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Review of CT Angiography of Aorta

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During the past decade CT angiography (CTA) has become a standard noninvasive imaging modality for the depiction of vascular anatomy and pathology. The quality and speed of CTA examinations have increased dramatically as CT technology has evolved from one-channel spiral CT systems to multichannel (4-, 8-, 10- and 16-slice) spiral CT systems. Sixty-four multidetector row CT (MDCT) became available in 2004 [1–4]. The imaging modality most commonly used for diagnosis of aortic disease is CT, followed by transesophageal echocardiography, MR imaging, and aortography. If multiple imaging is performed, the initial imaging technique most frequently used is CT [5].

CT techniques

Examination protocols

CTA of the aorta using four-slice scanners produces images with a lower spatial resolution and a relatively longer scan time than those produced using scanners with 16 or more slices. The spatial resolution needed to render diagnostic images of the smaller branches of the aorta and of intimal tears becomes feasible with the latter scanners. The scan should cover the area from a level 3 cm above the aortic arch to the level of the femoral heads. Typical protocols for 4-, 16- and 64-slice scanners for aortic CTA are given in Table 1.

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***Table 1:* Scan protocols for CT angiography of the entire aorta with a range of 100 cm for different scanners**

Scanner	Rotation time (s)	Collimation	Table feed (mm/s)	Slice thickness (mm)	Slice interval (mm)	Duration (s)	Number of images
4-slice	0.5	4 × 2.5 mm	30	3	1.5	33	667
	0.8	4 × 2.5 mm	19	3	1.5	53	667
16-slice	0.5	16 × 1.5 mm	48	2	1.2	21	833
64-slice	0.33	32 × 0.6 mm × 2	48	1	0.8	21	1250

Currently the standard tube voltage for CTA is 120 kV. The tube current should be approximately 120 mAs, and automated dose modulation should be used. A tube voltage of 100 kV increases the contrast-to-noise ratio because of effective X-ray absorption by iodine at lower tube voltages, which improves the quality of images and reduces the radiation exposure to patients by 35% in comparison with 120 kV at a constant tube current [6]. CTA of the abdominal aorta performed at a low voltage results in higher attenuation in the aorta with reduced radiation dose and without degrading the diagnostic image quality. The volume of iodinated contrast medium can be reduced by lowering the voltage during CTA [7,8].

The beating of the heart results in both circular and perpendicular motion of the aorta that is most pronounced near the heart. Pseudodissection of the thoracic aorta, a well-known pitfall, occurs predominantly at the right anterior and left posterior aortic circumference (Fig. 1) [9]. Multiplanar reconstruction of images from contrast-enhanced or unenhanced helical CT provides evidence of motion artifacts [10]. Hofmann and colleagues [11] recommended the use of retrospective ECG gating for imaging of the heart, the aortic root, and the ascending aorta, especially when motion artifacts may influence the diagnosis critically (eg, when aortic dissection is suspected); however, an ECG-gated scan increases the radiation dose to the patient. Morgan-Hughes and colleagues [12] suggested that in patients who have slower heart rates ($\leq$ 70 beats per minute), a reconstruction window should be centered at 75% of the R-R interval and that in patients who have faster heart rates (> 70 beats per minute) the construction window should be centered at 50% of the R-R interval. ECG-assisted MDCT shows a significant reduction of motion artifacts for the entire thoracic aorta compared with non–ECG-assisted MDCT [9].

Protocols for administration of contrast medium

High-quality CTA of the aorta requires sufficient contrast enhancement. An intra-arterial target threshold higher than 200 Hounsfield units (HU) produces adequate aortic enhancement for a diagnostic study [13]. As blood and the contrast media travel downstream, gradual mixing of the central and peripheral parts of the lumen occurs; to compensate for this dilution effect, a high-contrast delivery rate should be used to reach the target threshold. In addition, the reduction in the volume of contrast material for a given

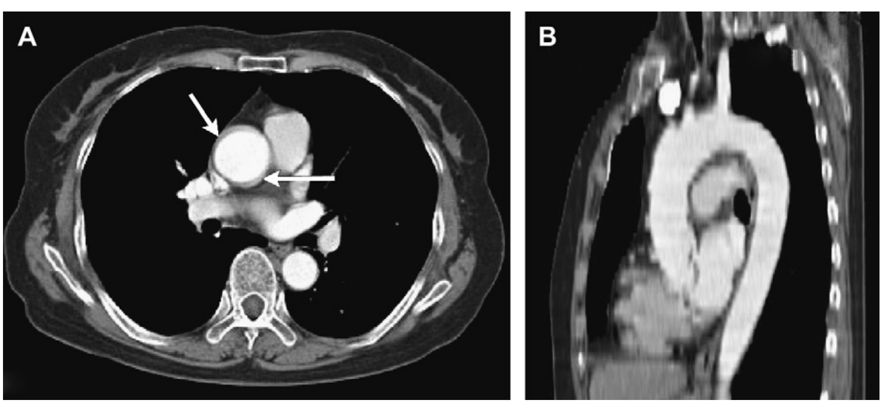

Fig. 1. (*A*) The motion of the heart transfers motion to the right anterior and left posterior walls of the ascending aorta (*white arrows*), which mimics aortic dissection. (*B*) Sagittal multiplanar reformation reconstruction shows evidence of motion artifact.

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