The Characteristics of Coronary Artery Disease in Patients Accompanied by Metabolic Syndrome and the Associations with the Components of Metabolic Syndrome

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ABSTRACT Objective: To investigate the characteristics of CHD in patients accompanied by metabolic syndrome(MS) and to study the relationship between the severity of coronary atherosclerosis and the components of MS. Methods: 540 cases of coronary heart disease patients were chosen, of which 164 cases were combined with MS, 376 cases were not combined with MS. All patients were divided into five groups, based on the number of components of MS; and also be divided into two groups, according to the diagnostic criteria for MS. The extent of coronary artery lesions and other indicators in CHD patients between different groups were compared, and the relationships between the degree of CHD and ingredients of MS was explored. Results: ①The indicators of BMI, FBG, TG, LDL-C, TC, UA, FIB, high blood pressure levels were higher in patients of MS group than that in non-MS group, while the HDL-c, LVEF were lower in MS group, the differences were significant (P<0.01). ② The patients accompanied by MS had higher gensini score and higher incidence of trunk lesions and triple-vessel lesions, lower incidence of single-vessel lesions, the differences were significant (P<0.01). ③ Coronary Gensini score gradually increased, with the combined increasing in the number of MS ingredients, the differences between five groups were significant (P<0.01). ④ Coronary Gensini score had positive correlation with the BMI, Blood pressure levels, TG, TC, LDL-C, UA (P<0.05). while it had negative correlation with gender, HDL-c. Adjustment for traditional risk factors, and the relationship between Gensini score and the number of MS ingredients was significant(r = 0.739, P<0.01). Conclusion: Coronary heart disease patients had a higher prevalence of MS, when accompanied by MS. The extent of CHD was more severe, mostly triple-vessel lesion and trunk lesion; With the combined increase in the number of MS ingredients, the degree of CHD tendED to be worse; The components of MS were significantly related to CHD, can be used as predictors of the severity of coronary heart disease.

Key words: Coronary artery disease; Metabolic syndrome; Gensini score; Risk factors

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Introduction

Metabolic syndrome was a clinical syndromes, which referred to a variety of metabolic abnormalities components clustering in the same individual, including:obesity, especially abdominal obesity, hypertension,diabetes or impaired glucose metabolism, and high triglyceride (TG) and low High-density lipoprotein cholesterol deposit (HDL-C) [1]. The direct consequence of MS was the high incidence of CHD and diabetes, seriously reduced people's quality of life, so, it greatly attracted the attention of academia. However, the relationship between metabolic syndrome and CHD has not yet entirely clear. The prediction capabilities of MS were still controversial in causing CHD [2,3]. This study investigated the the impact of MS ingredients on the extent of CHD, to study the predictive value of MS in the severity of CHD, and to provide more theoretical basis for clinical treatment.

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1 Subjects and methods

1.1 The subjects

552 patients in the CHD from 2010.12 to 2011.8 were chosen, who hospitalized in the Affiliated Hospital of Qingdao University Medical College Department of Cardiology. They were first diagnosed as being CHD after coronary angiography, of which 540 cases of patients with complete medical records, male 364 cases (67.4 %), female 176 cases(32.6 %), age 38 to 86 years, mean age (659 years). Patients were divided into five groups based on the combined number of MS components, Namely group 0 (28 cases), group1 (140 cases), group 2 (208 cases),Group 3 (124 cases), group 4 (40 cases), and (Group 3 +group 4)also known as MS group, (Group 0 +Group 1 + Group 2) as non-MS group.

All selected objects must meet the following conditions: (1) first coronary angiography; (2) no previous history of coronary intervention or bypass; (3) except for serious liver kidney diseases, cancers, blood diseases; (4) except for treatments of lipid-lowering drugs a moth before, and other diseases affecting lipid metabolism, such as thyroid dysfunction, etc.

1.2 General data collection

All patients were recorded height, weight, body mass index

(BMI), gender, age, smoking history, drinking history; measure blood pressure after admission in the resting state, and record its grade according to their degree of hypertension ;The next day after 12 hours fasting, collected venous blood for testing fasting blood glucose, blood triglyceride (TG), total cholesterol (TC), low-density lipoprotein cholesterol (LDL-c), high density lipoprotein cholesterol(HDL-c), uric acid (UA), fibrinogen (FIB); All biochemical detection tasks were completed in Qingdao University Medical College Affiliated Hospital Laboratory, using internationally accepted methods and standards reagents, the equipment is the Hitachi 7170 automatic biochemical analyzer. After admission all patients accepted the echocardiography examination, operated by the experienced cardiac sonographer, using HPSONOS 5500 color Doppler, the probe frequency 2.5 ~ 5.0 MHz, and the patient's left ventricular ejection fraction (LVEF) were recorded. All patients were given selectively left and right coronary angiography in the case of no surgical contraindications, using Judkins method, multi-position, multi-angle projection. The results were determined by experienced physicians in Cardiology of the Hospital, using vsual method (also known as coronary artery stenosis diameter method that is the diameter compared with the adjacent normalcoronary artery stenosis). CHD is defined as: one or more main branches of coronary artery luminal diameter narrowing greater than or equal 50 %[4,5].

1.3 Diagnostic criteria for MS

The diagnosis of MS comes from Chinese Diabetes Society (CDS) in 2004 proposed diagnostic criteria (CDS Standard)[6] , which is based on the study of Chinese people. include: ① the over weight or obese: BMI ⩾ 25 kg/m^2. ② high blood pressure:systolic blood pressure ⩾140 mmHg and / or diastolic blood pressure ⩾ 90 mmHg. ③ lipid abnormalities: hypertriglyceridemia (TG ⩾1.7 mmol / L) and / or low high-density lipoprotein cholesterol (HDL-C) viremia (men <0.9 mmol / L, female <1.0 mmol / L). ④ High blood sugar: fasting blood glucose (FBG) ⩾6.1 mmol / L or 2h after glucose load glucose ⩾7.8 mmol / L. Also includes those who have a history of hypertension, or had received antihypertensive drug treatment; High blood sugar also includes patients who have a history of diabetes or received hypoglycemic drug or insulin treatments. Patients who meet three criteria of the above four can be diagnosed as MS.

1.4 Assess the extent of CHD

According to coronary angiography to determine the degree of stenosis, the stenosis can be manifested in left main, left anterior descending, left circumflex artery or right coronary artery,and divided into 1, 2 or 3-vessel disease according to lesion count. Left main disease is seen as involving the left anterior descending and left circumflex artery at the same time. The degree of coronary artery stenosis is recorded according to Gensini score criteria [7]: Stenosis ⩽25 %,1 point;26 %~50 %, 2 points; 51 %~75 %; 4 points ,76 % ~90 %, 8 points; 91 %~99 %, 16 points; Stenosis 100%, 32 points; different segments of coronary multiplied by the corresponding factor: left main disease, score×5; the left anterior descending artery proximal×2.5, the middle score ×1.5, ×distal score l; the first diagonal branch ×l; second diagonal branch ×0.5; left circumflex artery proximal ×2.5, distal and posterior descending artery are×1, posterior collateral artery×0.5; right coronary artery, medium and distal, and posterior descending artery are×1. Gensini score in this article is the sum of points for each branch.

1.5 Statistical Methods

Measurement data is expressed by "$\overline{X}\pm S$", T-test is used to compare between the two sets of data; count data is expressed by frequency and/or proportions, using x^2-test; Oneway ANOVA was used to compare the difference of gensini score between 5 groups; Multiple linear regression was used to analyze the correlation between the severity of CHD and risk factors, P<0.05 was considered statistically significant. All data were analyzed through the statistical analysis software SPSS170.

2 Results

2.1 Compare the general informations and biochemical indicators between two groups

In this study, 164 cases of patients with MS (30.4 %), non-MS patients 376 (69.6 %); Compared with non-MS group, MS patients have higher levels of BMI , FBG, TG, LDL-C, TC, UA, FIB, high blood pressure levels; while lower levels of HDL-c and LVEF; the difference were statistically significant(P<0.01); However, there is no significant difference in gender, age, smoking history, drinking history between the two groups, in Table 1.

2.2 Comparison of the count and the severity of coronary stenosis between the two groups

Compared with non-MS group, MS group had a higher incidence of three-vessel disease and left-trunk disease, had a lower incidence of single-vessel disease, the difference was statistically significant (P<0.01). The incidence of double vessel disease in MS patients is slightly lower, but the difference was not statistically significant (P= 0.423); MS patients have a higher Gensini score, the difference was statistically significant (P<0.01), in Table 2.

2.3 The impact of combined number of MS components on the severity of CHD

In this study, all patients were divided into five groups based on the number of MS components combined, that is group 0, group 1, group 2, group 3 and group 4; Oneway ANOVA analysis showed that: the differences between the five groups was statistically significant (F = 26.26, P <0.01); With the combined increase in the number of components, coronary Gensini points also would be increased, the differences between any two groups was statistically significant too; in Table 3.

2.4 The correlation between various indicators and the severity of CHD

Putting gender, age, smoking history, drinking history, BMI, hypertension, FBG, TG, TC, LDL-C, HDL-C, UA, FIB as indepe-

ndent variables, and Gensini score as dependent variable, We conducted multiple linear regression analysis, and concluded: coronary Gensini score had a positive correlation with BMI, hypertension, TG, TC, LDL-C, UA (P <0.05), and a negative correlation with gender, HDL-c (P<0.01) ; Adjustment for traditional risk factors, the partial correlation analysis showed Gensini score and the number of MS components were significantly correlated(r = 0.739, P<0.01), in Table 4.

Table 1 Comparison of the general informations and biochemical indicators $\bar{X}\pm S$

		MS group	Non-MS group	Statistics (t/x^2)	Significance(P)
Number of cases n (%)		164(30.4 %)	376(69.6 %)		
Gender (male /%)		104 (63.4 %)	260 (69.1 %)	x^2=1.70	P=0.196
Age (years)		64.68 9.14	65.07 9.31	t=-0.45	P=0.651
BMI (kg/m2)		27.56 3.10	24.50 2.82	t=11.26	P<0.01
FBG (mmol/L)		7.58 2.26	6.37 2.74	t=4.94	P<0.01
TG (mmol/L)		2.48 2.33	1.26 0.61	t=6.58	P<0.01
LDL-C (mmol/L)		2.51 0.82	2.20 0.67	t=4.36	P<0.01
TC (mmol/L)		4.24 1.24	3.78 0.91	t=4.28	P<0.01
HDL-C (mmol/L)		1.08 0.23	1.25 0.27	t=-7.06	P<0.01
UA (pmoL / L)		342.22 85.92	309.19 81.61	t=4.26	P<0.01
FIB (g/L)		3.17 0.97	2.87 0.67	t=3.58	P<0.01
LVEF (%)		56.92 8.33	6.05 6.17	t=-7.06	P<0.01
Drinking history n (%)		72(43.9 %)	176(46.8 %)	X^2=0.39	P=0.53
Smoking history n (%)		60(36.6 %)	160(42.6 %)	X^2=1.68	P=0.216
Hypertension n (%)	No hypertension	4 (2.4 %)	120 (31.9 %)	X^2=72.22	P<0.01
	Hypertension 1	4(2.4 %)	16(4.3 %)		
	Hypertension 2	64(39.0 %)	60(16.0 %)		
	Hypertension 3	92(56.1 %)	180(47.9 %)		

Table 2 Comparison of characteristics of coronary lesions between the two groups n (%)

	Single-vessel disease	Double-vessel disease	Three-vessel disease	Left-trunk disease	Gensini score
MS group	28 (17.1 %)	48 (29.3 %)	88(53.7 %)	44(26.8 %)	75.84 15.89
Non-MS group	132 (35.1 %)	124(33.0 %)	120 (31.9 %)	36(9.6 %)	55.44 13.52
Statistics(X^2/t)	X^2=17.81	X^2=0.72	X^2=22.80	X^2=26.94	t=15.27
Significance(P)	P<0.01	P=0.423	P<0.01	P<0.01	P<0.01

Table 3 The impact of combined number of MS components on the severity of CHD

	Group 0	Group 1	Group 2	Group 3	Group 4	Total
Number of Cases n	28	140	208	124	40	540
Gensini-score $\bar{X}\pm S$	33.43±3.52	51.34±11.83	61.15±11.23	68.85±8.78	97.50±13.28	61.63±17.08

3 Discussion

With the economic development and people's living standards improving, people's lifestyle is also undergoing dramatic changes; Irrational diet, sharp reduction in the exercise and the increasing mental stress,etc. are causing a variety of metabolic abnormalities which clustered in the same individual ; This phenomenon was defined as the metabolic syndrome (MS) by WHO [8] in 1999, the

Table 4 The relationship between various indicators and the severity of CHD

	Non-standardized coefficient B	Standard error	Standard coefficient	t	Significance(P)
(Constant)	40.933	9.049		4.524	0.000
XB	-10.101	1.492	-0.277	-6.770	0.000
BMI	1.044	0.195	0.197	5.360	0.000
Hypertension	7.468	1.666	0.215	4.482	0.000
TG	0.862	0.447	0.075	1.928	0.044
TC	4.986	1.338	0.306	3.726	0.000
LDL-C	4.942	1.763	0.212	2.803	0.005
HDLC	-24.570	3.386	-0.385	-7.255	0.000
UA	0.027	0.011	0.134	2.568	0.010

Dependent variable: Gensini Score

main clinical manifestations include obesity, especially abdominal obesity, impaired glucose tolerance or diabetes, dyslipidemia, hypertension, and so on. Since then a lot of academic research were done on the mechanisms and damages of MS. The most direct consequence of MS is to increase the morbidity and mortality of CHD and diabetes , seriously affecting people's quality of life [9,10]. Recent years, numerous studies at home and abroad have shown that the incidence of MS were increasing year by year, a survey in shanghai showed [11,12]that the incidence of MS had reached 14 % ~16 % in 2007. In CHD patients ,MS is more prevalent; Gorter PM, etc. [13] who studies patients with atherosclerotic disease, found that the prevalence of MS was 41.4 % in CHD population; in this set of data ,the prevalence rate of 30.4 %, consistent with the above results.

At present, most studies suggest[14] that MS is a complex pathophysiological process, in which insulin resistance(IR) is the pathological basis, abdominal Obesity is the central element, involving a variety of mechanisms and accompanied by chronic inflammation. Some studies have [15,16] shown that obese patients had a high incidence of IR and hyperinsulinemia(HIS); IR can increase the activity of liver lipase, so increasing the decomposition of HDL,the synthesis of free fatty acid (FFA) and TG,leading to lipid disorders; HIS can play a catalytic role on the mitogen, promoting the DNA synthesis and cell proliferation of smooth muscle cell(SMC), reducing the NO synthesis, increasing sympathetic activity and thus causing increased blood pressure and endothelial dysfunction; Endothelial damage can also activate the coagulation system, increase the level of plasma plasminogen activator inhibitor PAI-1, and then inhibit the fibrinolytic system [17,18]; When the coagulation system is activated,the fibrinolytic system is inhibited, IR / HIS patients will be more prone to lipid deposition, thrombus formation, vascular smooth muscle cell proliferation; IR / HIS can stimulate the subintimal smooth muscle cell proliferation and the medial smooth muscle cell migration to the intima, and through the mediating of tumor necrosis factor-a (TNF-a), interleukin -6 (IL-6) and other inflammatory factors, causing endothelial cell injury; Greater oxidative stress in vascular endothelium can also lead to gradual loss of the ability to regulate vasomotor, increased vasoconstrictor cytokines, such as thromboxane A2 (TXA2), and reduced vasodilator factor NO,etc. will lead tovasospasm and myocardial ischemia [19]. The various components of MS is not independent of each other, but synergistic. The interaction of multiple risk factors accelerated the clinical course of MS, causing wider organ damage and more severe events in cardiovascular and cerebrovascular. Studies have shown [1,14] the risk of cardio-cerebral vascular diseases (CHD and stroke) increased 3 times in MS population, the risk of cardiovascular death increased 2 times, the risk of total mortality increased 1.5 times, the various components of MS are the risk factors for CHD; This set of data also showed that the patients with MS had a higher level of BMI, hypertension, FBG, TG, LDL-c, TC,etc. a lower lever of HDL-c, LVEF, a higher coronary Gensini score, and dominated by triple-vessel lesions and Left-trunk lesions; suggest that: MS aggravated the severity of CHD, reduced left ventricular function, and seriously damaged the patient's quality of life. The number of MS components are also significantly related to the severity of CHD, some studies suggest that [22,23] the incidence of CHD increased 5 times in patients with 4 ingredients of MS, compared with those only one component of MS. In this study, Oneway ANOVA shows: with the associated MS components increasing, coronary Gensini score also gradually increased; Partial correlation analysis also showed that there was a strong correlation between the number of MS components and the severity of CHD ($r = 0.739$, $P < 0.01$), suggest that the degree of CHD become more severe with the number of MS components increasing, consistent with the above reports. Multiple linear regression analysis showed that coronary Gensini score was positively correlated with obesity, high blood sugar, hypertension, high TG, TC, LDL-c, and negatively correlated with gender, HDL-c; Once again proved that there was a close relationship between MS and CHD, each component of MS could

be used as a predictor of the severity of CHD[24,25].

In conclusion, CHD patients have a high prevalence of MS, if accompanied by MS, CHD patients will become more severe, and have a high incidence of three-vessel disease and Left-trunk disease; With the combined increase in the number of MS components, the degree of CHD tended to be worse; The various components of MS were significantly related to the severity of CHD, could serve as early predictors of CHD; In the treatment of CHD patients accompanied by MS, the prevention should be considered very important, controlling MS is a key step in the prevention of CHD. Actively control obesity, low-fat diet, controlling blood cholesterol, regular exercise, controlling inflammatory response are beneficial in reducing the impact of MS on the cardiovascular, and helpful in improving the quality of life in patients with CHD.

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冠心病合并代谢综合征患者的冠状动脉病变特点及与代谢综合征组分的相关性研究

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摘要 目的:探讨冠心病合并代谢综合征(metabolic syndrome,MS)患者的冠脉病变特点及冠心病与 MS 各组分的相关性。方法:选取 540 例冠心病患者为研究对象,其中合并 MS 患者 164 例,非合并 MS 患者 376 例,并将所有患者根据 MS 的组分个数进行分组,比较冠心病合并 MS 的病变特点、MS 组分个数对冠状动脉病变程度的影响及冠状动脉病变程度与代谢综合症各组分的相关性。结果:①冠心病合并 MS 组 BMI、FBG、TG、LDL-C、TC、UA、FIB、高血压分级等指标较非 MS 组高,差异有统计学意义(P<0.01),HDL-C、LVEF 较非 MS 组低,差异有显著性(P<0.01);②MS 组冠脉 Gensini 积分较高,三支病变、主干病变发生率高,差异有显著性(P<0.01);③随着合并 MS 组分个数的增加,冠脉 Gensini 积分也逐渐增加,各组间比较有显著性差异(P<0.01);④冠脉 Gensini 积分与 MS 组分 BMI、高血压分级、TG、TC、LDL-C、UA 等指标存在正相关(P<0.05),与性别、HDL-C 存在负相关(p<0.01);调整传统危险因素后,Gensini 积分与 MS 的组分数显著相关(r=0.739、P<0.01)。结论:冠心病患者有较高的 MS 患病率,冠心病合并 MS 患者冠脉病变程度更重,且以多支病变、主干病变为主;随着合并 MS 组分个数的增加,冠脉病变程度也呈加重趋势;MS 的各个组分均与冠状动脉病变程度显著相关,可以作为冠心病严重程度的预测指标。

关键词:冠心病;代谢综合征;Gensini 积分;危险因素

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