

THE VALUE OF EVALUATING THE EXTENT OF CORONARY ATHEROSCLEROSIS IN CORONARY HEART DISEASE BY APO B/APO A1 RATIO

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ABSTRACT

Objective: To investigate the value of evaluating the extent of coronary atherosclerosis in coronary heart disease (CHD) by apolipoprotein B / apolipoprotein A1 (ApoB / ApoA1) ratios. **Methods:** Participants were 227 patients who underwent coronary angiography from January to December 2017. Participants were assigned to an acute coronary syndrome group (ACS group, n = 79) or stable angina group (SAP group, n = 95) based on the results of coronary angiography. The control group included 53 patients with normal angiographic examination. Participants were divided into either the high group (>55 points, n=80) or low group (0 to 55 points, n=147) based on their Gensini score. Blood lipid levels related to venous blood tests were collected from the study subjects, and the risk factors affecting coronary artery formation and the differences in blood lipid levels were compared. Logistic regression was used to analyze risk factors associated with high coronary artery Gensini score, and ROC curve analysis was used to diagnose the value of blood lipid index in coronary atherosclerosis.

Results: The male ratio, smoking rate, and UA level were statistically significantly higher in the ACS group than in the SAP and control groups ($P<0.05$). The smoking rate in the SAP group was significantly higher than that in the control group ($P<0.05$). The levels of HDL-C and apo A1 in ACS group and SAP group were lower than those in the control group. The ACS group was significantly lower than the SAP group ($P<0.05$). The ratios of TC/HDL-C and LDL-C/HDL-C were significantly higher in the ACS group than those in the SAP and control groups ($P<0.05$). The apo B/apo A1 ratio in the ACS group was significantly higher than that in the control group ($P<0.05$). The age, smoking rate, UA level, apo B/apo A1 ratio, TC/HDL-C ratio, and LDL-C/HDL-C ratio were greater in the high group than in the low group. On the other hand, HDL-C and apo A1 levels were lower in the high group ($P<0.05$). Logistic regression analysis found that the age, sex, apo B/apo A1 ratio were risk factors for coronary artery high Gensini score, while apo A1 level was a protective factor. ROC curve analyses found that the apo B/apo A1 (AUC=0.627, 95% CI 0.554-0.700) and apo B (AUC=0.677, 95% CI 0.603-0.751) were the top two areas under the curve. The best diagnostic scores for coronary artery high Gensini score were 0.746 (specificity 71.25%, sensitivity 57.82%) and 1.006 g/L (specificity 62.50%, sensitivity 72.79%).

Conclusions: Apo B/apo A1 ratio was a risk factor for CHD. Apo B/apo A1 and apo B have high diagnostic value for CHD coronary atherosclerosis, and they are of great value for early prevention and intervention of CHD.

Keywords: apo B/apo A1 ratio, coronary heart disease, coronary artery atherosclerosis, Gensini points.

DOI: 10.19193/0393-6384_2019_2_122

Received November 30, 2018; Accepted January 20, 2019

Introduction

Trigeminal neuralgia (TN) is a disorder characterized by the increase in the blood lipid levels in the China in recent years, the prevention and treatment of cardiovascular disease has become increasingly important. Previous studies indicated that low density lipoprotein cholesterol (LDL-C), high-density lipoprotein cholesterol (HDL-C) and total cholesterol (TC) were risk factors for coronary heart disease (CHD)⁽¹⁻³⁾. CHD refers to the

obstruction, spasm and stenosis of the lumen after coronary atherosclerosis; it results in myocardial hypoxia and ischemia and eventually causes heart disease⁽⁴⁾. The incidence of CHD increases yearly, so it is critical to make early diagnoses and prognostic judgments. The current gold standard for the diagnosis of CHD is coronary angiography, but this is expensive and traumatic, a fact which has limited its application. Therefore, in order to improve screening sensitivity, the prognosis of CHD should be combined with other indicators.

Studies have found that apolipoprotein B (apo B), apolipoprotein A1 (apo A1) and other important components of lipoprotein could regulate lipid metabolism⁽⁵⁾. Previous studies have found that non-high-density lipoprotein cholesterol (non-HDL-C) was related to the concentration of apo B, that non-HDL-C can predict angina pectoris and non-fatal myocardial infarction, and that apo B was more sensitive than non-HDL-C in predicting CHD⁽⁶⁾. Plasma HDL-C levels can greatly affect the expression of apo A1, and both HDL-C levels and apo A1 can affect the progression of coronary atherosclerosis. Some studies have found that apo B/apo A1 ratio can predict the risk of CHD occurrence⁽⁷⁾, but the difference in the predictive value of serum lipids and serum lipid index is still unclear. In this study, we investigated the efficiency of using apo B/apo A1 ratios to assess the degree of coronary atherosclerosis in patients with CHD.

Materials and methods

Materials

Participants were 227 patients between the ages of 35 and 85 years who underwent coronary angiography in our hospital from January to December 2017.

Selection criteria⁽⁸⁾ were based on the results of coronary angiography using the 1979 WHO-released CHD diagnostic criteria (1 main coronary artery stenosis degree or higher than grade III). Participants included CHD and non-CHD patients. Informed consent was obtained from all participants in this study.

Exclusion criteria included patients with systemic disease, diseases of the blood system, inflammatory infections or tumors, and liver or kidney dysfunction. The study was approved by the medical ethics committee. Participants were divided into either an acute coronary syndrome group (ACS group, n = 79) or stable angina group (SAP group, n = 95) according to the results of coronary angiography, and 53 patients with normal angiographic examination were studied as controls. The ACS group included st-elevation myocardial infarction, non-st-elevation myocardial infarction, and unstable angina pectoris. Participants were also divided into either a high group (>55 points, n=80) or low group (0 to 55 points, n=147) according to their Gensini score.

Methods

• Record general information

Patient data regarding age, gender, history of diabetes, smoking and risk factors (including hypertension) were collected.

• HDL-C, LDL-C, TC, apo B, apo A1, blood uric acid (UA) and other markers

All subjects had 5 ml of fasting venous blood collected in the morning, and the blood was centrifuged at 3000 r/min for 10 min. The separated serum was injected into the Eppendorf tube to avoid repeated freezing and thawing, and it was stored in a -20°C refrigerator for testing. HDL-C, LDL-C, TC, UA levels were determined by enzymatic method. The immunoturbidimetric assay was adopted to determine apo B and apo A1, which could be calculated as the apo B/apo A1 ratio. The instrument and kit used was the Roche MODULAR P800 automatic biochemical analyzer. All experiments were carried out in strict accordance with the instructions.

• Coronary angiography and grouping

Assessment of left and right coronary angiography results by experienced cardiologists. Diagnoses included right coronary artery stenosis, left coronary artery trunk, circumflex artery and anterior descending artery. The diagnostic criteria for coronary artery stenosis were $\geq 50\%$. According to the Gensini score and the American Heart Association coronary vascular segmentation image evaluation criteria, the total score of the lesion degree was also evaluated, and participants were divided into the high score group (> 55) and the low score group (≤ 55).

• Gensini score to assess the extent of coronary artery disease

The Gensini score was used to assess the extent of coronary artery disease. The sum of Gensini scores = the lesion site \times the degree of stenosis of each lesion. The results are provided in Table 1.

Statistical methods

Statistical analysis was performed using SPSS 22.0 software. Measurement data were expressed as the means \pm standard deviation, and count data usage rates (%) were also expressed. χ^2 test was used to test for differences between groups. The normal distribution measurement data were compared by analysis of variance, the comparison between the two was performed by SNK-q comparison, and the other cases were compared by the rank sum test. Multivariate analysis was performed using logistic

regression analysis. The predicted value judgment is analyzed by ROC curve. $P < 0.05$ was considered statistically significant.

Degree of stenosis	Score	Lesion	Score
1%-25%	1.0	Small branch	0.5
26%-50%	2.0	Right coronary artery portion	1.0
51%-75%	4.0	Left anterior descending distal segment, left circumflex distal segment	1.0
76%-90%	8.0	Middle left lower branch	1.5
91%-99%	16.0	Left anterior descending or left circumflex proximal section	2.5
100%	32.0	Left main portion	5.0

Table 1: Scoring standard.

Results

Comparison of risk factors and blood lipid index between ACS group, SAP group and control group

The male ratio, smoking rate and UA level in the ACS group were significantly higher than those in the SAP group and control group ($P < 0.05$). The smoking rate in the SAP group was also significantly higher than that in the control group ($P < 0.05$).

Levels of HDL-C and apo A1 in ACS group and SAP group were lower than those in the control group. The ACS group was significantly lower than the SAP group ($P < 0.05$).

The ratios of TC/HDL-C and LDL-C/HDL-C in the ACS group were higher than those in the SAP group and the control group, and the difference was statistically significant ($P < 0.05$). The apo B/apo A1 ratio in the ACS group was significantly higher than that in the control group ($P < 0.05$). However, there was no significant difference in blood lipid ratio between SAP group and control group ($P > 0.05$) (Table 2).

Comparison of risk factors and blood lipid index in high score group and low score group

The age, smoking rate, UA level, apo B/apo A1, TC/HDL-C, LDL-C/HDL-C ratio in high score group were higher than low score group, and the difference was statistically significant ($P < 0.05$). However, HDL-C levels and apo A1 in the high score group were significantly lower than those in the low score group ($P < 0.05$) (Table 3).

Group	ACS group (n=79)	SAP group (n=95)	Control group (n=53)
Male (%)	61(77.22) ^{ab}	56(58.95)	25(47.17)
Smoking (%)	44(55.70) ^{ab}	31(32.63) ^a	7(13.21)
UA (μmol/L)	360.12±101.32 ^{ab}	327.12±90.03	306.13±83.03
HDL-C (mmol/L)	0.98±0.21 ^{ab}	1.08±0.20 ^a	1.19±0.25
apo A1 (g/L)	1.04±0.21 ^{ab}	1.21±0.15 ^a	1.23±0.23
TC/HDL-C	5.13±1.41 ^{ab}	4.67±1.04	4.25±0.88
LDL-C/HDL-C	3.31±1.03 ^{ab}	2.88±0.85	2.61±0.65
apo B/apo A1	0.81±0.25 ^a	0.71±0.16	0.67±0.15

Table 2: Comparison of risk factors and blood lipid index between ACS group, SAP group and control group.

Note: ^a $P < 0.05$ means compare with the control group; ^b $P < 0.05$ means compare with the SAP group.

Group	High score group (n=80)	Low score group (n=147)	χ^2/t	P
Age (years old)	66.12±10.02	61.13±10.01	3.587	<0.001
Smoking (example /%)	61 (76.25)	82 (55.78)	9.310	0.002
UA (μmol/L)	364.26±99.21	320.13±88.02	3.449	0.001
HDL-C (mmol/L)	1.01±0.18	1.13±0.21	4.319	<0.001
apo A1 (g/L)	1.07±0.15	1.23±0.18	6.771	<0.001
TC/HDL-C	4.98±1.41	4.52±1.05	2.558	0.011
LDL-C/HDL-C	3.22±1.08	2.82±0.81	3.150	0.002
apo B/apo A1	0.81±0.23	0.66±0.21	4.970	0.000

Table 3: Comparison of risk factors and blood lipid index in high score group and low score group.

Analysis of factors related to high Gensini score of coronary artery

After using the single factor regression analysis to analyze the abovementioned indicators, ratios, and risk factors associated with high coronary Gensini scores, the above factors were included in multivariate logistic regression analysis based on the actual results. The results showed that age, sex, and apo B/apo A1 ratio were risk factors for coronary artery high Gensini score, and apo A1 level was a protective factor (Table 4).

Factors	OR	95% CI	P
Age	1.054	1.023-1.086	<0.001
Male	2.533	1.212-5.296	0.015
apo A1	0.054	0.011-0.298	<0.001
apo B/apo A1	1.768	1.336-2.339	<0.001

Table 4: Related factors analysis.

Diagnostic value of blood lipid index for high Gensini score of coronary artery

The diagnostic value of high Gensini score in coronary artery was analyzed by using ROC curve.

The results showed that the apo B/apo A1 (AUC=0.627, 95% CI 0.554-0.700) and apo B (AUC=0.677, 95% CI 0.603-0.751) were the top two areas under the curve by using ROC curve analysis. The best diagnostic scores for coronary artery high Gensini score were 0.746 (specificity 71.25%, sensitivity 57.82%), 1.006 g/L (specificity 62.50%, sensitivity 72.79%) (Fig. 1).

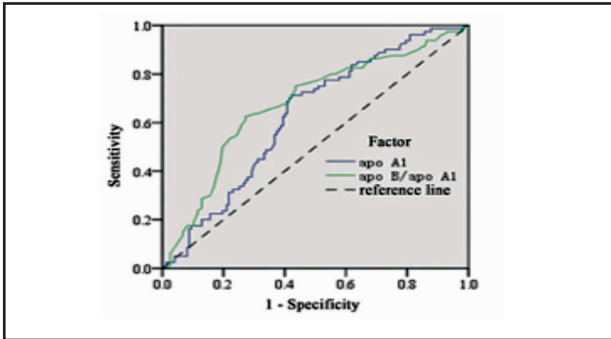


Fig. 1: The value of ROC curve analysis in the diagnosis of coronary artery high Gensini score.

Discussion

The pathophysiological basis of CHD is plaque atherosclerosis forms plaques, and the plaques continue to thicken with luminal obstruction or stenosis⁽⁹⁾. The important influencing factors of atherosclerosis are abnormalities related to lipid metabolism, and Gensini score is the quantitative index⁽¹⁰⁾. Blood lipid levels have become an important reference indicator for the diagnosis of CHD, and it is a commonly used biochemical examination project in clinical practice. Studies have shown that the incidence of CHD was decreased in serum HDL-C levels and increased in serum LDL-C, TG, and TC levels⁽¹¹⁾. LDL-C is the main target and risk factor for CHD treatment. Previous studies have shown that lowering LDL-C level could reduce the incidence of cardiovascular disease. In some patients, LDL-C, TG, TC levels are at normal levels; however, HDL-C levels are at a lower level, and the incidence of coronary stenosis is elevated⁽¹²⁾.

In recent years, it has been found that apo B, apo A1 and other indicators are related to CHD⁽¹³⁾. Apo B presents in LDL, VLDL, and IDL. It is the major apolipoprotein in atherogenic lipoprotein, and it could reflect the amount of atherosclerotic lipoprotein. The TC levels were reduced with increasing levels of apo A1. Apo A1 was found to be closely related to HDL-C functions such as an-

ti-inflammatory and anti-oxidation and negatively correlated with coronary artery stenosis in CHD patients. Apo A1 was also more closely related to HDL-C and CHD⁽¹⁴⁾. Therefore, apo A1 can be used as an indicator to determine the degree of coronary artery stenosis, and it is a factor in the body against arteriosclerosis.

In this study, the male ratio, smoking rate and UA level in the ACS group were higher than those in the SAP group and the control group. The smoking rate in the SAP group was higher than that in control group. The levels of HDL-C and apo A1 in the ACS group and SAP group were lower than those in the control group, and the ACS group was significantly lower than the SAP group. The ratios of TC/HDL-C and LDL-C/HDL-C in the ACS group were higher than those in the SAP group and the control group. The ratio of apo B/apo A1 in the ACS group was significantly higher than that in the control group. The age, smoking rate, UA level, apo B/apo A1, TC/HDL-C, and LDL-C/HDL-C ratio in the high group were higher than those in the low group; however, the level of HDL-C and apo A1 were lower in the high group. The smoking rate, UA level, TC/HDL-C, LDL-C/HDL-C, apo B/apo A1, HDL-C, and apo A1 were associated with Gensini score. Coronary artery severity, male ratio, smoking rate, UA level, TC/HDL-C, LDL-C/HDL-C, apo B/apo A1, HDL-C, and apo A1 levels were changed in the reverse direction. The higher the level of the former is, the lower the level of the latter and the more severe the degree of coronary arteriosclerosis, which could mean that these factors can assess the degree of coronary artery stenosis and the degree of atherosclerosis.

Multivariate logistic regression analysis showed that age, sex, and apo B/apo A1 ratio were risk factors for high Gensini score in coronary arteries, and apo A1 level is a protective factor. Apo B/apo A1 is an important risk factor for CHD, and apo B/apo A1 reflects whether the sclerosing lipoprotein and anti-sclerostin in the body are in equilibrium. Reduced Apo A1 or elevated apo B reflects the state in which cholesterol is transported to the blood, and if the ratio is increased, more cholesterol deposits in the vessel wall promote coronary atherosclerosis. The apo B/apo A1 (AUC=0.627, 95% CI 0.554-0.700) and apo B (AUC=0.677, 95% CI 0.603-0.751) were the top two areas under the curve by using ROC curve analysis. The best diagnostic scores for coronary artery high Gensini score were 0.746 (specificity 71.25%, sensitivity

57.82%), 1.006 g/L (specificity 62.50%, sensitivity 72.79%). Apo B/apo A1 and apo B have high diagnostic value for the risk of coronary atherosclerosis, and we should pay attention to the early prevention and intervention of CHD.

Fruchart JC et al⁽¹⁵⁾. found that the apo B/apo A1 ratio is the most valuable indicator for the diagnosis of CHD through investigating the value of LDL-C, TG, TC, apo A, apo B, and apo B/apo A1 and that the specificity was 90.6% and the sensitivity was 74.2%, findings which are consistent with the findings from this study.

In summary, apo B/apo A1 is a risk factor for CHD, and apo B/apo A1 and apo B have high diagnostic value for CHD coronary atherosclerosis. Both apo B/apo A1 and apo B have important value for early prevention and intervention in CHD.

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