Computed Tomographic Angiography of the Abdominal Aorta

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KEYWORDS

• Computed tomographic angiography • Aorta • Aneurysm • Aortitis • Abdominal aortic aneurysm • Aortic dissection

KEY POINTS

- CT angiography has become the preferred imaging method for planning aortic aneurysm repair, monitoring complications, and routine follow-up.
- CT angiography is widely available, using thin slice isotropic imaging, rapid bolus contrast injection, and fast multidetector CT technology.
- Acute aortic syndromes, aortitis/inflammatory vasculitides, and chronic atherosclerotic changes have characteristic CT angiographic manifestations that allow radiologists to provide accurate diagnoses and guide management.
- In development are new CT angiographic techniques that will enable aortic evaluation with lower contrast and radiation doses.

INTRODUCTION

Computed tomographic angiography (CTA) of the abdominal aorta has replaced angiography as the initial imaging test of choice for acute aortic disease, occlusive atherosclerotic disease, inflammatory vasculitis workups, and preintervention/postintervention imaging of abdominal aortic aneurysms (AAA) at most centers. For many years after its arrival in 1971, CT was too slow for optimal imaging of the cardiovascular system. With the introduction of slip ring technology and the change from single to multiple detector CT (MDCT), the temporal capabilities of CT became adequate for assessing the vascular system.[1] With the widespread availability of state-of-the-art multidetector technology, CT can provide submillimeter resolution along the z-axis, allowing for isotropic volumetric data sets. This technology offers exquisite detailed anatomic information that guides operative procedures for AAA. In addition, it rapidly dictates patient management in the acute and chronic settings for most aortic diseases. In this article, basic abdominal aortic anatomy is reviewed, technical aspects of CTA image acquisition and the latest advances in technology are outlined, and diagnoses of various acute and chronic aortic diseases in the abdomen are discussed.

ANATOMY

Normal Anatomy

The abdominal aorta begins at the level of the diaphragmatic hiatus, which is usually at approximately the T12 vertebral body level (**Fig. 1**). The abdominal aorta gives off several major and minor branches in the anterior, lateral, and posterior directions before it terminates at the L4 vertebral body level into bilateral common iliac arteries (CIAs). Unpaired anterior branches supply the gastrointestinal tract; the celiac axis (CA), superior mesenteric artery (SMA), and the inferior

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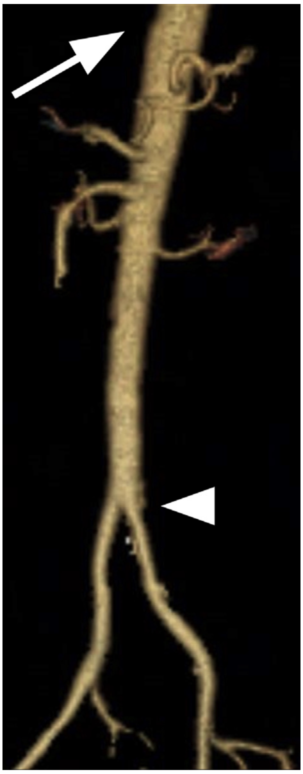

Fig. 1. Oblique coronal three-dimensional volume-rendered image of the abdominal aorta in a normal 19-year-old man. The abdominal aorta originates at the diaphragmatic hiatus (T12 level [*arrow*]) and extends until the bifurcation into the CIAs (*arrowhead*).

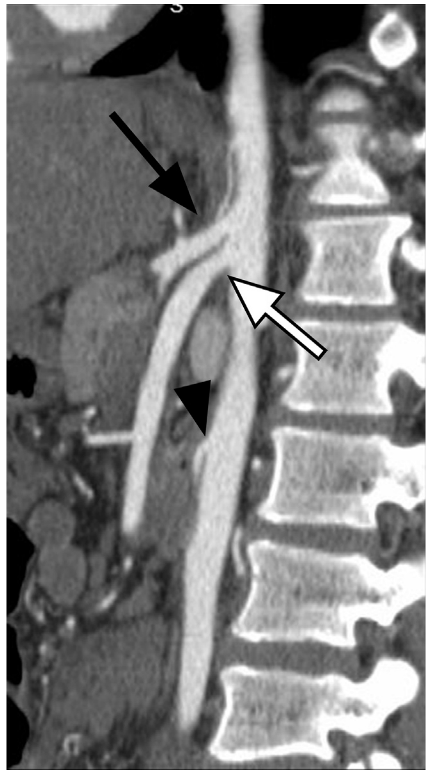

Fig. 2. Sagittal CTA image of the abdominal aorta well shows the origins of the CA (*black arrow*), SMA (*white arrow*), and IMA (*black arrowhead*).

mesenteric artery (IMA) are often best visualized in the sagittal plane (**Fig. 2**). Paired arteries in the lateral plane arise off the aorta to supply the genitourinary and endocrine organs: the renal, adrenal, and gonadal (ovarian or testicular) arteries (**Fig. 3**), often best seen in the coronal plane. In the posterior plane, paired inferior phrenic and lumbar arteries arise from the aorta to supply the diaphragm and body wall musculature (**Fig. 4**). The artery of Adamkiewicz provides collateral supply to the lower spinal cord, arising variably from a lumbar artery or a posterior intercostal artery near the level of the thoracolumbar junction.[2] The middle sacral artery is an unpaired posterior branch of the aorta near the bifurcation that supplies the rectum.

The paired CIAs arise from the aortic bifurcation to then bifurcate at the pelvic brim into the external iliac artery (EIA) and internal iliac artery (IIA, also called hypogastric artery). The EIAs then supply the lower extremities, whereas the IIA bifurcates into anterior and posterior divisions (**Fig. 5**). Anterior division branches include obturator, inferior gluteal, umbilical, uterine and vaginal (females), inferior vesicular, internal pudendal, and middle rectal arteries. Posterior division branches include iliolumbar, lateral sacral, and superior gluteal branches. Anatomic variations of these divisions are common, and numerous classification schemes are used for interventional purposes.[3]

Variant Anatomy

Anatomic variation of the visceral branches arising off the aorta is commonly encountered. The most common branching variant is that of accessory renal arteries, with many patients having 3 or more renal arteries arising off the aorta (**Fig. 6**). CTA has proved to have excellent correlation with surgical findings in the evaluation of variant renal arterial supply in the renal donor population.[4] Similarly, the branching pattern of the CA frequently shows variation (**Fig. 7**).[5–7] The most common variants involve the hepatic arteries, with the right hepatic artery being replaced off the SMA in up to 17.7% of individuals and the left hepatic artery arising off the left gastric artery in up to 5.5% of people.[5,7] With