Analysis of the Relationship between Blood Lipid Level and Carotid Plaque in Patients with Hyperlipidemia

Liu Peng[1,2], Li Meng[1,2,*], Hui Rong[1,3]

[1]Shaanxi University of Chinese Medicine, Xianyang, Shaanxi, 712046, China
[2]Shaanxi Provincial Hospital of Chinese Medicine, Xi'an, Shaanxi, 710003, China
[3]Xi'an Hospital of Traditional Chinese Medicine, Xi'an, Shaanxi, 710016, China
*Corresponding author: zmwq7812@sina.com

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Abstract: This paper mainly studies and explores the relationship between carotid plaques and common pathogenic factors in patients with hyperlipidemia, as well as the relationship between blood lipid levels and carotid plaque volume. This study collected 106 patients with hyperlipidemia and carotid artery plaques admitted to Xi'an Traditional Chinese Medicine Hospital. Xi'an Traditional Chinese Medicine Hospital uses ultrasound equipment to collect the location and volume information of carotid artery plaques, and uses Hitachi fully automatic analyzer to collect blood lipid values. This article analyzes the relationship between carotid artery plaques and common risk factors (age, underlying diseases, lifestyle habits), as well as the relationship between carotid artery plaque size and TC, TG, LDL-C, HDL-C, and apolipoprotein. The independent sample t-test results showed that carotid artery plaques were associated with hypertension, age, and hyperlipidemia ($P<0.05$). Correlation analysis results: The size of carotid artery plaques is positively correlated with TC and LDL-C, while negatively correlated with HDL-C and serum apolipoprotein A1 ($P<0.05$). Carotid artery plaques are associated with hypertension, age, and hyperlipidemia. The size of carotid artery plaques is positively correlated with TC and LDL-C, while negatively correlated with HDL-C and serum apolipoprotein A1.

1. Introduction

As a common clinical metabolic disease, Hyperlipidemia is also one of the important pathological basis of arterial vascular disease. The incidence of hyperlipidemia is increasing year by year with the improvement of modern living standards[1]. Ultrasound is a common means of examining carotid plaques. With the advancement of technology, Color Doppler is gradually widely used, and the information of carotid plaques can be more accurately analyzed. In this study, the ultrasonic linear array probe was used to explore the carotid artery, and the imaging information of carotid plaque was obtained. The blood lipid analysis, basic information, living habits, basic diseases and other information of patients were collected, and the relationship between carotid plaque volume and the above factors was analyzed.

2. Materials and methods

2.1 Material Collection

The information of patients with Hyperlipidemia and Carotid Plaque admitted to Xi'an Hospital of Traditional Chinese Medicine from July 2021 to December 2022 was selected. Hyperlipidemia test results, Carotid Plaque information, basic disease information and basic information were collected. Criteria for selecting research subjects: 1.Meet the diagnostic criteria of hyperlipidemia and carotid plaque; 2. Age between 18 to 75 years old; 3. With or without Diabetes or Hypertension; 4. With or without overweight or obesity: BMI ≤ 30kg/m^2(The cutoff value of obesity in Chinese adults: BMI ≥ 24 kg/m^2,<28 kg/m^2 for overweight, BMI ≥ 28 kg/m2 for obesity[2]); 5. Patients with major surgical history excluded; 6. Patients with liver and kidney dysfunction were excluded; 7. Exclusion of patients with Immune System diseases.

2.2 Evaluating Indicator

Carotid intima-media thickness > 1.00 mm is carotid intima thickening, Carotid plaque is generally local uplift thickness > 1.5mm. Carotid Plaques mostly grow in the posterior wall of the initial segment of the right subclavian artery, common carotid artery, and internal carotid artery plaques mostly grow in the initial segment[3-4]. Diagnostic riteria for Hyperlipidemia: According to the 'Chinese Guidelines for Prevention and Treatment of Dyslipidemia in Adults ' provisions[5]: TC≥6.2 mmol/L,TG≥2.3 mmol/L,LDL-C≥4.1 mmol/L,HDL-C≤1.0 mmol/L, If one of the above blood lipid indexes is abnormal, it can be diagnosed as dyslipidemia. Diagnostic criteria of Hypertension: According to the 2018 revised edition of the 'Chinese Guidelines for the Prevention and Treatment of Hypertension 2018 Revision ', systolic blood pressure > 140 mmHg and diastolic blood pressure > 90 mmHg were used as diagnostic criteria for hypertension. [6].According to the "Guidelines for the Diagnosis and Treatment of Diabetes in the Elderly in China (2021 Edition)" [7]: The diagnostic criteria for diabetes were as follows : fasting plasma glucose ≥ 7.0mmol / L (whole blood ≥ 6.1mmol / L), any plasma glucose or oral glucose tolerance test (OGTT) 2h plasma glucose ≥ 11.1mmol / L, glycosylated hemoglobin (HbA1c) ≥ 6.5 %. Smoking history criteria: In 1997, WHO defined smoking as continuous or cumulative smoking for 6 months or more in a lifetime [8].

2.3 Grouping Methods age cohorts

Young and middle-aged group: 18-59 years old, elderly group: 60-80 years old. Basic disease group: Hypertension, diabetes. Living habits grouping: smoking; the patients were divided into ≥ 24 kg/m^2 group and < 24 kg /m^2 group according to BIM.

106 patients were grouped according to the above method. Selection criteria for Carotid Plaque: According to the collected data, patients with multiple carotid plaques were selected as the study subjects.

2.4 Apparatus Selection

For carotid plaque information collection: Philips EPIQ 5 ultrasonic diagnostic instrument, 9 L linear array probe, the frequency of the instrument is 4 ~ 9 MHz [9]. For the collection of blood lipid information: venous blood was collected from patients, and six parameters of blood lipid were analyzed by HITACHI Automatic Analyzer, including: TG, TC, HDL-C, LDL-C, Apo-A1, Apo-B.

2.5 Statistical Method

The relevant data and information were collected and sorted out, and SPSS 19.0 software was used for statistical analysis. The data of blood lipid examination and the relationship between the predisposition factors of carotid plaque and the volume of carotid plaque were analyzed, and statistically significant conclusions were drawn. Independent sample T test was used for multivariate analysis to explore the relationship between carotid plaque volume and common influencing factors of cerebrovascular diseases. Linear regression was used to analyze the relationship between blood lipid parameters and carotid plaque volume. $P<0.05$ was considered statistically significant.

3. Results

3.1 Analysis of the relationship between Carotid Plaque volume and common risk factors

The average volume of Carotid Plaque in 106 patients included in the study was $34.64 \pm 18.84 mm^2$, and the Independent Sample T test was used to analyze the results: Among them, the Carotid Plaque in the elderly group, patients with Hypertension and Hyperlipidemia was significantly larger than that in the young and middle-aged group, patients without Hypertension and Hyperlipidemia, and the difference was statistically significant($P<0.05$), there was no significant difference between Carotid Plaque and smoking history, Diabetes and BMI group ($P>0.05$), details are shown in Table 1.

Table 1: Relationship between Plaque Volume and Common Risk Factors

Correlation Factor	Number	Plaque Volume (mm^2)	T Ratio	P Value
Young middle-aged Group	51	30.65±16.63	-2.135	0.035
Aged Group	55	38.34±20.13		
Non-smoking History	54	33.55±19.34	-0.604	0.547
Smoking History	52	35.77±18.42		
Non-diabetic	21	34.26±16.95	-0.102	0.919
Diabetic	85	34.73±19.37		
Non-hypertension	29	27.12±15.70	-2.590	0.011
Hypertension	77	37.47±19.23		
Non-hyperlipidemia	46	30.31±18.32	-2.106	0.038
hyperlipidemia	60	37.96±18.71		
BMI<24 kg/m^2	43	33.16±18.60	-0.668	0.505
BMI≥24 kg/m^2	63	35.65±19.08		

3.2 To analyze whether the influence of suspicious related factors on Carotid Artery Plaque is independent

Multivariate linear regression was used to analyze whether the relationship between Carotid Plaque and Blood Lipid, age and hypertension was independent. Taking carotid plaque volume as dependent variable and age, hypertension and hyperlipidemia as independent variables, the results showed that hyperlipidemia was an independent influencing factor of plaque volume, details are shown in Table 2.

Table 2: Relationship between Plaque Volume and Suspicious Influencing Factors

Model	Successive Regression			T Ratio	P Value
	Non-standard X Coefficient		Normal Coefficient		
	B	Standard Error	β		
(Constant)	16.228	6.059		2.679	0.009
Age	5.598	3.662	0.149	1.529	0.129
Blood Pressure	7.996	4.111	0.190	1.945	0.055
Blood Lipids	7.244	3.529	0.191	2.053	0.043

3.3 Analysis of the relationship between Carotid Plaque volume and Blood Lipid parameters

The relationship between Carotid Plaque and Blood Lipid parameters was analyzed by Correlation Analysis. The relationship between Blood Lipid parameters and Carotid Plaque volume was analyzed with Blood Lipid parameters as independent variables and plaque volume as dependent variables. TC and LDL-C in Blood Lipid analysis were positively correlated with Carotid Plaque volume. The correlation coefficient between Carotid Plaque volume and TC: $r=-0.211$, $P<0.05$, The correlation coefficient with LDL-C: $r=0.225$, $P<0.05$; HDL-C was negatively correlated with plaque volume: $r=-0.226$, $P<0.05$, Apolipoprotein A1 was negatively correlated with plaque volume: $r=-0.197$, $P<0.05$), details are shown in Table 3.

Table 3: Correlation analysis of carotid plaque volume and blood lipid parameters

Blood Lipid Parameters	Pearson Crrelation	P Value
TC	0.211	0.030
TG	-0.084	0.393
HDL-C	-0.226	0.020
LDL-C	0.225	0.020
Apo-A1	-0.197	0.042
Apo-B	0.025	0.801

3.4 Analysis of the Location of Carotid Plaque

The main predilection sites of Carotid Plaque are: common carotid artery bifurcation and extracranial segment of internal carotid artery[10], A total of 106 cases were collected, 65 cases occurred in the left common carotid artery, accounting for: 61.32 %, 50 cases occurred in the right common carotid artery, accounting for: 47.17 %, 4 cases occurred in the left internal carotid artery, accounting for: 3.78 %, 10 cases occurred in the right internal carotid artery, accounting for: 9.43 %, 5 cases occurred in the left subclavian artery, accounting for: 4.72 %, 95 cases occurred in the right subclavian artery, accounting for: 89.62 %. Right subclavian artery, left common carotid artery and right common carotid artery are the predilection sites of carotid plaque.

4. Discuss

In the past, the main cause of Carotid Plaque is fat accumulation, according to modern research, dyslipidemia is an independent factor causing Carotid Plaque [8]. When the level of TC increases, it can promote the release of Arachidonic Acid from Membrane Phospholipids, and make Arachidonic Acid metabolize Lipoxidase to Epoxidase, resulting in the increase of plasma Thromboxane (TXA) 2 level, which is a major mechanism of thrombosis [11]. High TG in the blood can inhibit the

Fibrinolytic system, causing HDL-C decreased, LDL-C levels increased, leading to Atherosclerosis [12]. LDL-C can be oxidized to ox-LDL by Oxyradical. Ox-LDL promotes the transformation of Monocytes into Macrophages. Activated Macrophages form Oxyradical and become foam cells by modifying and engulfing ox-LDL, which is the early stage of Carotid Plaque [13-14]. HDL-C is an ATP-binding ABCG1 transporter that inhibits the apoptosis of macrophages mediated by oxidized LDL-C or cholesterol, thereby delaying the progression of Atherosclerosis. The decrease in HDL-C content can cause Atherosclerosis and Thrombosis, accelerate Atherosclerosis [15-16]. In the latest research, it is believed that Atherosclerosis is a Chronic Inflammatory Disease. In the occurrence and development of Atherosclerosis, inflammatory factors such as CRP, Hcy and MMPs may affect nerve function by affecting the generation of nerve cell factors [17-18].

In Xu Xu's study on the 'Correlation between Serum Apolipoprotein E and Carotid Plaque [19], 1243 cases of physical examination personnel were collected from the Aerospace Center Hospital, and the relationship between Carotid Plaque and common predisposing factors was analyzed. The results showed that the age, Blood Pressure, Blood Glucose and Blood Lipid levels of the Carotid Artery Abnormal Thickening group and the Carotid Atherosclerotic Plaque group were significantly higher than those of the Carotid Artery normal group, and the difference was statistically significant (P<0.05). The results of this analysis are slightly different from the results of this analysis. The results of this analysis show that Carotid Plaque is related to age and Hypertension. The increase of age is a major factor in the increase of Carotid Plaque volume. The Carotid Plaque volume of patients with Hypertension and Obesity is significantly larger than that of patients without Hypertension. There was no significant difference in the relationship between Carotid Plaque and Diabetes history, smoking history and BMI. According to Fan Weiqun 's study on 'carotid atherosclerosis and carotid plaque prediction model based on healthy people [20], 8308 cases of physical examination were collected, and the comparative analysis of Carotid Plaque and Blood Lipid parameters was analyzed, the results showed that: Carotid Plaque was positively correlated with TC and LDL-C, and negatively correlated with HDL-C and Apo-A1. The difference was statistically significant. The relationship between Carotid Plaque and TG, Apo-B was not statistically significant. The location information of the collected Plaques was analyzed. The predilection sites of Carotid Plaques were: Right Subclavian Artery, Left Common Carotid Artery, and Right Common Carotid Artery. Carotid Plaques were more likely to occur in the bifurcation of blood vessels.

Carotid Plaque is the most important risk factor for cerebrovascular disease, related studies have shown that the incidence of Carotid Plaque is positively correlated with the incidence of cerebrovascular disease [8]. The shedding of Carotid Plaque is the main cause of serious complications. Therefore, it is of great significance to evaluate the risk factors of Carotid Plaque for the prevention, diagnosis and treatment of carotid Atherosclerosis. Exploring the risk factors of Carotid Plaque can prevent Carotid Plaque in advance. When the related factors of Carotid Plaque formation occur, medication in advance or improvement of living habits can be used to prevent Carotid Plaque in order to reduce the occurrence of cerebrovascular disease. Therefore, it is of clinical significance to explore the predisposing factors of Carotid Plaque.

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