Applying computed tomography angiography in diagnosing and classifying abdominal aortic aneurysm

Biying Yuan, Jianhua Liu, Jiale Tian, Nannan Xu*
Department of Radiology, the Second Hospital of Jilin University, Changchun, 130041, China
Corresponding author: nnxu@jlu.edu.cn

Abstract. Abdominal aortic aneurysm (AAA) is the most common arterial dilatation disease. Computed tomographic angiography has been used all the time in the diagnosis of AAA. Applying the techniques in AAA, we can not only locate the position of AAA, but also classify it, and provide more valuable information for clinicians. Currently, post-processing methods include MPR, CPR, VR. These methods have their own advantages.

1. Introduction
Abdominal aortic aneurysm (AAA) is a dilated disease of abdominal aorta. When the diameter of the abdominal aorta expands to 1.5 times the normal diameter, it is called AAA [1]. AAA mainly occurs in the elderly over 60 years old, often accompanied by hypertension and heart diseases [2-3]. AAA is a silent, progressive disease, but once it starts, aneurysms occur rupture or accompany other infections, and this disease can be very parlous [4]. In order to avoid the deterioration of the disease, we need to make an accurate diagnosis. The diagnosis of AAA has many techniques of examination, such as magnetic resonance imaging (MRI), ultrasound (US), and computed tomography angiography (CTA). Scanning time of MRI is longer than other measures, and in severe cases, it will be intolerable. Studies have shown that there are some errors in the average measured values of conventional US [5]. Therefore, CTA with powerful post-processing technologies is the best choice for the diagnosis of AAA [6]. It can accurately evaluate the shape of the aneurysm and guide clinical treatment. According to the above information, aortic computed tomography can classify for AAA, which is divided into Crawford Type I, Crawford Type II, Crawford Type III, Crawford Type IV [7].

The purpose of this research was to prove the practicability of post-processing techniques of computed tomography imaging in various types of AAA. The above techniques are valid methods to estimate AAA.

2. Materials and methods

2.1. Patient characteristics
From Aug 2020 to Nov 2020, 395 patients chose aortic CTA were selected for the research. Patients are usually accompanied by acute chest pain or other symptoms. They excluded relevant contraindications, such as severe arrhythmias, allergy to contrast agents, and taking taboo drugs.
2.2. Computed tomography protocol
Aortic CTA were used on 256 slice CT (Philips CT) with ECG gated. Scanning direction was from chest level to foot level. The range was from 3 cm above aortic arch to the bilateral inguinal (including distal femoral artery). Tube voltage was 120 kVp, tube current was 200-600mAs and slice thickness was 0.9-2.5mm. The contrast agent was injected in a single phase. The rotation speed of the frame was about 330ms/cycle.

2.3. Post-processing technique
All patients' images could be observed from work window, technician printed 144 axial sections to show the entire aorta, ranging from chest level to the distal segment of femoral artery. AAA in MPR was clearly, it could help imaging doctors find the origin of AAA and judge the possibility of rupture. For CPR images, the images showed the largest diameter of AAA, whether accompanied by aortic dissection, intramural hematoma or other diseases. The occurrence of multiple AAA in an individual should be judged and measured in turn, and classified finally. In addition, VR helped the clinician to understand the overall structure.

3. Results and Discussions

3.1. Patient characteristics
We have selected 395 patients of AAA from Jun 2020 to Nov 2020, which contained 116 females and 279 males. Aneurysm of crawford Type I was found in 90 patients (22.8%), Aneurysm of crawford Type II was found in 56 patients (14.2%), Aneurysm of crawford Type III was found in 102 patients (25.8%), Aneurysm of crawford Type IV was found in 147 patients (37.2%).

3.2. Crawford Type I
Aneurysm of crawford Type I began at the distal end of the left subclavian artery and involved the upper abdominal aorta of the renal artery. As shown in Fig.1.1, aneurysm was observed in the descending thoracic aorta (white arrow). Fig.1.2 showed the aneurysm accompanied by severe intramural hematoma (white arrow). Fig.1.3 showed the aneurysm involved the upper abdominal aorta of the renal artery (white arrow), right renal artery was mild stenosis. Fig.1.4 showed VR imaging of aorta.

![Fig.1 CTA characteristics of AAA of type I. (1.1) Aneurysm in the descending aorta (white arrow). (1.2) AAA in the aortic arch (white arrow). (1.3) AAA is above the renal artery (white arrow). (1.4) VR of aorta.](image)

3.3. Crawford Type II
Type II involved the whole descending thoracic aorta and abdominal aorta. As shown in Fig.2.1, aneurysm was observed the largest diameter of aneurysm (white arrow). Fig.2.2 showed the aneurysm in the CPR, it also occurred aortic dissection. Fig.2.3 showed the aneurysm involved the bifurcation of
abdominal aorta, at the same time, abdominal aorta was accompanied by severe intramural hematoma. Fig.2.4 showed VR imaging of aorta.

3.4. Crawford Type III
Type III involved the distal descending thoracic aorta and the whole abdominal aorta. As shown in Fig.3.1, aneurysm was observed in the distal of descending aorta (white arrow). Fig.3.2 showed the aneurysm accompanied serious intramural hematoma (white arrow). Fig.3.3 showed the aneurysm in the CPR of sagittal view, it also showed aortic dissection. Fig.3.4 showed VR imaging of aorta.

3.5. Crawford Type IV
Type IV involved the whole abdominal aorta, including the renal artery, but the descending thoracic aorta was normal. As shown in Fig.4.1, descending thoracic aorta was accompanied by atherosclerosis and intramural hematoma, but no aneurysm occurred (white arrow). Fig.4.2 showed ascending aorta, aortic arch and corresponding vessels. Fig.4.3 showed the aneurysm in the CPR of sagittal view (white arrow). Fig.4.4 showed VR imaging of aorta.
4. Conclusion

The post-processing technology in CTA can quickly diagnose and classify AAA. In many examinations, it is unique and has become the preferred method in clinical diagnosis and treatment. It has the advantages of low risk, high credibility and no pain. The techniques in this research can win more treatment time for patients and minimize the risk of aneurysm rupture.

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