Correlation Between CT Body Fat Distribution and Carotid Plaque Characteristics

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Abstract: Objective: To analyze the relationship between CT body fat distribution and the characteristics of carotid artery plaques. Method: A retrospective analysis was conducted on the clinical and imaging data of 50 patients who underwent CT examination in our hospital. Within 2 weeks, 50 patients were required to undergo abdominal CT and head CTA examinations. Transfer various data to the workstation and conduct research and analysis on the type of carotid artery plaque and degree of stenosis evaluated by CT angiography of the patient's head and neck. Determine the type of carotid artery plaque in patients and divide them into stable plaque group and unstable plaque group. According to the degree of carotid artery stenosis, patients are divided into no/mild stenosis group and moderate/severe stenosis group. Compare clinical laboratory indicators separately. Use SPSS21.0 statistical software for data processing. The measurement data in line with normal distribution were compared between the two groups by t test; The measurement data of non normal distribution were compared between the two groups by Mann Whitney U test. The difference was statistically significant with $P<0.05$. The VFA/SFA ratio was higher in the unstable plaque group than in the stable plaque group, and the difference between the two groups was statistically significant (P=0.028); There was no statistically significant difference in VFA and SFA between the two groups (P=0.106, 0.695); The total cholesterol in the unstable plaque group was lower than that in the stable plaque group, and the difference was statistically significant (P=0.052). The incidence rate of coronary heart disease in patients with moderate/severe stenosis was higher than that in patients with no/mild stenosis, and the difference between the two groups was statistically significant (P=0.037); The quantitative parameters of CT body fat distribution (VFA, SFA, VFA/SFA ratio) showed no statistically significant differences between the no/mild stenosis group and the moderate/severe stenosis group (P values>0.05). Conclusion: The quantitative parameter VFA/SFA ratio of abdominal fat is closely related to the stability of carotid artery plaques. The higher the VFA/SFA ratio, the poorer the stability of plaques.

Keywords: Plaque Stability; Narrow Degree; Visceral Fat Area; Subcutaneous Fat Area

1. Materials and Methods

1.1 Clinical data

We selected 50 patients who came to our hospital for treatment as experimental subjects and analyzed the clinical and imaging data of the patients' head and neck CTA examination. The selection criteria for the experimental subjects are: firstly, patients need to undergo both abdominal CT examination and head and neck CTA examination, and the examination interval should not exceed two weeks. Secondly, the quality of scanned images can meet the requirements of clinical analysis. Thirdly, there is arterial stenosis, ranging from 10% to 99%.

Exclusion criteria for research subjects: Firstly, the patient does not suffer from other major diseases, such as abdominal tumors or a history of tumor treatment, and has undergone pelvic and abdominal surgery. Secondly, the patient has

congenital metabolic diseases and a history of chronic diseases that affect their weight. If suffering from hyperthyroidism, liver and kidney dysfunction, long-term chronic infectious diseases, or systemic blood diseases; The patient has received treatment for cardiovascular and cerebrovascular diseases, and has been taking medication such as statins and stent placement, resulting in carotid artery stenosis and other reasons. BMI is calculated according to the formula: BMI=weight (kg)/height (m).

1.2 Head and neck CTA examination method

Adopting a Canon 640 layer volumetric CT scanner (Aquilion ONE, Toshiba Medical Systems) or Siemens (SOMATOM Definition Flash) second-generation dual source CT 128 row CT. Scanning parameters: detector width is 0.625mm × 64, layer thickness 0.625mm, pitch 0.9, reconstruction interval 0.300mm, ball tube rotation time 0.5s/r, tube voltage 120kVp, effective tube current 200mAs. Using a non ionic contrast agent, iodofol (concentration 350mgl/mL, Jiangsu Hengrui Pharmaceutical Co., Ltd., specification 350mgl/ml), 40 to 60ml was administered through the elbow vein using a high-pressure intravenous syringe at a flow rate of 4-5ml/s. The scanning range is from the aortic arch to the skull top. Transfer the scanned images to the Philips post-processing workstation (IntelliSpace PortalRelease v6.0.6.20039) for image subtraction and vascular reconstruction. Observe the blood vessels from multiple angles and switch to Maximum Density Projection (MIP) to observe the condition of the vessel wall. Use multiplanar reconstruction (MPR) and surface reconstruction (CPR) to reconstruct the vessel structure.

1.3 Abdominal CT examination and measurement of abdominal fat area

The subject is placed in a supine position and subjected to a full abdominal CT plain scan or dual phase enhanced scan. Adopting a Canon 640 layer volumetric CT scanner (Aquilion ONE, Toshiba Medical Systems) or Siemens (SOMATOM Definition Flash) second-generation dual source CT 128 row CT. Scanning parameters: tube voltage 120kVp, effective tube current 200mAs, pitch 0.9, 0.5s per revolution, field of view (F0V): 512mm × 512mm, collimated width 128 × 0.6mm, scanning layer thickness 5mm, layer spacing 5mm, recombination layer thickness 0.625mm, layer spacing 0.300mm. The scanning range is from the diaphragm top to the level of pubic symphysis.

1.4 Evaluation criteria

1.4.1 Types of carotid artery plaques

Referring to Saba et al.'s methods, plaques are classified into soft plaques, calcified plaques, and mixed plaques based on their composition. Soft plaques: There are obvious lipid necrotic cores in the plaques, and CT shows obvious low-density areas within the plaques. The CT value of the core area is<50HU. Calcified plaques: The CT value of the core part of the plaque is>120HU. Mixed plaque: Contains two components: fat and calcium, with a core CT value of 50-120HU. Mixed plaques can be further divided into two subtypes: calcification or fatty composition. In this study, calcified plaques and mixed plaques mainly composed of calcified components were classified as stable plaques. Soft plaques and mixed plaques mainly composed of fat are classified as unstable plaques.

1.4.2 Measurement of degree of carotid artery stenosis

Refer to the North American Symptomatic Carotid endarterectomy Test (NASCET) standard for assessing the degree of carotid stenosis. Measure the degree of stenosis at the most severe location of each segment of the blood vessel using the following method: Stenosis degree=(diameter of the proximal stenosis artery - diameter of the most obvious stenosis artery)/diameter of the proximal stenosis artery × 100%. According to the degree of stenosis, it can be divided into mild

stenosis (10% -29%), moderate stenosis (30% -69%), severe stenosis (70% -99%), and complete occlusion (100%).

1.5 Statistical Analysis

Use SPSS21.0 for data processing. After the normality test of the measurement data, the measurement data conforming to the normal distribution is represented by ($x \pm s$), the comparison between the two groups is represented by t test, the measurement data of non normal distribution is represented by M (1/4,3/4), the comparison between the two groups is represented by Mann Whitney U test, and the counting data is represented by $\times^2$ Inspection. $P<0.05$ indicates a statistically significant difference.

2. Results

2.1 General Information

This study included a total of 50 patients, 31 males (62%) and 19 females (38%), with a male to female ratio of approximately 2.12:1, aged 42-87 years, and a median age of 63 years. The average SFA value is 177.24cm², Median 167.21cm². The average VFA value is 145.23cm², Median 164.44cm². The average value of VFA/SFA is 0.89, with a median of 0.87.

2.2 Clinical laboratory and abdominal fat quantification parameters for different types of carotid artery plaques

The VFA/SFA of patients with unstable plaques was higher than that of patients with stable plaques, and the difference was statistically significant (P=0.027). There was no statistically significant difference in SFA and VFA parameters between the two groups (P>0.05). The total cholesterol in the unstable plaque group was lower than that in the stable plaque group, with a statistically significant difference of P=0.033.

2.3 Clinical laboratory indicators and abdominal fat quantification for different degrees of carotid artery stenosis

There was no statistically significant difference in SFA, VFA, and VFA/SFA between the no/mild stenosis group and the moderate/severe stenosis group (P>0.05). The history of coronary heart disease showed statistical differences among groups with different degrees of stenosis, with a higher incidence of coronary heart disease in patients with moderate/severe stenosis compared to those without/mild stenosis (P=0.026).

3. Discussion

Through the content of this study, we understand the relationship between body fat distribution and the stability of carotid artery plaques. The results indicate that there is a stable relationship between quantitative parameters of abdominal fat and carotid artery plaques. Due to the presence of abdominal fat, patients are very prone to developing carotid artery plaque disease, making abdominal fat a potential disease risk factor for the human body. The above research indicates that the distribution of body fat, especially the reduction of visceral fat in the body, is directly related to the stability of carotid artery plaques. By reducing the visceral fat rate, it can alleviate the stability of the carotid artery and has certain significance in preventing cardiovascular and cerebrovascular events. By improving the distribution of body fat, patients can reduce their body fat, greatly reducing the risk of carotid artery plaque rupture and reducing the occurrence of cardiovascular and

cerebrovascular events.

There are still the following shortcomings in this study: (1) This study is a retrospective analysis, and the sample size included is relatively small; (2) The measurement of the area of abdominal visceral fat and subcutaneous fat requires manual delineation, and there may be some errors in the measurement results; (3) Although CT is the gold standard for quantifying abdominal fat, it also carries certain radiation risks. Therefore, this study found that the quantitative parameter VFA/SFA of abdominal fat is related to the stability of carotid artery plaques, with higher VFA/SFA leading to poorer plaque stability.

Summary

This study shows that coronary heart disease is directly related to carotid artery stenosis. Atherosclerosis is the main factor leading to coronary heart disease. In the current pathogenic analysis, carotid artery and coronary artery have the same pathological basis. Carotid atherosclerosis is positively correlated with coronary atherosclerosis. Carotid artery can be used as a window to reflect the degree of atherosclerosis in the body, thus indirectly suggesting the degree of coronary atherosclerosis, The carotid plaque occurred earlier than coronary atherosclerosis. Therefore, imaging monitoring of carotid atherosclerotic plaque load may predict coronary plaque, which has important clinical application value in the clinical evaluation of coronary heart disease.

References

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