Study of aortic ulcer by using MDCTA

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Authors: L. Saba, R. Sanfilippo, M. Atzeni, D. Ribuffo, R. Montisci, G. Mallarini; Cagliari/IT
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Learning objectives

The learning objectives in this work are:

1) to understand the physiopathology of aortic ulcer.

2) To learn the CT technical parameter to be used, as well as the correct delay time, concentration and volume of contrast material.

3) To show which post-processing methods can be used and their indications, including maximum intensity projection (MIP), multi-planar reconstruction (MPR) and volume rendering (VR).
Background

The first author that describe the penetrating atherosclerotic ulcer of the aorta was Stanson in 1986. This pathology is characterized by ulceration that penetrates through the elastic lamina and into the media and is associated with a variable amount of hematoma within the aortic wall. Penetrating atherosclerotic ulcer has been described as a process involving the thoracic aorta that is distinct from aneurysm and classic aortic dissection. Atheromatous ulcers that are confined to the intimal layer sometimes appear radiologically similar to penetrating atherosclerotic ulcers. Therefore, care should be taken in making a diagnosis of penetrating atherosclerotic ulcer.

In a penetrating aortic ulcer, an atheromatous plaque ulcerates and disrupts the internal elastic lamina, burrowing deeply through the intima into the aortic media. When an atherosclerotic plaque penetrates into the media, the media is exposed to pulsatile arterial flow, which causes hemorrhage into the wall that then leads to intramural hematoma. The plaque may precipitate a localized intramedial dissection associated with a variable amount of hematoma within the aortic wall, may break through into the adventitia to form a pseudoaneurysm, or may rupture. Ulceration of an aortic atheroma occurs in patients with advanced atherosclerosis.

The development of penetrating atherosclerotic ulcer is characterized by several stages. Usually the atheromatous ulcer develop in patients with advanced atherosclerosis. At this stage, the lesions are usually asymptomatic and confined to the intimal layer. In the next stage, the lesion progresses to a deep atheromatous ulcer that penetrates through the elastic lamina and into the media (ie, penetrating atherosclerotic ulcer). Hematoma formation may extend along the media, resulting in either "double-barreled" or "thrombosed" aortic dissection. Double-barreled aortic dissection demonstrates communication between the true and false lumina, whereas thrombosed aortic dissection shows no opacification of the false lumen. In some cases, hematoma extension causes stretching of the weakened aortic wall, leading to the formation of a saccular aortic aneurysm. The aortic aneurysm and dissection may eventually rupture.

Spontaneous rupture of the thoracic descending aorta is a rare condition that occurs in the absence of a true aneurysm. Most cases involve predisposing conditions such as hypertension and atherosclerosis. The precise mechanism of spontaneous rupture is not well understood. However some authors have hypothesized that there may be pressure atrophy of the media due to overlying intimal atherosclerotic plaque with localized balloononing of the aortic wall prior to perforation. Most spontaneous aortic ruptures are believed to be associated with perforation through the atheromatous plaque.
Unlike typical aortic dissection, penetrating atherosclerotic ulcers most often occur in elderly patients with severe underlying atherosclerosis. These ulcers typically involve the aortic arch and descending thoracic aorta and occur rarely in the ascending aorta, where rapid blood flow from the left ventricle provides protection against atherosclerosis.
Imaging Technique

At our Institution, helical CT examinations are performed with a multi-detector-row scanner. The examination begins with the acquisition of an unenhanced CT scan. Coverage begins 3 cm above the aortic arch and continues to the upper side of the femoral head. Unenhanced CT scans are useful for diagnosing acute hemorrhage.

After unenhanced CT, contrast-enhanced CT is performed with a bolus injection of 120 mL of nonionic contrast material at a rate of 3-5 mL/sec through a 18-gauge catheter. The catheter should be positioned in the right arm, if possible, to avoid opacification of the left brachiocephalic vein, which could result in a perivenous artifact that substantially degrades visualization of the origin of the brachiocephalic artery. In general, optimal imaging of the thoracic aorta and abdominal aorta is obtained with scanning delays of 15-30 and 20-30 seconds, respectively. The use of bolus tracking is extremely important in order to have a complete vessel opacification Enhanced CT is performed with the following parameters: 200-260 mA, 120 kV, pitch of 1. Coverage begins 3 cm above the aortic arch and continues to the bifurcation of the iliac artery.

Imaging findings

CT findings of penetrating ulcers include focal involvement with adjacent subintimal hematoma located beneath the frequently calcified and inwardly displaced intima in the middle or distal third of the thoracic aorta. The ulcer is often associated with thickening or enhancement of the aortic wall.

On imaging, a penetrating aortic ulcer can be distinguished from an atheromatous plaque by presence of a focal, contrast-filled outpouching surrounded by an intramural hematoma. The atheromatous plaque with ulceration but without penetration through the intima shows irregular margins, but no contrast material extends beyond the level of intima, which is frequently calcified, and no intramural hematoma is present.

Compared to CT, the MRI allows multiplanar imaging without use of contrast material.

Multiple penetrating atherosclerotic ulcers may also be seen. Some of these ulcers may develop after the extension of hematoma, presumably secondary to weakening of the intimal layer.
Conclusion

To distinguish ulcer from other causes of aortic disease such as aortic dissection, is not always possible by using MDCTA. The use of advanced post-processing procedures allow a better analysis of this pathology.
Personal Information

Luca Saba MD, A.O.U. of Cagliari. Department of Radiology


