61. Thoracic Vasculature

In the workup of pulmonary embolism, CE CT is most commonly used, while MR is reserved for patients with iodinated contrast allergies or in whom radiation exposure should be minimized. Nevertheless, MR remains promising due to its ability to obtain a variety of morphologic and functional information about the lungs, their vasculature, and other relevant structures within a single exam. On FSE images the pulmonary vasculature appears as low SI distinct from a high SI intraluminal embolus. Peripherally, less uniform blood flow leads to inconsistent signal voids, rendering this pattern less useful. On cine SSFP sequences emboli appear as low SI against high SI blood. By far the most commonly acquired MR scan for the assessment of pulmonary embolism is 3D CE MRA. Both pulmonary perfusion studies and high-resolution CE GRE T1WI may also be obtained. In the latter, emboli appear as foci of low SI against the enhancing vasculature.

Chronic emboli have a different presentation on imaging, as seen in the MIP CE MRA images of Figure 61.1 A, where enhancing vasculature is absent in the right middle and inferior lobes and the central pulmonary arteries are dilated. A four-chamber cine image of the same patient demonstrates additional findings, specifically right ventricular dilatation and hypertrophy (Fig. 61.1 B). Together these signs suggest pulmonary hypertension and cor pulmonale secondary to chronic pulmonary emboli.

In pulmonary hypertension, cine imaging may also demonstrate paradoxic bulging of the intraventricular septum toward the left ventricle in systole and low SI jets of tricuspid regurgitation. Right ventricular ejection fraction may be diminished and pulmonic arterial flow inhomogeneous on velocity-encoded MR. Pulmonary perfusion MRA involves acquiring CE T1WI in short-succession (< 20 seconds). Digital subtraction of images prior to parenchymal enhancement from images with maximal enhancement is performed, allowing for perfusion evaluation. These images may improve detection of subsegmental infarcts as wedge-shaped areas of hypoperfusion and allow monitoring of reperfusion after anticoagulation. Concurrent evaluation with ventilation scans utilizing aerosolized contrast, helium, or alternatively oxygen-enhanced MR (wherein the T1 shortening effect of molecular oxygen provides contrast) allows the distinction between hypoxic vasoconstriction (without ventilation-perfusion mismatches) and pulmonary embolus. Although not commonly performed, concurrent acquisition of lower extremity MR venography further highlights the versatility and potential of the modality, enabling detection of venous thrombi.

Pulmonary AVMs—associated with hereditary hemorrhagic telangiectasia (i.e. Osler Weber Rendu)—are also well-visualized on CE MRA. A MIP from a patient with the latter entity

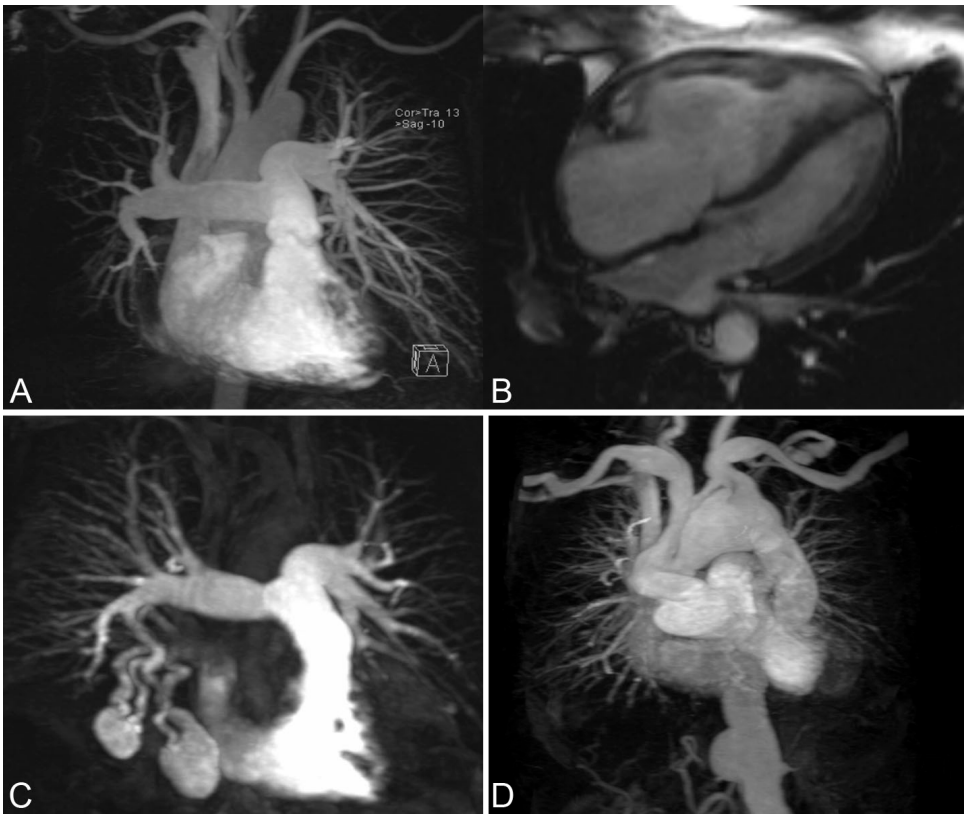

Fig. 61.1

is presented in Figure 61.1 C, with large AVMs noted within the right lower lobe. Preoperatively, 3D CE MRA allows identification and evaluation of feeding vessels.
For the thoracic aorta itself, MR can be useful in the detection of aneurysms and quantification of their size—dilatation of ascending aortic aneurysms over 5.5 cm necessitates surgical intervention. Aneurysms are divided into saccular (circumferentially localized) and fusiform (circumferentially diffuse) types: false aneurysms (contained by fewer than 3 layers of vessel wall) tend to be the former, and true aneurysms (contained by the entire wall) the latter. The longitudinal span and the number of aneurysms present as well as involvement of any branching arteries should be evaluated. MRI also effectively depicts concomitant processes, such as thrombus formation (within the aneurysm), compression of adjacent structures by an aneurysm, leakage, and para-aortic hematoma. Dissections of the aorta result from an intimal tear that allows blood to enter the aortic wall, creating a false lumen. 95% start in the thoracic aorta: Stanford type A (DeBakey 1 and 2) involve the ascending aorta and type B (DeBakey 3) do not. Type A dissections may involve the aortic valve or coronary arteries, and due to their severity may require immediate intervention. In hemodynamically stable patients, MR is preferred for evaluation. Cine SSFP sequences and 3D CE MRA allow for identification of an intimal flap, detection of thrombus within the false lumen, and the determination of branching

vessel origins. The MIP CE MRA images of Figure 61.1 D demonstrate a Stanford type A aortic aneurysm. In this case, the patent false lumen appears to feed the right brachiocephalic artery. In comparison, a thrombosed false lumen will demonstrate a more heterogenous SI on delayed CE MRA, a lower SI than the true lumen on cine SSFP, and a lack of flow void (higher SI) on FSE T1WI. A completely thrombosed false lumen may be difficult to distinguish from an aneurysm with mural thrombus. Characteristics favoring the former include longitudinal extension of the thrombus, a noncircular, compressed false lumen, or a change in the position of the thrombus as a result of the spiral configuration of the dissection membrane.