QUALITY CONTROL OF LOWER LIMB ARTERY IMAGING BY 320 - SLICE SPIRAL CT AND ITS EFFECT IN ARTERIAL STENOSIS ASSESSMENT

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ABSTRACT

Objective*: This study aims to evaluate specific effect of 320-slice spiral CT in assessment of lower limb arterial stenosis, analyze the specific factors affecting imaging quality of lower limb artery by 320-slice spiral CT, and propose effective countermeasures.*

Methods*: The 400 patients receiving 320-slice spiral CT of lower limb arterial imaging examination in our hospital from March 2014 to March 2016 were included in the study. The differences in relevant parameters of general data, clinical manifestation and scanning were analyzed, the specific factors affecting lower limb artery imaging quality were analyzed; According to the standard of spiral CT imaging, arterial stenosis of the patients was divided into 4 levels by considering general data, respectively less than 50%, 50%-75%, 76% -99%, occlusion. The specific effect of lower limb artery imaging by 320 - slice spiral CT under different grades of arterial stenosis was analyzed.*

Results*: As can be seen from the imaging results, the higher the level of arterial stenosis is, the higher the sensitivity and specificity of 320-slice spiral CT in evaluation of lower limb artery imaging is, especially sensitivity. There are significant differences between the different levels ($P < 0.05$); The imaging quality of lower limb artery by 320 - slice spiral CT is affected by such factors as contrast agent velocity, contrast agent concentration, contrast agent dose, delay time, scanning parameters, vascular calcification, patient age and reconstruction technique ($P < 0.05$).*

Conclusion*: Lower limb artery imaging by 320 - slice spiral CT has a high sensitivity and specificity, which enjoys great value in clinical application.*

Keywords*: 320-slice spiral CT, Lower limb artery imaging, Arterial stenosis assessment, Quality control.*

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Introduction

Arterial occlusion of the lower limb is an important manifestation of atherosclerosis. The statistics show that incidence of the disease in China stands as high as 12% -20%, especially in elderly patients whose incidence reaches 7.97%. With the upward trend in aging population, incidence of lower limb arterial occlusive disease also shows an uptrend. Studies suggest that lower limb arterial occlusive disease is mainly due to accumulation of lipid plaque deposition on the blood vessel wall, which makes the wall stiff and narrow and leads complete occlusion as narrowness deteriorates[1-3]. In order to prevent deterioration of lower limb arterial occlusive disease, early accurate diagnosis is needed so as to start early treatment.

Digital subtraction angiography has been an effective diagnostic method for lower limb arterial occlusive disease in the clinic, which is also considered as a "gold standard"[4]. In this paper, the specific effects of 320-slice spiral CT in arterial stenosis assessment were studied, and the related factors affecting lower limb artery imaging quality were summarized. See below for details.

Materials and methods

General Information

The 400 patients receiving 320-slice spiral CT of lower limb arterial imaging examination in our hospital from March 2014 to March 2016 were selected as research objects, including 217 males and 183 females. Patients were aged 45 to 79 years old, with average age at (52.5 ± 7.4) years. In the clinic, the patients had different degree of lower limb swelling, lower skin temperature, toe end darkening, weakened dorsalis pedis artery pulsation, intermittent claudication, rest pain and limb gangrene, etc. All the patients were aware of purpose and significance of this study, the clinical data are complete with research value.

Examination methods

For lower limb artery imaging examination, Toshiba Aquilion one 320-slice, 640-slice spiral CT was used for lower limb scanning. The scanning ranged from renal artery level to the foot. The patient took the supine position in scanning with foot first in and fixed as varus. For the scanning condition, tube voltage was 120 kV, tube current was 350 mA, rotation time was 0.75 s, screw pitch was 1.25 (5-6). The contrast agent was 300 mg/ml of iohexol, to be injected through the elbow vein with speed at 3.5 ml/s and dosage of 100 ml, followed by dilution with 20 ml normal saline. Contrast agent tracking SURESTART technology was adopted for scanning, trigger threshold was set at ROI of bilateral renal level of abdominal aorta, usually100 HU is chosen. The delay time of determination is 25-35 s. Then, the blood vessel volume data obtained by 320-slice spiral CT scanning were sent to the VITREA workstation for volume rendering, maximal density projection, surface reconstruction, multiplanar reconstruction and surface cover reconstruction, obtaining close-up view of lower limb artery vessel. Then specific stenosis grade and specific location of stenosis of the patients' lower limb artery were analyzed by professional CT doctor of our hospital.

Then, Philips 3,000 digital subtraction angiography contrast agent was used for lower limb artery contrast examination. Seldinger puncture method was adopted to puncture the ipsilateral or contralateral femoral artery. The intubation tube was moved to the ipsilateral artery in prograde or retrograde motion. Radiography was done to common iliac artery, internal iliac artery, external iliac artery, femoral artery, popliteal artery, anterior tibial artery, tibiofibular artery, posterior tibial artery, peroneal artery, dorsalis pedis artery of the left and right limbs[7-8].

Clinical evaluation methods

The image quality of the lower limb angiography is divided into 1-6 levels, with corresponding score reduced from 6 points to 1 point[9]. Double blind method was adopted to score the lower limb artery imaging quality. There were 20 segments of blood vessels in each patient's lower limbs, including common iliac artery, internal iliac artery, external iliac artery, femoral artery, popliteal artery, anterior tibial artery, tibiofibular artery, posterior tibial artery, peroneal artery and dorsalis pedis artery, which were graded based on number of segments with vascular edge blur, staggered layer and ladder-like artifacts: zero for grade1 (6 points), 1 segment for grade 2 (5 points), 2 segments for grade 3 (4 points), 3 segments for grade 4 (3 points), 4 segments for grade 5 (2 points), 5 segments or above for grade 6 (1 point).

The degree of stenosis was divided into mild stenosis (<50%), moderate stenosis (50%-75%), severe stenosis (76%-99%) and occlusion (100%). With examination results of lower limb arteriography as the standard, sensitivity and specificity of 320-slice spiral CT were evaluated.

Statistical methods

In this study on quality control of lower limb artery imaging by 320 - slice spiral CT and its effect in arterial stenosis assessment, SPSS19.0 statistical software was employed for related data analysis and processing. The count data were expressed as (n, %), with chi-square for test. When $P < 0.05$, difference is deemed to be statistically significant.

Results

As can be seen from the study results, quality of lower limb artery imaging by 320-slice spiral CT is affected by the following factors:

• Contrast agent dosage, speed, concentration: In this study, when the contrast agent level reached 100 / 35/300, lower limb arterial stenosis was detected in 189 patients (47.25%) by lower limb artery imaging, including 96 cases (24%) reaching grade 6. This result is significantly superior to imaging quality of other radiography grade, differ-

ence between groups meets P <0.05;

• Delay time: When the delay time was 29-31s, the imaging quality was the highest with grade higher than 4. The imaging showed 187 cases (46.75%) of lower limb arterial occlusion, whose quality was significantly higher than that with delay time below 25s, between 26-28s, between 22-34s, above 35s. Comparison of difference meets P <0.05;

• Reconstruction technology: Imaging quality with volume rendering, maximum intensity projection was higher than grade 4, with respective detection rate of lower limb arterial occlusion at 147 (36.75%) and 145 (36.25%). Compared with other imaging techniques, P <0.05, while in comparison of the two imaging techniques, P>0.05;

occlusive disease (see Figure 1-3).

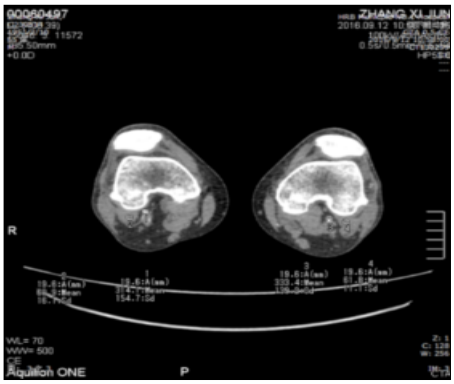

Fig. 2: patient's lower limb arterial examination imaging by 320-slice spiral CT.

The lower limb arteries were divided into 10 segments of common iliac artery, internal iliac artery, external iliac artery, femoral artery, popliteal artery, tibiofibular artery, anterior tibial artery, posterior tibial artery, peroneal artery and dorsalis pedis artery. With 20 segments for each patient, there were a total of 8,000 segments. See Table 1 for demonstration ability of lower limb imaging.

	Common iliac artery	Internal iliac artery	External iliac artery	Femoral artery	Popliteal artery	Tibiofibular artery	Anterior tibial artery	Posterior tibial artery	Peroneal artery	Dorsalis pedis artery
	8,000	7,982	7,982	7,978	7,967	7,966	7,955	7,955	7,945	7,921
Lower Artery Angiography by 320 - slice spiral CT	8,000	7,987	7,987	7,994	7,994	7,969	7,968	7,972	7,963	7,934

Table 1: Demonstration ability of 320 - slice spiral CT for lower limb arterial occlusion.

• Patient's age: As can be seen from the study, the imaging quality of lower limb arterial occlusion of 161 (40.25%) patients younger than 50 years of age was significantly higher that that of other age patients. Comparison between groups meets P <0.05, with statistical significance.

• Vascular calcification: Imaging quality of 185 (46.25%) patients without vascular calcification and 136 (34%) patients with mild calcification were above grade 4, significantly higher than that of the 42 (10.5%) patients with moderate calcification and 37 (9.25%) patients with severe calcification. Comparison between groups meets P <0.05, with statistical significance.

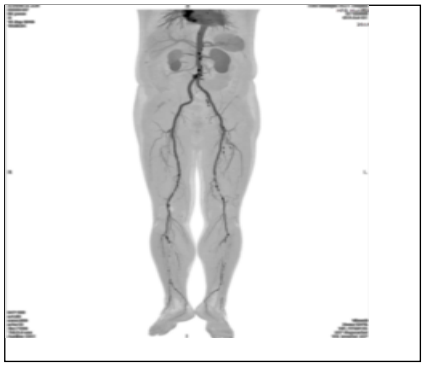

Fig. 1: Lower arterial embolism radiography.

At the same time, the results of this study reveal that 320 rows of multi-slice spiral CT enjoys good effect in examination of lower limb arterial

Fig. 3: patient's lower limb arterial examination imaging by 320-slice spiral CT.

Source: Wang Linlin, Dong Zhendong. Open dynamic volume era: Aquilion ONE 320-slice CT. Chinese Medical Equipment Journal, 2010,31 (01): 13-16.

In Table 2, with test results of lower limb arteriography as the standard, sensitivity and specificity of 320-slice spiral CT for different degrees of lower limb arterial stenosis show a gradually increasing trend. See Table 2 for details.

Degree	<50%	50%-75%	76%-99%	Occlusion
Sensitivity	46.25%	59.25%	77%	88.25%
Specificity	89.25%	90%	94.50%	97.25%

Table 2: Sensitivity and specificity of examination of lower limb arterial stenosis by 320-slice spiral CT (n, %).

Discussion

As can be known from this study, imaging quality of lower limb arterial occlusive disease by 320-slice spiral CT is affected by factors such as contrast agent dose, speed, concentration; delay time; reconstruction technology; patient's age; vascular calcification.

The higher the contrast agent, the faster the injection rate, and the higher the concentration is, the higher the imaging quality of lower limb artery is. Otherwise, the lower the total volume of contrast agent, the slower the injection rate and the lower concentration is, the lower the imaging quality of lower artery is[10-12]. For position of poorly demonstrated blood vessels in the examination, image quality can be improved by increasing the amount of contrast agent, its concentration, and lengthen the delay scanning time.

In addition, arterial calcification exerts considerable impact on analysis of degree of lower limb arterial stenosis. In the examination, proper treatment of mild, moderate calcification is needed for the sake of a more accurate assessment of degree of lower limb arterial stenosis[13].

The younger the patient is, the higher the imaging quality of the lower limb artery is; the older the patient is, the worse the imaging quality of the lower limb artery is. Study suggests that this phenomenon may be because younger patients have better lower limb function, adequate blood supply to the various branches of blood vessels and can understand and follow the various precautions mentioned by the doctor in examinations. Nevertheless, older patients have poor lower limb function, vascular blood supply, plus other complications, and lack of cooperation in examination[14-18]. Therefore, in the examination, it is necessary to provide detailed nursing to patients and inform patients of the necessity to cooperate with examination, so that examination image quality can be improved.

Conclusion

In summary, 320-slice spiral CT angiography of lower limb is with a variety of reconstruction modes, can clearly and accurately show the patient's lower limb arterial occlusive lesions. With small difference from lower limb arteriography, it is worthy of extensive use in the clinic.

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