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Correlations of degree of coronary artery stenosis with blood lipid, CRP, Hcy, GGT, SCD36 and fibrinogen levels in elderly patients with coronary heart disease

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Abstract. – OBJECTIVE: To explore the correlations between the degree of coronary artery stenosis with blood lipid, C-reactive protein (CRP), homocysteine (Hcy), gamma-glutamyl transpeptidase (GGT), soluble cluster determinant 36 (sCD36), and fibrinogen (Fib) levels in elderly patients with coronary heart disease.

PATIENTS AND METHODS: The Gensini scores for the coronary artery stenosis were analyzed in patients with single-vessel, double-vessel, and multi-vessel coronary artery diseases in observation group and normal people in control group. Changes in blood lipid-associated parameters, including total cholesterol (TC), triacylglycerol (TG), low-density lipoprotein cholesterol (LDL-C), and high-density lipoprotein cholesterol (HDL-C), CRP, Hcy, GGT, sCD36, and Fib were compared between the two groups. The correlations between the Gensini score with changes of the blood-associated parameters, CRP, Hcy, GGT, sCD36, and Fib were analyzed. Finally, univariate and multivariate logistic regression analyses were conducted to determine the risk factors for coronary artery stenosis in elderly patients with coronary heart disease.

RESULTS: The Gensini score was significantly higher in coronary heart disease patients with multi-vessel, double-vessel, and single-vessel coronary artery diseases compared with that in normal people ($p<0.05$). The levels of the blood lipid-associated parameters TC, TG, and LDL-C in observation group were substantially higher than those in control group ($p<0.05$), and the level of HDL-C was notably lower than that in control group ($p<0.05$). Subjects in observation group had markedly higher levels of CRP, Hcy, GGT, sCD36, and Fib than control group ($p<0.05$). The Gensini score for the degree of coronary artery stenosis was positively correlated with the levels of the blood lipid-associated parameters TC and TG, CRP, Hcy, GGT, sCD36, and Fib ($p<0.05$) and negatively associated with the level of HDL-C ($p<0.05$). Blood lipid-associated parameters, CRP, Hcy, GGT, sCD36, and Fib were the independent risk factors for coronary artery stenosis in elderly patients with coronary heart disease patients.

CONCLUSIONS: The elevations of blood lipid, CRP, Hcy, GGT, sCD36, and Fib levels are closely associated with coronary artery stenosis, and serve as the independent risk factors for coronary artery stenosis.

Key Words:
The elderly, Coronary heart disease, Degree of coronary artery stenosis, Blood lipid, CRP, Hcy, GGT, sCD36, Fibrinogen.

Introduction

Coronary heart disease is a common multiple cardiovascular disease in the elderly and mainly based on coronary atherosclerosis. As the development of cardiovascular lesions, coronary artery cavity obstruction, and even coronary artery stenosis will occur[1], further leading to myocardial blood supply insufficiency, ischemia, hypoxia, and even necrosis. Angina is the major typical clinical symptom of coronary heart disease, and the patients will suffer from cardiac function impairment. Besides, this disease has extremely high mortality and disability rates[2]. Coronary angiography is the gold standard for the diagnosis, but it is costly and invasive. Particularly, in elderly patients complicated with multiple internal diseases, the relatively high risk limits its clinical application[3].

The pathogenesis of coronary heart disease involves multiple factors[4]. Previous studies have corroborated that age, educational level, family income, diet, exercise, smoking, excessive drinking, and increases in blood pressure and glucose were risk factors for the onset of coronary heart disease. The morbidity rate of coronary heart disease increases year by year, seriously endangering the health of humans[5]. Therefore, it is very neces-

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sary to promptly and effectively diagnose coronary heart disease at an early stage. In addition, searching risk factors and developing corresponding preventive approaches contribute to improve the prognosis of coronary heart disease. The exploration of the risk factors for coronary artery stenosis in coronary heart disease is currently well explored[6]. Noninvasive and effective early diagnosis of coronary heart disease and determination of the degree of coronary artery stenosis were highlighted in this paper. We mainly investigated the correlations of the degree of coronary artery stenosis with blood lipid-associated parameters, C-reactive protein (CRP), homocysteine (Hcy), gamma-glutamyl transpeptidase (GGT), soluble cluster determinant 36 (sCD36), and fibrinogen (Fib) in elderly patients with coronary heart disease.

Patients and Methods

General information

A total of 60 coronary heart disease patients over 60 years old with coronary artery stenosis, who were treated in our hospital from November 2017 to June 2019, were selected as observation group. In addition, 40 healthy people who received physical examination and had no coronary artery stenosis in the same period were enrolled as control group. Coronary artery stenosis was diagnosed or excluded through coronary angiography in all the subjects. Prior to experiments, all subjects had informed consent. The present investigation was approved by the Ethics Committee of our hospital. Inclusion criteria: coronary heart disease patients aged ≥ 60 years old, and with normal liver and kidney functions. Exclusion criteria: subjects complicated with cerebrovascular diseases, malignant tumors, mental diseases, blood glucose abnormality, autoimmune system diseases, or primary hyperlipoproteinemia were excluded. Subjects with severe infection, insulin or estrogen treatment at 1 week before enrollment, and with language expression ability or hearing disorders were excluded. Based on coronary angiography findings, the patients in observation group were further classified into three groups, namely single-vessel disease group (n=20), double-vessel disease group (n=20), and multi-vessel disease group (n=20). There were 13 males and 7 females, aged 60-80 years old (73.2±2.4 years) in single-vessel disease group, and they had the disease course of 3-20 years (5.3±0.2 years). Double-vessel disease group was composed of 14 males and 6 females, aged 60-81 years (73.3±2.5 years), with the disease course of 3-20 years (73.3±2.5 years). Multi-vessel disease group comprised 11 males and 9 females, aged 60-82 years (73.5±2.3 years) with the disease course of 5-25 years (11.4±1.1 years). Control group had 27 males and 13 females, with the age of 60-80 years (73.3±2.3 years).

Observation Indicators

The Gensini score for coronary artery stenosis was statistically analyzed in all the subjects, including the patients with single-vessel, double-vessel, and multi-vessel coronary artery diseases in observation group and normal people in control group. Changes in the levels of blood lipid-associated parameters, including total cholesterol (TC), triacylglycerol (TG), low-density lipoprotein cholesterol (LDL-C), and high-density lipoprotein cholesterol (HDL-C), CRP, Hcy, GGT, sCD36, and Fib were compared between the two groups. The correlations between the Gensini score for the degree of coronary artery stenosis with the changes in the blood-associated parameters, CRP, Hcy, GGT, sCD36, and Fib were examined. Finally, the risk factors for coronary artery stenosis in the elderly patients with coronary heart disease were verified through univariate and multivariate logistic regression analyses.

Evaluation Criteria

The degree of coronary artery stenosis in elderly patients with coronary heart disease was evaluated based on the criteria of the narrowing degree of the diseased vessels, namely the Gensini score of the American Heart Association, ranging from 1-32 points. Higher Gensini score indicates narrower coronary arteries. TC (<5.18 mmol/L), TG (<1.7 mmol/L), LDL-C (3.37 mmol/L), HDL-C (>1.04 mmol/L), CRP (<10 mg/L), Hcy (5.0-13.9 μmol/L), GGT (determined by colorimetry, 2-17 U/L), sCD36 (measured by ELISA kit provided by Shanghai Jianglai Biotech Co., Ltd., Shanghai, China) and Fib (determined by biuret colorimetry, 2-4 g/L) were determined.

Statistical Analysis

Statistical Product and Service Solutions (SPSS) 20.0 (IBM Corp., Armonk, NY, USA) was used for statistical processing. Measurement data were expressed as mean ± standard deviation ($\bar{x}\pm s$). The *t*-test was performed for the difference comparison between the two groups, and the intergroup rate comparisons were conducted using the χ^2-test. Pearson correlation analysis was conducted, and the factors for coronary artery stenosis in the elderly coronary heart disease were

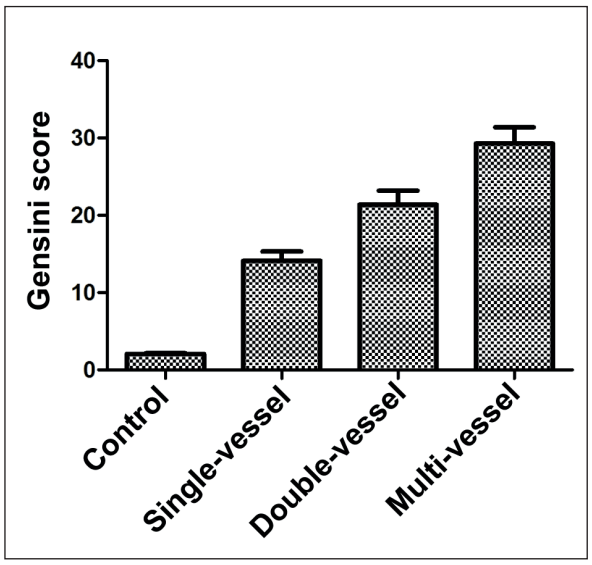

Figure 1. Gensini score for the coronary artery stenosis of all subjects.

determined by univariate and multivariate logistic regression analyses. $p<0.05$ suggested that the difference was statistically significant.

Results

Gensini Score for the Coronary Artery Stenosis of All Subjects

The Gensini score was (2.1±0.1) points in controls, (14.1±1.2) points in patients with single-vessel coronary artery disease, (21.1±1.8) points in those with double-vessel coronary artery disease, and (29.3±2.1) points in those with multi-vessel coronary artery disease. It can be seen that the Gensini scores of patients with single-vessel, double-vessel, and multi-vessel coronary artery diseases exhibited an evidently increasing trend compared with that of normal people ($p<0.05$; Figure 1).

Comparisons of Blood Lipid-Associated Parameters Between the Two Groups

Observation group had substantially higher levels of blood lipid-associated parameters TC, TG, and LDL-C ($p<0.05$), but a notably lower level of HDL-C than control group ($p<0.05$; Table I).

Comparisons of CRP, Hcy, GGT, sCD36, and Fib levels between the two groups

The levels of CRP, Hcy, GGT, sCD36, and Fib in observation group were higher than those in control group ($p<0.05$; Table II).

Analysis of Correlations of the Gensini Score for the Degree of Coronary Artery Stenosis With Blood Lipid-Associated Parameters

The Gensini score for the degree of coronary artery stenosis was positively correlated with the levels of the blood lipid associated-parameters TC and TG ($p<0.05$), but negatively correlated with the level of HDL-C ($p<0.05$; Figures 2-4).

Analysis of Correlations of the Degree of Coronary Artery Stenosis With the Changes in CRP, Hcy, GGT, sCD36, and Fib Levels

The Gensini score for the degree of coronary artery stenosis was positively associated with the changes in the levels of CRP, Hcy, GGT, sCD36, and Fib ($p<0.05$; Figures 5-9).

Table I. Comparisons of blood lipid-associated parameters between the two groups (mmol/L, $\bar{x}$±s).

	TC	TG	LDL-C	HDL-C
Observation group	6.4±0.2	2.3±0.2	4.1±0.2	0.8±0.1
Control group	3.9±0.1	1.2±0.1	3.1±0.1	1.3±0.1
t	70.711	31.113	28.284	22.361
p	0.000	0.000	0.000	0.000

Table II. Comparisons of CRP, Hcy, GGT, sCD36 and Fib levels between the two groups ($\bar{x}$±s).

	CRP (mg/L)	Hcy (μmol/L)	GGT (U/L)	sCD36 (mmol/L)	Fib (g/L)
Observation group	15.3±1.1	21.2±0.9	25.3±1.2	2.4±0.2	5.2±0.3
Control group	8.3±0.5	11.1±0.6	8.3±0.3	1.7±0.1	3.3±0.1
t	36.640	59.055	86.923	17.799	38.000
p	0.000	0.000	0.000	0.000	0.000

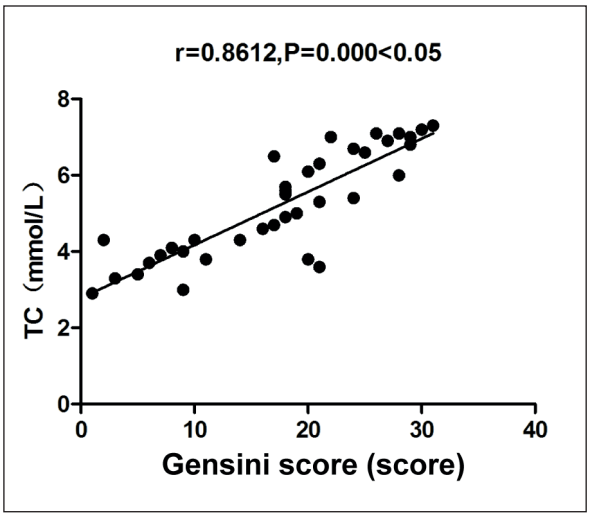

Figure 2. Analysis on correlation of the Gensini score for the degree of coronary artery stenosis with TC.

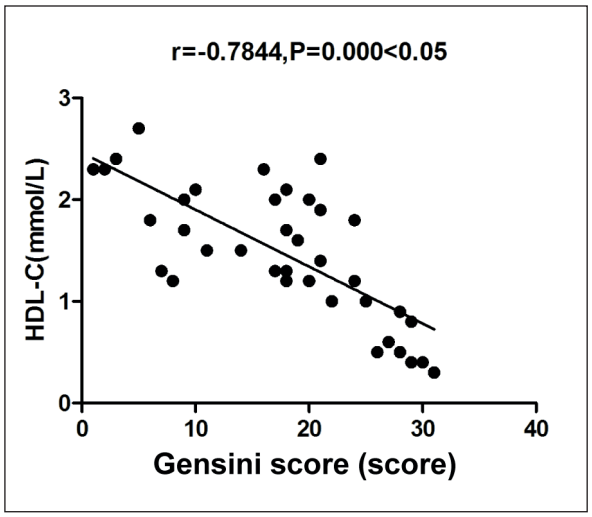

Figure 4. Analysis on correlation of the Gensini score for the degree of coronary artery stenosis with HDL-C.

Univariate Analysis on the Factors Affecting Coronary Artery Stenosis i n the Elderly Patients With Coronary Heart Disease

Univariate analysis on the factors affecting coronary artery stenosis in elderly patients with coronary heart disease uncovered that tCRP, Hcy, GGT, sCD36, and Fib were the relevant risk factors for coronary artery stenosis in coronary heart disease (Table III).

Multivariate Logistic Regression Analysis on the Factors Affecting Coronary Artery Stenosis in the Elderly Patients With Coronary Heart Disease

Multivariate logistic regression analysis results revealed that the increases in the levels of blood lipid, CRP, Hcy, GGT, sCD36, and Fib were the independent risk factors for coronary artery stenosis in the elderly patients with coronary heart disease (Table IV).

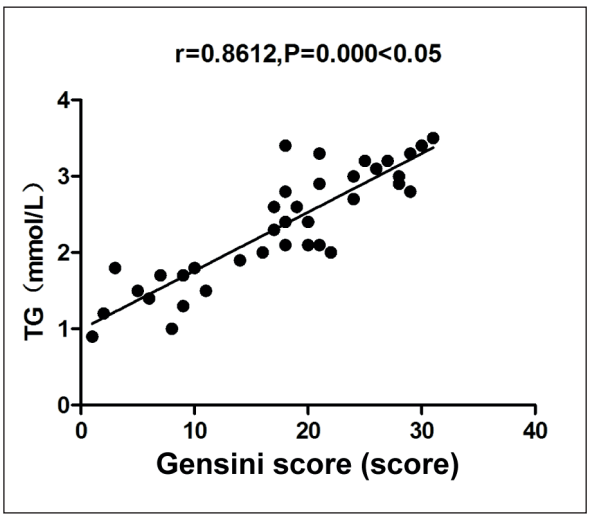

Figure 3. Analysis on correlation of the Gensini score for the degree of coronary artery stenosis with TG.

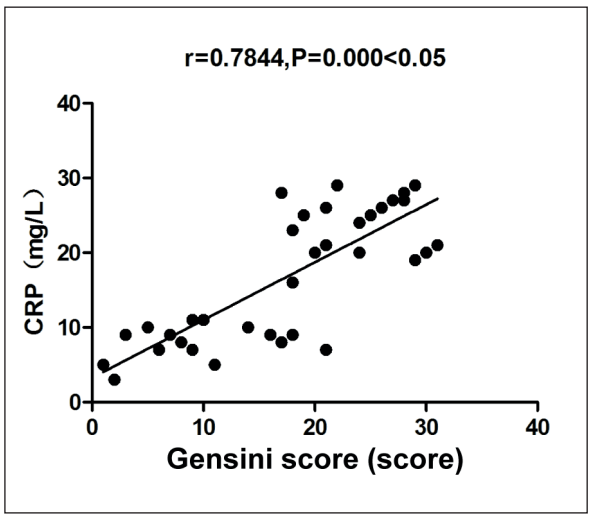

Figure 5. Analysis on correlation of the Gensini score for the degree of coronary artery stenosis with CRP.

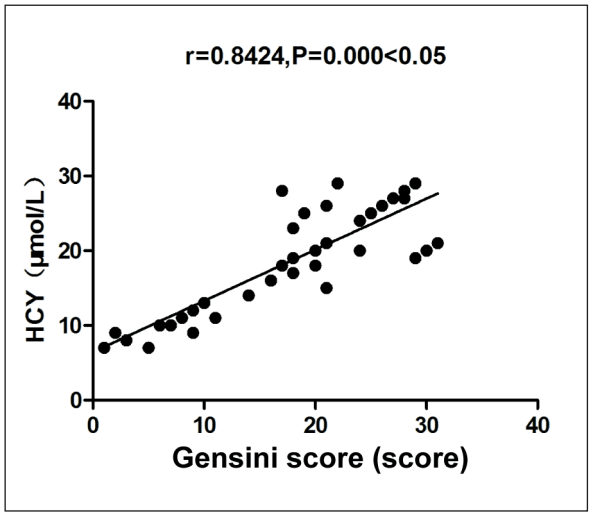

Figure 6. Analysis on correlation of the Gensini score for the degree of coronary artery stenosis with Hcy.

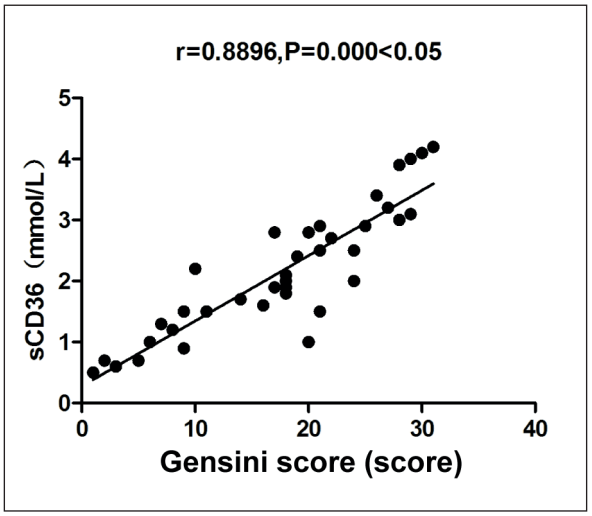

Figure 8. Analysis on correlation of the Gensini score for the degree of coronary artery stenosis with sCD36.

Discussion

Coronary heart disease is a kind of common cardiovascular disease involving multiple factors and is generally believed to be closely correlated with genetics, environment, and living habits[7]. Although there are many available preventive and therapeutic approaches for cardiovascular disease, coronary heart disease is still regarded as one of the leading causes of death in humans[8]. It is reported that[9] the case of deaths of cardiovascular disease ranks the top among the total deaths in China, which cannot be reversed in the following several decades and even be growing rapidly. Thus, effectively controlling the risk factors for cardiovascular diseases and improving their prognosis is of great significance for increasing the health level of humans[10]. Notably, the elderly, the main population at risk of coronary heart disease, have both the risk of complications and mortality and disability rates significantly raised. According to a study[11], the primary prevention of coronary heart disease in elderly patients can effectively lower the mortality rate and the onset risk of other vascular diseases. Therefore, the early recognition of the risk factors for coronary

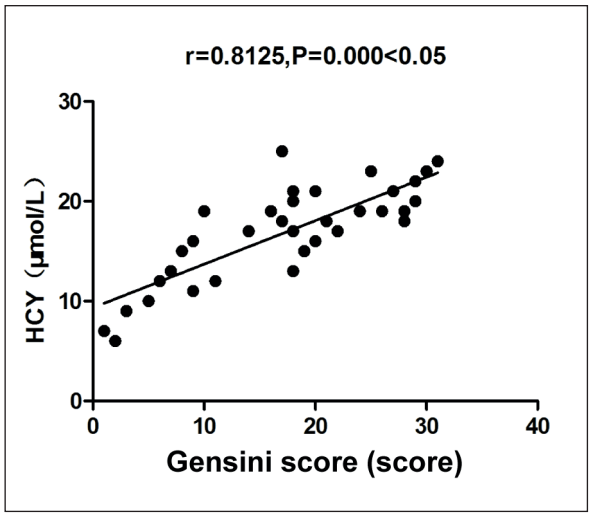

Figure 7. Analysis on correlation of the Gensini score for the degree of coronary artery stenosis with GGT.

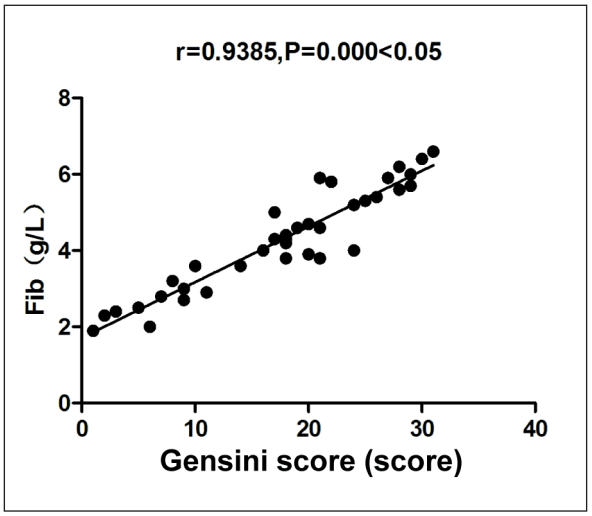

Figure 9. Analysis of correlation of the Gensini score for the degree of coronary artery stenosis with Fib.

Table III. Univariate analysis of the factors affecting the degree of coronary artery stenosis in the elderly patients with coronary heart disease.

		Coronary artery stenosis	Normal	χ^2	p
Blood lipid level	Increased	36	4	54.586	0.000
	Normal	2	38		
CRP level	Increased	35	5	55.000	0.000
	Normal	1	39		
Hcy level	Increased	34	6	42.155	0.001
	Normal	4	36		
GGT level	Increased	37	3	45.255	0.011
	Normal	6	34		
sCD36 level	Increased	36	4	54.586	0.000
	Normal	2	38		
Fib level	Increased	38	2	57.836	0.000
	Normal	3	37		

artery stenosis in hyperlipidemia and proactive intervention are of great value for decreasing the morbidity and mortality rates of coronary heart disease. In elderly patients with coronary heart disease, the noninvasive detection indicators are especially required for alleviating the pain of coronary angiography and reducing medical expenses[12].

The present study analyzed the levels of blood lipid-associated parameters, CRP, Hcy, GGT, sCD36, and Fib in coronary heart disease patients with coronary artery stenosis, and compared them with those of healthy people without coronary heart disease. It was found that compared with that of normal people, the Gensini scores of elderly patients with single-vessel, double-vessel, and multi-vessel coronary artery diseases exhibited an obviously increasing trend. Moreover, observation group had substantially higher levels of blood lipid-associated parameters TC, TG, and LDL-C, CRP, Hcy, GGT, sCD36, and Fib, but a notably lower level of HDL-C than control group, implying pronounced inflammatory response and hyperhomocysteinemia in elderly patients with coronary heart disease. Besides, the Gensini score for the degree of coronary artery stenosis was positively correlated with the levels of the blood lipid associated-parameters TC and TG, CRP, GGT, sCD36, and Fib, but negatively correlated with the level of HDL-C. Finally, blood lipid-associated parameters, CRP, Hcy, GGT, sCD36, and Fib were identified to be the relevant risk factors for coronary artery stenosis in patients with coronary heart disease.

The elevation of lipoprotein level in the body of hyperlipidemia patients causes vascular endothelial function impairment and the changes in the surface property of endothelial cells, monocytes, and lymphocytes[13], promoting the adherence of monocytes to vascular endothelial cells. Additionally, macrophages are transformed into macrophage foam cells through the phagocytosis of oxidized low-density lipoprotein (Ox-LDL) by scavenger receptors, ultimately forming atherosclerotic lipid stripes[14]. As the major member of the scavenger receptor B family[15], sCD36 physiologically mediates the phagocytosis of Ox-LDL by macrophages and promotes the formation of

Table IV. Multivariate logistic regression analysis of factors influencing coronary artery stenosis in the elderly patients with coronary heart disease.

	β	SE	W	OR	p	95% CI
Increase in blood lipid level (mmol/L)	0.89	0.53	9.47	2.44	0.00	1.38-4.31
Increase in CRP level	1.83	0.57	4.82	1.96	0.04	1.03-7.45
Increase in Hcy level	1.71	33.60	7.11	5.52	0.00	3.10-9.83
Increase in GGT level	2.92	0.54	4.46	6.86	0.04	1.59-9.24
Increase in sCD36 level	1.12	5.50	6.38	3.07	0.00	1.76-5.34
Increase in Fib level	2.34	0.46	9.92	2.81	0.01	1.21-4.40

foam cells in the body, which is considered as the core factor for atherosclerosis[16]. Hyperhomocysteinemia will make the plaques formed in coronary artery endothelial cells more prone to detachment. In hyperlipidemia, lipocyte filling causes vascular intimal hyperplasia, thus weakening vascular wall elasticity and further worsening coronary artery stenosis[17]. In addition, this study found that GGT was also closely correlated with coronary artery stenosis. GGT is considered as a cytokine widely distributed in vital organs such as the myocardium, kidney, pancreas, and spleen, and it is closely associated with the development of coronary heart disease, ischemic stroke, and other cardiovascular and cerebrovascular diseases[18]. By binding to LDL, GGT promotes its adhesion to vascular endothelial cells, thus speeding up the formation of atherosclerotic plaques[19]. Fib is a multi-functional glycoprotein mainly synthesized in the liver, and it promotes coronary artery stenosis probably because it is involved in blood coagulation, accelerates platelet aggregation, inhibits immunocompetence, and affects inflammatory processes[20].

Conclusions

In summary, the increases in blood lipid, CRP, Hcy, GGT, sCD36, and Fib levels are closely associated with coronary artery stenosis, and they are the independent risk factors for coronary artery stenosis.

Conflict of Interests

The Authors declare that they have no conflict of interests.

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