RELATIONSHIP OF THE METABOLIC SYNDROME AND CORONARY ARTERY DISEASE IN PATIENTS WITH STABLE ANGINA

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Abstract

INTRODUCTION: In view of the high prevalence of coronary artery diseases (CAD) and the fact that the metabolic syndrome is known to predispose to CAD, we studied the relationship between various components of the metabolic syndrome and the severity of CAD.

METHODS: A total of 545 patients with stable angina were included in this cross-sectional study. Questionnaires were used to obtain information on demographic characteristics, drug history, and history of previous hospitalization. Blood pressure (BP) and waist circumference (WC) were measured. Ten-hour fasting blood samples were taken to measure blood sugar, high-density lipoprotein cholesterol (HDL-C), and triglyceride (TG) using autoanalyzer. Angiography was performed with the standard method and the patients were scored using extent scoring. The metabolic syndrome was defined according to ATP-III. SPSS 11 was use to analyze data with t-test, ANOVA, correlation and logistic regression tests.

RESULTS: The patients had a mean age of 57.93±10.13 years. High HDL-C was the most frequent abnormality, followed by increased WC and TG. Severity of metabolic syndrome increased with age. CAD was detected in 78.9% of patients with the metabolic syndrome and 46.7% of patients without it ($P<0.05$). In regression analysis, the metabolic syndrome was found to be a risk factor for CAD (OR=1.35, CI=1.13-1.60). Direct correlation was found between angiography score and metabolic syndrome ($P<0.01$, $r=0.15$).

CONCLUSIONS: The metabolic syndrome is a predisposing factor to CAD; hence CAD prevention should involve measures to control metabolic syndrome, especially through lifestyle modification.

Key Words: Metabolic syndrome, CAD.

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Introduction

Coronary Artery Disease (CAD) is the leading cause of death in Iran.[1] Atherosclerosis is the principal factor which predisposes to CAD. Risk factors such as age, obesity, diabetes mellitus, dyslipidemia, and hypertension are also involved in CAD etiology.[2]

However, some individuals without these risk factors suffer from a host of metabolic disorders collectively known as the metabolic syndrome.[3]

Decreased high-density lipoprotein cholesterol (HDL-C), elevated fasting blood sugar (FBS), increased waist circumference (WC), and hypertension are common in individuals with the metabolic syndrome.[4] According to one study, the metabolic syndrome affects nearly 20% of the Americans and half of the Canadians.[5,6] A study conducted in Isfahan showed 24% of the adult population to be affected by the metabolic syndrome.[7]

Different studies have demonstrated varying degrees of relationship between components of the metabolic syndrome and CAD.[8]

Some studies have shown that individuals with the metabolic syndrome are at a higher risk of myocardial infarction (MI) and coronary accidents, and require a wider range of therapeutic interventions to maintain the patency of coronary arteries.[9] The present study was conducted to investigate the components of the metabolic syndrome in patients undergoing coronary angiography due to chest pain, in an effort to assess the relationship between this syndrome and CAD,

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and propose secondary prevention measures for controlling the metabolic syndrome if this relationship is found to be significant.

Materials and methods

In a cross-sectional study, we evaluated 545 patients who had undergone coronary angiography due to chest pain, at Chamran Heart Center, Isfahan, Iran.

Patients with history of recent MI or systemic diseases were excluded.

Questionnaires on demographics, past history of disease, drug history, smoking status, previous heart surgery or angioplasty, stroke and MI were filled out by patients a day before angiography. WC was measured in standing position at the level of the umbilicus. Blood pressure (BP) was measured twice after 15 minutes of resting in sitting position and the average of two measurements was recorded as the patient's BP. Ten milliliters of venous blood was taken after 10 hours in fasting state and HDL-C, triglyceride (TG), and FBS were measured using autoanalyzer. All patients underwent angiography with the standard method. Extent scores were given to the patients by three cardiologists according to the severity and extent of coronary occlusion.[10]

Based on ATP III, the metabolic syndrome was defined as meeting at least 3 of the following criteria:

1. WC > 102 cm in men, WC > 88 cm in women
2. BP ≥ 135/85 mmHg
3. TG ≥ 150 mg/dl
4. FBS ≥ 110 mg/dl
5. HDL-C < 40 mg/dl in men, HDL-C < 50 mg/dl in women[11]

One point was given to each of the five items above; individuals with three points or more were considered as being affected by the metabolic syndrome.

Extent scoring of the coronary arteries is as follows:

1. One point is given for occlusion of each of the main coronaries (i.e. circumflex artery, left anterior descending artery, right coronary artery); 0-3 points may be given.
2. One point is given for each involved segment, i.e. proximal, medial, and/or distal. Each coronary artery is given a score; 0-9 points may be given.
3. Occlusions of <50%, 50-75% and >75% are given one, two, and three points, respectively; 0-9 points may be given. An individual may score between 0 and 21 based on the extent of coronary occlusion. Data were analyzed with SPSS 11.5 using t-test, ANOVA, Pearson correlation, and logistic regression tests.

P values less than 0.05 were considered as significant.

Results

A total of 545 patients, including 317 men and 228 women with a mean age of 57.93±10.13 years were studied. Table 1 shows the frequency of different components of the metabolic syndrome in percentages. The most frequent disorders were decreased HLD-C, increased WC and elevated TG.

Table 2 shows mean and standard deviations in the patients' biological characteristics.

There was no significant age difference between individuals with varying numbers of metabolic syndrome components; however, TG, systolic BP, diastolic BP, WC and FBS increased and HDL-C decreased as the number of metabolic syndrome components increased (P<0.05).

Table 3 compares mean scores of the extent of CAD in male and female patients, as well as in healthy individuals. Both in the overall study population, and within the male and female populations, individuals with the metabolic syndrome had higher CAD scores.

Evidence of the metabolic syndrome was present in 78.9% of individuals with the metabolic syndrome, while such evidence was found in 46.7% of those without the syndrome (P<0.05).

Analysis of angiography scores and the metabolic syndrome shows a direct correlation between the two (P<0.001, r=0.015).

Sex-controlled partial correlation test also revealed a direct correlation between angiography score and the metabolic syndrome (P<0.001, r=0.22).

TABLE 1. Frequency percentage of various markers of the metabolic syndrome in patients with scores 0-5 of the syndrome.

MS* score	N (%)	Decreased HDL	Elevated BP	Elevated TG	Increased WC	Elevated FBS
0	26(5%)	0(0%)	0(0%)	0(%)	(0%)	(0%)
1	90(17%)	38(7%)	14(3%)	11(2%)	16(3%)	11(2%)
2	154(28%)	86(16%)	52(10%)	61(11%)	64(12%)	45(8%)
3	147(27%)	121(22%)	63(13%)	92(17%)	96(18%)	68(12%)
4	95(17%)	87(16%)	64(12%)	81(15%)	84(15%)	64(12%)
5	33(6%)	33(6%)	33(6%)	33(6%)	33(6%)	33(6%)

*MS: Metabolic Syndrome

TABLE 2. Frequency percentage of various markers of the metabolic syndrome in patients with scores 0-5 of the syndrome.

MS* score / Variable	0	1	2	3	4	5	P value
Age	55.92±9.43	57.63±11.62	57.18±10.49	58.74±9.43	57.49±9.13	61.68±9.33	0.200
Systolic BP (mmHg)	112.31±8.63	117.66±14.81	121.68±16.47	124.36±16.24	132.793±17.86	144.39±14.40	0.000
Diastolic BP (mmHg)	72.21±5.49	72.42±8.25	74.12±9.04	75.22±7.97	78.05±8.11	82.58±8.67	0.000
Weight (kg)	64.23±12.00	66.81±12.10	71.44±10.893	72.85±11.94	76.33±11.88	75.15±10.98	0.000
WC (cm)	79.85±14.21	86.97±11.17	93.5±12.80	96.42±13.79	102.25±8.60	103.12±9.85	0.000
FBS (mg/dl)	94.08±7.99	104.47±34.98	117.08±51.47	137.39±73.8	148.82±65.22	166.06±48.20	0.000
HDL (mg/dl)	49.31±6.86	44.32±9.69	42.07±9.66	37.65±9.72	38.89±8.37	267.03±120.38	0.000
TG (mg/dl)	104.35±23.51	116.52±41.47	160.32±91.97	206.28±155.13	242.86±139.27	262.03±120.38	0.000

*MS: Metabolic Syndrome

TABLE 3. Mean and standard deviation of involvement of coronary arteries in healthy individuals and patients in the general population

	Mean score of involvement		
Sex	Individuals with metabolic syndrome (n=275)	Individuals without metabolic syndrome (n=270)	P*
Male	10±6.2 (n=125)	7.8±6.1 (n=192)	P<0.01
Female	7.2±5.6 (n=150)	4.2±4.9 (n=78)	P<0.001
Total	8.5±6.0	6.8±6.0 (n=270)	P<0.01

P values below 0.05 are statistically significant

TABLE 4. Assessment of the relationship between various components of the metabolic syndrome and severity of CAD (CI: Confidence interval)

	Variable	OR	95% CI	P
	Age	1.01	0.99-1.02	0.187
	Sex	2.83	1.98-4.04	0.000
Metabolic syndrome components	TG	1.01	1.01-1.02	0.00
	HDL	-0.91	0.18-0.94	0.00
	FBS	1.01	1.01-1.02	0.00
	WC	1.07	1.05-1.10	0.0000
	BP	10.87	6.36-18.57	0.00

Logistic regression test demonstrated the metabolic syndrome to be a risk factor for CAD (OR=1.35, CI=1.13-1.60). Furthermore, regression table for individual components of the metabolic syndrome showed each of these components to be a risk factor for CAD. HLD levels inversely correlated to risk of CAD; however, we found no correlation with age. The strongest correlation was found between severity of CAD and hypertension (Table 4).

Discussion

Our findings show a strong relationship between the metabolic syndrome score and CAD in both sexes. Moreover, decreased HDL-C was the most frequent abnormality in CAD patients. Other common abnormalities were increased WC and elevated TG, in the order mentioned. The metabolic syndrome has been recognized as a prelude to atherosclerosis and diabetes.[15] Recent studies have suggested that the metabolic syndrome is associated with increased risk of CAD even in the absence of major risk factors.[34-36] Some studies have established a direct relationship between CAD and the number of disorders seen in the metabolic syndrome.[35] Further, individuals with more marked TG, BP and WC abnormality tended to have more severe CAD and were at greater risk of its complications.[35]

Another study found women with the metabolic syndrome and evidence of CAD in their angiograms to have more severe disease and a decreased 4-year survival rate. By contrast, the metabolic syndrome did not increase the risk in women without coronary disease on angiography. A cumulative effect seems to exist between the metabolic syndrome and other CAD factors. This can be noted in the present study. The primary reason for increased apolipoprotein B is the rise in small LDL lipoproteins which leads to atherogenic dyslipidemia[39] subsequent to visceral fat build-up.

Also worthy of noting is the presence of new metabolic syndrome risk factors such as CRP, fibrinogen and microalbuminuria which in turn increase the effect of major risk factors.[40] Another study demonstrated a higher prevalence of the metabolic syndrome in postmenopausal women,

suggesting that the relationship between the metabolic syndrome and severity of CAD is not linked to the overall progress of disease, but raises the risk of coronary accidents. The present study, however, demonstrated a link between metabolic syndrome score and CAD. Another study of 2175 Americans showed that the highly prevalent metabolic syndrome in the US is an independent prognostic factor in CAD and related cardiac accidents in the elderly.[19] In a study conducted in Taiwan in 2004, the metabolic syndrome was found to be more prevalent in CAD patients than in healthy individuals. In the current study, regression analysis showed hypertension to be the best prognostic factor in patients with the metabolic syndrome.[21] Wong et al. showed that non-diabetic individuals with the metabolic syndrome and CAD had an increased likelihood of inducible myocardial ischemia.[16]

Based on another study, the presence of metabolic factors can be a strong prognostic indicator of risk of cardiac accidents in women with significant CAD suspected of myocardial ischemia.[17] Anderson showed the metabolic syndrome to be associated with a higher risk of CAD, but suggested that blood sugar and TG abnormality were of prognostic value.[11]

A study of Canadian men and women evidenced the presence of metabolic syndrome in more than half of CAD patients, while showing a greater risk in patients with higher scores of the syndrome.[18]

A study conducted by Turhan in Turkey demonstrated a significantly higher prevalence of metabolic syndrome in young women with early-onset ischemic heart disease, while stressing the need for controlling metabolic factors as part of primary and secondary prevention strategies.[20]

It can thus be concluded that changes in metabolic syndrome markers are closely linked. Severity of the metabolic syndrome increases with the decrease in HDL-C and increase in FBS, BP, WC and TG, hence the rise in metabolic syndrome score was associated with increased atherosclerotic involvement of the coronary arteries.

One out of every four people in Central Iran is affected by the metabolic syndrome; therefore prevention and control of this syndrome should be given high priority in health and treatment strategies in this part of the country. Furthermore, measures to control the metabolic syndrome should supplement those adopted for reducing major risk factors of ischemic heart disease in affected patients.

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