MDCT findings of abdominal aortic aneurysm and its complications

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Learning objectives

Abdominal aortic aneurysm (AAA) is a localized dilatation of aortic wall and accurate detection of its complications is crucial to perform prompt therapeutic interventions. Computed tomography angiography (CTA) is of vital importance for monitoring the size of the aneurysm, as well as differentiation of the potential complications.

We intend to demonstrate the spectrum of multi-detector computed tomography (MDCT) findings in AAA as well as its various consequences including intraluminal thrombosis, impending rupture, contained rupture, rupture and aorto-venous fistula.
Background

The prevalence of AAA has been reported to be 2-4 % in patients older than 50 years of age. It has been postulated that increasing incidence of AAA is related to improved abilities of imaging modalities and increased life expectancy of the general population. Atherosclerosis is the leading cause of AAA. In addition, it might develop secondary to cystic media necrosis, inflammation, infection (mycotic aneurysm) or trauma.

CTA is the preferred imaging modality for detecting and monitoring of AAA due to its high accuracy and noninvasive nature. The most valuable advantages of using CT angiogram over magnetic resonance imaging (MRI) include not only shorter scan time but also its widespread availability. Addition of multi-planar reformatted and three-dimensional rendering images may help in easy identification of the exact site and level of AAA.
Imaging findings OR Procedure details

Intraluminal thrombosis

Intraluminal thrombosis frequently occurs in AAA and may be definitely diagnosed based on its presence along the inner aspect of intimal calcification as well as its irregular border with the patent lumen (see figure 1). In contrast to conventional angiography, CTA is able to detect the presence and also the extent of intraluminal thrombus.

Impending rupture

Interestingly, the growth rate of even small AAA in sequential studies is correlated with increased likelihood of aneurysmal rupture. Therefore, periodic radiologic surveillance is advised for all AAAs. When the diameter of AAA increases, the thrombus-to-patent lumen ratio of aneurysm will decrease. Thus, decreased thrombus-to-patent lumen ratio is another sign of impending rupture. Another helpful radiological finding, in favor of impending rupture is hyperattenuating crescent sign which reflects hemorrhage in the mural thrombosis or in the aneurysm wall. This sign, if present, appears as an intramural area with attenuation of more than patent luminal region in unenhanced computed tomography (CT) (see figure 2) or more than that of psoas muscle in contrast-enhanced CT (see figure 3). Extravasation of contrast media into mural thrombosis of AAA, in the absence of frank retro- or intra- peritoneal hemorrhage, is also considered another sign of impending rupture and represents dissection of blood from patent lumen into luminal thrombosis which has not disrupted the aneurysm wall yet (see figure 4).

Contained rupture

Previous rupture into a confined anatomic compartment should be suspected in patients with known history of AAA, previous episodes of abdominal pain and stable hemodynamic status. Contained leakage of blood beyond the aneurysm wall can occur in any aspects of AAA (see figure 5); however, draped aorta sign may be helpful in diagnosis of contained aneurysmal rupture. This sign is present when the posterior part of AAA drapes over the adjacent vertebrae and/or when there is no distinct border between the posterior aspect of AAA and its adjacent structures (see figure 6).

Rupture

Posterolateral aspect of aortic wall is the most common site of rupture in AAAs, which results in hemorrhage into retroperitoneal spaces including perirenal space, pararenal spaces and psoas muscles. Thus, the most common imaging feature of aneurysmal rupture is the presence of retroperitoneal hematoma adjacent to AAA. This finding is best appreciated in contrast-enhanced CT but it may also be detected in unenhanced
CT, which might have been carried out for other reasons of abdominal pain. Focal discontinuity of intimal calcification, if present, may delineate the site of rupture (see figure 7). Intraperitoneal extravasation may also occur, resulting from disruption of the anterior or anterolateral aspect of the aneurysm.

**Aorto-caval fistula**

Aorto-caval fistula is an uncommon condition, found only in 4% of ruptured AAA. Its clinical manifestations include low back pain, pulsatile abdominal mass and continuous abdominal bruit, accompanied by hyper dynamic cardiac failure and regional venous hypertension. Characteristic CT findings of aorto-caval fistula include simultaneous contrast enhancement of dilated inferior vena cava (IVC) and adjacent AAA in arterial phase associated with absence of normal fat plane between them. Fistulous tract between AAA and IVC may be rarely detected, as well (see figure 8).
Images for this section:

**Fig. 1:** A 45-year-old man with ischemia of lower limbs. Contrast-enhanced CT reveals an incidentally found AAA. Intraluminal thrombosis (arrow) makes irregular border with the patent lumen. Also depicted is intraperitoneal free fluid around the liver and spleen.

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Fig. 2: A 76-year-old woman with back pain. Abdominal CT without intravenous administration of contrast agent shows impending rupture in AAA associated with hyper attenuating crescent sign, in which the attenuation of intraluminal thrombosis of the aneurysm (white arrow) is more than that of the patent lumen (black arrow).

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Fig. 3: A 62-year-old man with abdominal pain and constipation. Post-contrast CT shows diffuse dilatation of colon in a patient with sigmoid volvulus. Also noted is dilatation of abdominal aorta with hyperattenuating crescent sign (arrow), implying impending rupture of AAA.

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Fig. 4: an 84-year-old woman with history of hypertension and recent abdominal pain. CT angiographic scan demonstrates an infra renal AAA. Extravasation of contrast media into the intraluminal thrombosis (long black arrows) is seen accompanied by enlargement of aneurysmal diameter as compared with previous studies (not show); however, no evidence of either intraperitoneal or retroperitoneal hemorrhage is observed yet. The mentioned findings are most consistent with impending rupture. Calcified plaques in aneurysm wall (open arrow) and a few tiny calcified foci in the intraluminal thrombosis (short white arrow) are detected, as well.

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Fig. 5: A 78-year-old man with history of AAA and previous episodes of abdominal pain. CT angiographic image, at a lower level than in A, reveals the extension of AAA into left common iliac artery. Contained leak of aneurysm causes eccentric soft tissue density in anterior part of the affected artery (long arrows). Disrupted portion of intimal calcification (short arrows), a small branch of inferior mesenteric artery (curve arrow) and right common iliac artery (open arrows) are also delineated.

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Fig. 6: A 65-year-old woman with back pain. CT angiogram shows contained rupture of AAA, in which the posterior wall follows the contour of the anterior border of adjacent vertebral body (short arrows). Also noted is the presence of calcified foci in aneurysm wall (long arrows).

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Fig. 7: A 62-year-old man with known history of AAA and severe abdominal pain. CT angiographic image demonstrates a ruptured AAA accompanied by retroperitoneal hemorrhage (star), extravasation of contrast media into the intraluminal thrombosis (short black arrow) and discontinuity of intimal calcification (long white arrow). The latter is indicative of the site of rupture.

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**Fig. 8:** A 40-year-old man with abdominal pain. Axial CT angiographic image reveals communication between AAA and IVC (arrow), consistent with aorto-caval fistula.

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Conclusion

CTA is the best suited imaging modality for not only detecting AAA but also to evaluate its various complications. Familiarity with the characteristic imaging features of AAA is essential for clinical radiologists and also referring physicians in prompt diagnosis of its life-threatening complications.


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