 36.8% compared with 12.5% for the left pulmonic recess, 29.7% compared with 7.9% for the right pulmonic recess, 28.7% compared with 7.7% for the oblique sinus, 16.8% compared with 2.7% for the postcaval recess, 19.8% compared with 2.5% for the left pulmonary venous recess, and 10.8% compared with 4.7% for the right pulmonary venous recess.[4] Similarly, Basile et al[5] identified the high-riding superior pericardial recess (HRSPR) in 7% of patients using 1.5-mm collimation in 2006, whereas Choi et al[6] identified it in only 2% of patients when 8-mm collimation was used in 2000. Pericardial recesses are now routinely seen on MDCT. In a retrospective analysis of 588 MDCT scans of the chest obtained with a protocol for pulmonary embolism, the visualization rate of any pericardial recess was 85.2%.[3] Of 265 patients scanned using 64-row CT, the anterior superior aortic recess, posterior superior aortic recess, inferior aortic recess, left pulmonic recess, right pulmonic recess, oblique sinus, and the left pulmonary venous recess were all visualized in at least 25% of cases.[3] It is therefore important for radiologists to be aware of the different pericardial recesses to avoid misdiagnosis.

Distinguishing Features

Several imaging features allow confident diagnosis of pericardial recesses: they occur in typical locations, have fluid attenuation, do not cause mass effect on adjacent structures, and are contiguous with other pericardial spaces. Multiplanar reformatted images are especially helpful in demonstrating contiguity between recesses and other pericardial spaces. Another useful imaging finding is a characteristic "beaklike" appearance, which may be seen as fluid in the pericardial recesses drapes over mediastinal structures such as the heart, aorta, or pulmonary artery. Adenopathy, in contrast to pericardial recess fluid, typically has soft tissue attenuation and lobular margins. Unlike pericardial recess fluid, adenopathy may exert mass effect on adjacent structures and may show contrast enhancement. Alternate imaging modalities such as magnetic resonance imaging (MRI) or positron emission tomography-CT (PET-CT) may be used to distinguish adenopathy from pericardial fluid when CT is indeterminate. Simple pericardial recess fluid shows low signal intensity on T1-weighted spin echo imaging, high signal intensity on T2-weighted spin echo imaging, and bright on dynamic cine imaging, for example, with rapid gradient-echo or steady-state free precession sequences.[7] Lymphadenopathy has variable signal intensity on MRI depending on its

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http://dx.doi.org/10.1053/j.ro.2015.01.013

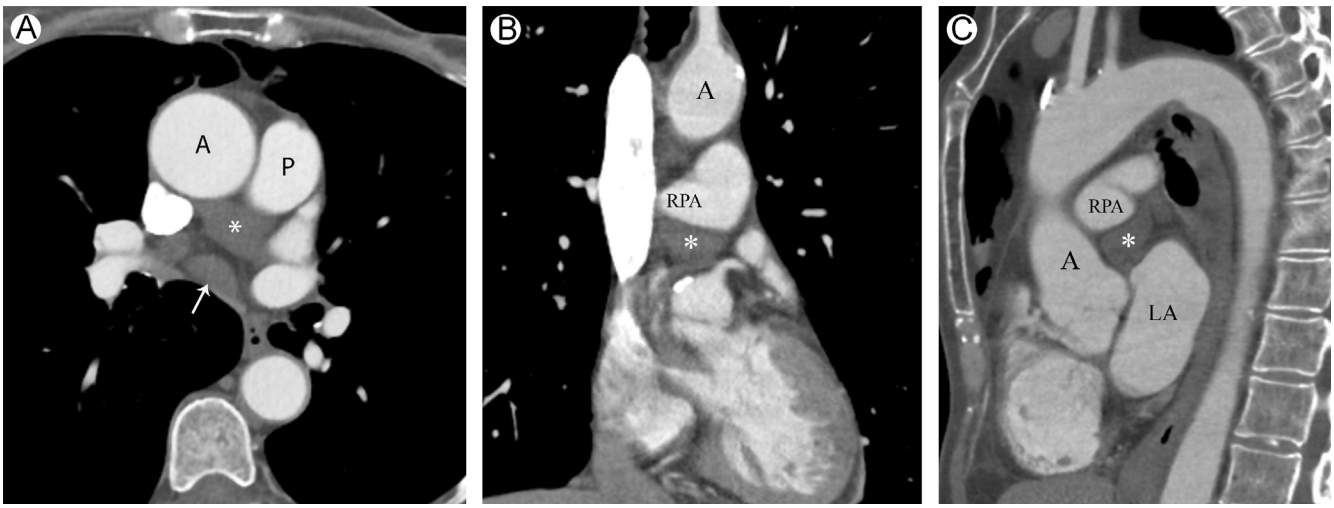

Figure 1 A 69-year-old woman with breast cancer. (A) Contrast-enhanced axial CT at a level just inferior to right pulmonary artery shows fluid in the transverse sinus (asterisk) and oblique sinus (arrow). (B) Coronal reformation shows transverse sinus (asterisk) located inferior to right pulmonary artery (RPA). (C) Sagittal reformation shows transverse sinus (asterisk) posterior to ascending aorta and cephalad to left atrium (LA). A = aorta, P = pulmonary artery, RPA = right pulmonary artery.

composition. Pericardial recesses do not enhance, whereas adenopathy usually enhances to some degree. Cine MRI sequences can also be useful to differentiate between fluid and adenopathy as they may show motion of fluid in the pericardial recesses. 18-Fluorodeoxyglucose (FDG)-PET-CT, which offers the advantage of providing the metabolic status of an abnormality, can also be used to help distinguish between pericardial recesses and adenopathy when CT features are inconclusive. Pericardial recesses do not show FDG uptake.

Pericardial Anatomy and Pitfalls

Transverse Sinus

The transverse sinus, located cephalad to the left atrium (LA) and posterior to the ascending aorta and pulmonary trunk, gives rise to 4 recesses that extend between the great vessels and the LA. The superior and inferior aortic recesses and the left and right pulmonic recesses are the 4 recesses of the transverse sinus.

The superior aortic recess, which represents the superior extent of the transverse sinus, extends upward along the right side of the ascending aorta usually to the level of the sternal angle.[8] At a lower level, the superior aortic recess lies behind the posterior aspect of the ascending aorta, and anteriorly, it travels across the ascending aorta and onto the upper part of the left pulmonary artery.[8] The superior aortic recess has 3 subdivisions: posterior, anterior, and right lateral portions (Fig. 2).

The posterior portion of the superior aortic recess, also referred to as the superior pericardial recess, is visualized as a crescent-shaped fluid collection that abuts the posterior wall of the ascending aorta. Visualization rate of this recess was 56.8% in the review by Ozmen et al.[3] The typical location, shape, and water attenuation allow differentiation of this recess from tracheobronchial adenopathy. Fluid in the superior pericardial recess may extend cephalad into the right paratracheal region in which case the recess is referred to as the high-riding superior pericardial recess (HRSPR). The HRSPR is defined as a sharply marginated homogeneous water-attenuation structure located in the paratracheal region between the brachiocephalic vessels and trachea, and contiguous with the superior pericardial recess (Fig. 3). The HRSPR was depicted in 6.6% (21 of 314) of patients in a retrospective review by Basile et al.[5] The extended recesses were rounded or oval in 5 patients and triangular, spindle, half-moon, or irregular shaped in the other 16 patients. The HRSPR ranged from 8-20 mm (mean = 14 mm) in short-axis diameter and was more than 10 mm in 5 of 6 patients evaluated by Choi et al.[6] In all 6 patients, the portion of the superior pericardial recess in the typical location was much smaller in diameter than the high-riding portion of

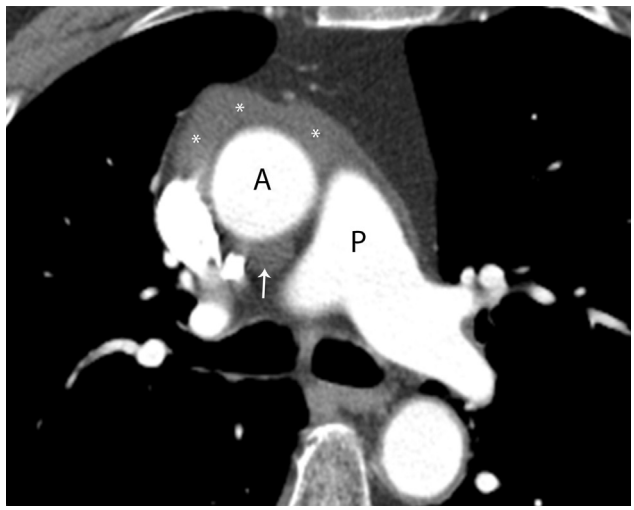

Figure 2 A 76-year-old man with melanoma. Contrast-enhanced CT at the level of aorta (A) and main pulmonary artery (P) shows anterior (asterisks) and posterior (arrow) portions of superior aortic recess.