Application of computed tomography angiography in thoracic aortic aneurysm

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Abstract
Thoracic aortic aneurysm (TAA) is the most common thoracic aortic dilatation. Computed tomography angiography can effectively assess the shape, location and degree of dilatation of TAA. It can also show the blood vessels involved in TAA, including left subclavian artery, double renal artery and abdominal aorta. At present, post-processing techniques of computed tomography angiography include MPR, CPR, VR. These methods are commonly used to evaluate TAA.

1. Introduction
Thoracic aortic aneurysm (TAA) is a common degenerative cardiovascular disease occurring in the elderly. Usually, TAA can be divided into fusiform aneurysms, saccular aneurysms and dissecting aneurysms. According to the location, it also can be divided into ascending aortic aneurysms, aortic arch aneurysms, descending aortic aneurysms and abdominal aortic aneurysms [1-2]. Studies have shown that the ascending aortic aneurysm grows slowly, about 0.1 cm per year (the descending aortic aneurysm grows somewhat faster) [3]. There are no obvious clinical symptoms in the early stage, with the aneurysm growing slowly, it may oppress trachea and esophagus, leading to the clinical symptoms such as cough and dysphagia. If the aneurysm ruptures, it can be life-threatening [4-8]. In clinical, most individuals with asymptomatic descending TAA may be safely managed with cardiovascular risk factor modification until the aneurysm size reaches 6 cm. If the limitation is exceeded, it will be offered the open surgical management or other medical therapies [9]. Therefore, early diagnosis of thoracic aortic aneurysm is of great significance to decrease the mortality. Computed tomography examination is always used to the clinic, which has fast scanning speed, wide scanning range, powerful post-processing function, obtaining high-quality reconstructed images to apply in the diagnosis of TAA [10-11].

The purpose of this research was to estimate the application of computed tomography angiography in TAA. We will use the multi-planar reconstruction (MPR), surface reconstruction (CPR), volume rendering (VR) and other post-processing techniques to diagnose and estimate TAA.

2. Materials and methods

2.1. Patient characteristics
293 patients chose aortic CTA were selected into this study from May 2020 to July 2020. All patients with or without chest symptoms were underwent the examination of aortic CTA. Patients with the medical history of arrhythmia, severe renal failure, organ failure or iodic allergy were excluded.
2.2. Computed tomography protocol
Aortic CTA were used on 256 slice CT (GE Spectrum CT) with ECG gated. Scanning direction was from head to toes, the range was from proximal part of brachiocephalic artery to the distal segment of bilateral femoral arteries. Tube voltage was 100kVp, tube current was 200-600mAs and slice thickness was 0.9-2.5mm. The contrast agent was injected in a single phase.

2.3. Post-processing technique
Axial section images were obtained in all patients with TAA. After scanning, we could get the original image at the work center, a film with 144 axial sections was printed, and it covers the neck, chest and lower abdomen of the body. Aorta in the MPR is multi angle. Imaging doctors could rotate, enlarge and adjust the contrast to get the best diagnostic image. It was of great significance to other abdominal organs. Furthermore, we observed the aorta from VR more vividly. CPR technique was used to show the position and range of TAA. In this background, We can record the largest diameter of TAA, the number and severity of the involved vessels. This is not only valuable for this diagnosis, but also for the reexamination of patients.

3. Results and Discussions

3.1. Patient characteristics
According to the morphology, 22 patients (7.5%) were diagnosed as fusiform aneurysm, 46 (15.7%) patients as saccular aneurysm, 39 patients (13.3%) as dissecting aneurysm, and 186 patients (63.5%) as other non-aortic aneurysm disease, such as main artery atherosclerosis or aortic dissection.

3.1.1. According to pattern
TAA can be divided into fusiform aneurysms, saccular aneurysms and dissecting aneurysms. As shown in Fig.1.1, fusiform aneurysm was observed in the descending aorta (white arrow). Fig.1.2 showed the saccular aneurysm in aortic root (white arrow). Fig.1.3 showed VR imaging of aorta, we can see the dissection (white arrow).

![Fig.1 CTA features of TAA. (1.1) Thoracic aortic aneurysm (white arrow). (1.2) Thoracic aortic aneurysm (white arrow). (1.3) VR of aorta.](image)

3.2. Patient characteristics
According to location, ascending aortic aneurysm was found in 56 patients (19.1%), descending aortic aneurysm was found in 33 patient (11.3%), aortic arch aneurysm was found in 42 patients (14.3%), abdominal aneurysm was found in 62 patients (21.2%). Other non-aortic aneurysm diseases were found in 100 patients (34.1%), such as main artery atherosclerosis or aortic dissection.
3.2.1. According to position
TAA can be divided into ascending aortic aneurysm, descending aortic aneurysm, aortic arch aneurysm and abdominal aortic aneurysm. As shown in Fig.2.1, aneurysm was observed in the ascending aorta (white arrow). The descending aorta was accompanied by a few intramural hematomas and atherosclerosis. Fig.2.2 showed the aneurysm in descending aorta (white arrow). Fig.2.3 showed VR imaging of aorta, we can see the aneurysm occurred in the aortic arch (white arrow).

Fig.2 CTA features of TAA. (2.1) Ascending aortic aneurysm (white arrow). (2.2) Descending aneurysm (white arrow). (2.3) VR of aorta.

4. Conclusion
Computed tomography angiography of aorta can diagnose and classify thoracic aortic aneurysms, judge the involved vessels finally. Through the application of post-processing technology, such as the pictures listed above, we can evaluate thoracic aortic aneurysms effectively. The technology used in this research plays an important role in the diagnosis of imaging doctors and the treatment of clinicians. Especially for asymptomatic TAA, early diagnosis and early treatment can avoid the deterioration of the disease.

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