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ORIGINAL PAPER

Metabolic Syndrome in Patients Undergoing Coronary Angiography

Derya Atik[1], Cem Atik[2], Hilal Karatepe[1]

Osmaniye Korkut Ata University, School of Health, Nursing Division, Osmaniye, Turkey[1]
Private New Life Hospital, Department of Cardiovascular Surgery, Osmaniye, Turkey[2]

Correspondence author: Derya Atik, PhD. GSM: 0534 970 15 68. E-mail: deryaatik09@hotmail.com

ABSTRACT

Introduction: Metabolic Syndrome (MetS) is basically a cluster of cardiovascular risks that involve changes in metabolic and hemodynamic indicators; various organizations have defined it with small differences. Metabolic syndrome is a lethal endocrinopathy starting with insulin resistance and inviting a chain of systemic disorders such as abdominal obesity, glucose intolerance or diabetes mellitus (DM), dyslipidemia, hypertension (HT) and coronary artery disease (CAD). **Material and methods:** This prospective and descriptive study was conducted at the Cardiology Clinic of a Private Hospital in Osmaniye between January 2014 and May 2014. The study population included all patients who were administered a CA procedure at the Cardiology Clinic of Private New Life Hospital in Osmaniye in 2014. **Results:** The majority of the patients were male (63.3%), the mean age was 59.09±10.98, vast majority of them had social security (98.5%), 32.8% of them smoked, 7.2% had peripheral arterial disease (PAD), 52.5% were diagnosed with DM, 24.8% with HT, percutaneous transluminal coronary angioplasty (PTCA) or stent was administered to 40.3% of the patients who underwent CA and coronary artery bypass grafting (CABG) was decided for 15.5% of them. 41.8% of the patients met the MetS diagnosis criteria. The mean BMI was found to be 28.61±4.68, the mean FBS to be 143.20±74.83, the mean triglyceride value to be 168.73±96.94 and the mean HDL value to be 37.04±9.20. Although male gender came first among the patients who underwent CA, the prevalence of MetS did not show a statistically significant correlation with gender, mean age or smoking. The prevalence of HT, PAD and DM was significantly higher in the patients who met the MetS criteria. The mean values of FBS, HDL, CK-MB, triglyceride and cholesterol were also significantly higher in the patients who met the MetS criteria. As BMI increased, the rate at which MetS criteria are met also increased. **Conclusion:** The objective is to prevent diabetes and cardiovascular diseases. Weight loss achieved with proper nutrition and an exercise program will have a reversing effect on all the disorders seen in metabolic syndrome.

Key words: metabolic syndrome, coronary angiography.

1. INTRODUCTION

Metabolic Syndrome (MetS) is basically a cluster of cardiovascular risks that involve changes in metabolic and hemodynamic indicators; various organizations have defined it with small differences. Metabolic syndrome is a lethal endocrinopathy starting with insulin resistance and inviting a chain of systemic disorders such as abdominal obesity, glucose intolerance or diabetes mellitus (DM), dyslipidemia, hypertension (HT) and coronary artery disease (CAD) (1). The etiology of MetS can be studied in three categories: obesity/fat tissue disorders, insulin resistance and independent factors (vascular, hepatic and immunologic molecules). There may be polygenic tendency, but sedentary lifestyle and high-calorie diet brought by modern urban life exacerbate the progress of the syndrome (2). Other causes increasing the prevalence of MetS include postmenopausal period, smoking, low income level, high-carbohydrate diet and physical inactivity (3).

According the Metabolic Syndrome Guide published in 2009 by the Endocrinology Metabolism Association of Turkey, the prevalence of MetS in our country is 25% in males and 40% in females, which are quite high figures. These figures increase with aging; while it is 6.7% in the 20-29 age group, it goes up to 43.5% in the 60-90 age group (1). According to the Turkish Adults Heart Disease and Risk Factors Study (TAHDRFS) 2012 report, the MetS prevalence was found to be 49.9% in the entire cohort of 3800 people, 45.1% in males and 54.5% in females (4). The cross-sectional and long-term studies have shown that the cardiovascular disease risk is more than 1.5 times in individuals with MetS. What increases the risk is not obesity but presence of metabolic syndrome (5).

Investigating the prevalence and causes of MetS, which plays an important role in the development and prognosis of cardiovascular disease, one of the most frequently seen diseases, identifying regional differences in our country, and planning treatment, care and training according to the results of the investigation will contribute to the betterment of the quality of public health. At this point, nurses assume important responsibilities including educating patients on the risk factors of MetS, increasing their awareness and attentiveness with respect to MetS, informing patients about ways to increase their activities and taking the lead to organize programs for aerobic and strengthening exercises. In our study, which we planned based on this idea, we aimed at determining the prevalence of MetS and MetS-related factors in patients who were administered coronary angiography (CA).

2. PATIENTS AND METHODS

This prospective and descriptive study was conducted at the Cardiology Clinic of a Private Hospital in Osmaniye between

January 2014 and May 2014. The study population included all patients who were administered a CA procedure at the Cardiology Clinic of Private New Life Hospital in Osmaniye in 2014. For sampling, we used the power analysis as a method guaranteeing the validity, reliability and sensitivity of the study result. Thus, starting from the fact that an average of 2500 CA procedures were performed in 2013, we determined how many patients our sample should include, accepting that the results will be within 95% confidence interval and may involve d=0.05 of sampling error. The sample size was found to be n=333 in the power analysis conducted. The study sample consisted of 335 patients who underwent CA.

The criteria for inclusion of patients in the study were being 18 years of age or older, having no communication problems, being capable of answering all the questions and agreeing to participate in the study.

The study data were collected using the data collection form containing the Metabolic Syndrome Diagnosis Criteria recommended by the Endocrinology Metabolism Association of Turkey, Metabolic Syndrome Work Group and a data collection form developed by the investigators. The data collection form contained sections where measurements such as gender, age, social security, height, weight, waist circumference and LDL (Low-density lipoprotein) were recorded. The Metabolic Syndrome Diagnosis Criteria recommended by the Endocrinology Metabolism Association of Turkey, Metabolic Syndrome Work Group are as follows:

At least one of the following:

- Diabetes mellitus or
- Impaired glucose tolerance or
- Insulin resistance and

At least two of the following:

- Hypertension (systolic blood pressure > 130, diastolic blood pressure > 85 mmHg or using antihypertensive drugs
- Dyslipidemia (triglyceride level > 150 mg/dl or HDL (High-density lipoprotein) level < 40 mg/dl in men and < 50 mg/dl in women)
- Abdominal obesity (BMI > 30 kg/m^2 or waist circumference > 94 cm in men and > 80 cm in women) (1).

The questions included in the data collection form were filled out from patient files and through face-to-face interviews with the patients. The triglyceride, total cholesterol, HDL, LDL, CK (creatine kinase), CK-MB, troponine and FBS (fasting blood sugar) values were obtained from the latest laboratory results of the patients. The body mass indexes were calculated after getting the weight and height values.

The data obtained from the study were analyzed on a computer using the SPSS 21.0 statistical program. The descriptive data are given in arithmetic mean ± standard deviation (SD), numbers and percentage distributions. The correlations between the variables were assessed using the independent sample t-test, crosstabs, one-way anova and Pearson correlation analysis. The data were evaluated at 95% confidence interval and at p<0.05 significance level.

The necessary permissions were obtained for the study from the institution where the study would be carried out. The participants included in the sample were informed about the study and data collection forms before administering them.

Characteristics	n	%	Characteristics	n	%
Gender			Diabetes mellitus		
Female	123	36.7	Yes	176	52.5
Male	212	63.3	No	159	47.5
Social security			Hypertension		
Yes	330	98.5	Yes	83	24.8
No	5	1.5	No	252	75.2
Smoking			Metabolic syndrome		
Yes	110	32.8	Yes	140	41.8
No	225	67.2	No	195	58.2
BMI (kg/m2)					
<18.5	2	0.6	Procedure		
18.5-24.9	62	18.5	Normal	52	15.5
25-29.9	155	46.3	Medical treatm.	96	28.7
30-34.9	89	26.6	PTCA+stent	135	40.3
35-39.9	18	5.4	Surgical treatm.	52	15.5
>40	9	2.7			
Peripheral arterial disease					
Yes	24	7.2			
No	311	92.8			

Table 1. *Breakdown of patients by their characteristics (n: 335). Categorical variables are presented in numbers (percentages)*

Characteristics	Min	**Max Mean**±Sd
Age (years)	29	84 59.09±10.98
Height (cm)	148	185 164.52±7.73
Weight (kg)	45	131 77.54±14.25
BMI (kg/m^2)	18	43.72 28.61±4.68
FBS (mg/dl)	47	602 143.20±74.83
Triglyceride (mg/dl)	36	631 168.73±96.94
Cholesterol (mg/dl)	83	384 189.67±46.78
HDL (mg/dl)	15	65 37.04±9.20
LDL (mg/dl)	42	240 120.48±34.94
CK (U/L)	12	4034 239.25±509.15
CK-MB (U/L)	1	718 54.15±85.35
Troponin (ng/ml)	0	50 2.66±8.05

Table 1. *Breakdown of patients by their characteristics (n: 335) (continued). Continuous variables are presented as mean±standard deviation*

3. RESULTS

The characteristics of the patients included in the study are shown in Table 1 and Table 2.

The majority of the patients were male (63.3%), the mean age was 59.09±10.98, vast majority of them had social security (98.5%), 32.8% of them smoked, 7.2% had peripheral arterial disease (PAD), 52.5% were diagnosed with DM, 24.8% with HT, percutaneous transluminal coronary angioplasty (PTCA) or stent was administered to 40.3% of the patients who underwent CA and coronary artery bypass grafting (CABG) was decided for 15.5% of them. 41.8% of the patients met the MetS diagnosis criteria. The mean BMI was found to be 28.61±4.68, the mean FBS to be 143.20±74.83, the mean triglyceride value to be 168.73±96.94 and the mean HDL value to be 37.04±9.20 (Table 1).

The characteristics of the patients who met and did not meet the metabolic syndrome criteria are shown in Table 2. Although male gender came first among the patients who underwent CA, the prevalence of MetS did not show a statistically significant correlation with gender, mean age or smoking. The prevalence of HT, PAD and DM was significantly higher in the patients who met the MetS criteria. The mean values of FBS, HDL, CK-MB, triglyceride and cholesterol were also significantly higher in the patients who met

	Metabolic Syndrome					
	Yes	%	No %	x^2	p	
Gender						
Female	52	42.27	71 57.73	0.19	0.89	
Male	88	41.50	124 58.50			
Smoking status						
Yes	53	48.18	57 138	51.82	2.75	0.09
No	87	38.66		61.34		
Hypertension						
Yes	60	72.28	23	27.72	42.10	**0.00**
No	80	31.74	172	68.26		
Peripheral arterial disease						
Yes	18	75.00	6	25.00	11.72	**0.00**
No	122	39.22	189	60.78		
BMI (kg/m^2)						
<18.5	0	0	2	100	72.99	**0.00**
18.5-24.9	17	27.41	45	72.59		
25-29.9	38	24.51	117	75.49		
30-34.9	65	73.03	24	26.97		
35-39.9	14	77.77	4	22.23		
>40	9	100	0	0		
Procedure						
Normal		30.76	36	69.24	4.74	0.19
Medical treatment	16 37 63	38.54	59	61.46		
PTCA+stent	24	46.66	72	53.34		
Surgical treatment		46.15	28	53.85		
Diabetes mellitus						
Yes	93 47	52.84	83	47.16	18.61	0.00
No		29.55	112	70.45		
Age (years)	59.20±10.74	59.02±11.18	F=0.02	0.88		
Height (cm)	164.38±8.00	164.62±7.56	F=0.07	0.78		
Weight (kg)	82.67±14.53	73.86±12.88	F=34.18	0.00		
BMI (kg/m^2)	30.57±4.77	27.21±4.08	F=47.73	0.00		
FBS (mg/dl)	164.80±88.39	127.68±58.85	F=21.26	0.00		
Triglyceride (mg/dl)	215.43±104.89	135.21±74.77	F=66.80	0.00		
Cholesterol (mg/dl)	199.68±46.20	182.48±45.99	F=11.35	0.00		
HDL (mg/dl)	34.00±7.86	39.22±9.49	F=28.33	0.00		
LDL (mg/dl)	123.67±35.65	118.19±34.33	F=2.00	0.15		
CK (U/L)	216.54±331.33	255.55±605.6	F=0.47	0.49		
CK-MB (U/L)	43.47±44.26	61.82±104.86	F=3.79	0.05		
Troponin (ng/ml)	2.12±6.03	3.05±9.23	F=1.10	0.29		

Table 2. *Patient characteristics with respect to presence of metabolic syndrome. Continuous variables are presented as mean±standard deviation and categorical variables as numbers (percentages)*

	MetS	Gen.	CA result	BMI	DM	HT	FBS	Trig.	HDL
MetS		0.007	0.036	0.392**	0.236**	0.355**	0.245**	0.409**	0.280**
Gender			0.207**	0.120*	0.129*	0.079	0.074	0.017	0.456**
CA result				0.001	0.185**	-0.035	0.016	0.026	0.126*
BMI					0.108*	0.009	0.182**	0.020	-0.027
DM						0.130*	0.441**	0.025	0.009
HT							0.033	0.228**	0.093
FBS								0.013	-0.161**
Triglyceride									-0.227**
HDL									

Table 3. *Correlation between gender, age, smoking, peripheral arterial disease, diabetes mellitus, HDL and LDL values and the procedure administered ("r" values of the correlation analysis). *p<0.05, **p<0.01*

the MetS criteria. As BMI increased, the rate at which MetS criteria are met also increased. Although statistically not significant, the number of PTCA + stent procedures applied and the number of CABG decisions given were proportionally greater in the patient group that met the MetS criteria (Table 2).

The relationship between the status of meeting the metabolic syndrome criteria and gender, CA result, BMI, DM, HT, FBS, HDL and triglyceride values was explored with a correlation analysis (Table 3). A considerably significant correlation in the positive direction was found between the status of meeting the metabolic syndrome criteria and BMI, DM, HT, FBS, HDL and triglyceride levels ($p<0.01$). In the average and chi-square tests performed to find out from where the statistically significant correlations originated, it was seen that PTCA+stent was decided for 47.2% of the men, CABG for 17.5% of them and the CA result turned out normal in only 6.6% of them, whereas PTCA+stent was decided for 28.5% of women, CABG for 12.2% of them and CA result was normal in 30.9%. The mean BMI of men was 29.26±5.10 and their mean HDL was 42.55±9.73; those of women were 28.76±8.77 and 33.84±7.16, respectively. The prevalence of DM was 61.1% in men and 47.6% in women. Medical treatment was proposed to only 17% of those with DM, PTCA+stent was decided for 45% of them and CABG for 22.2%; medical treatment was proposed to 41.5% of those with no DM, PTCA+stent was decided for 34.6% of them and CABG for 8.2%. The mean BMI of the patients diagnosed with DM was 29.84±9.62 and that of patients with no DM was 27.95±4.31. HT was present in 30.1% of the patients with DM and only in 18.9% of those with no DM. The mean HDL was 41.13±9.95 in the patients whose CA result was normal, 34.43±8.25 in those for whom a PTCA+stent decision was given and 38.07±9.30 in those for whom a CABG decision was made. The mean FBS was found to increase as BMI increased. The patients diagnosed with HT had a mean FBS of 147.48±58.70 and a mean triglyceride of 207.26±108.87 and they were 141.78±79.48 and 156.04±89.33 respectively in those who had no HT. The HDL level was negatively correlated with the FBS and triglyceride levels, which meant that the FBS and triglyceride levels dropped as HDL increased (Table 3).

4. DISCUSSION

Metabolic syndrome is an important and widely seen health problem across the world in the 21st century (6). It has been shown in three large-scale meta-analyses that there is a twofold increase in the risk of a cardiovascular event (cardiovascular mortality, myocardial infarction (MI), stroke) in individuals with MetS. It has also been shown in the same studies that mortality from all causes increases 1.5 times and the cardio-

vascular risk is high in people with MetS even if they have no DM (7-9). Since it became certain that MetS is the major condition that impairs metabolism and heart health, it is an appealing issue to find out what progress is exhibited by this syndrome.

According to TAHDRFS 2012 report, the MetS prevalence was 49.9% in the entire cohort, 45.1% in males and 54.5% in females (4). In the PURE TURKEY study (Prospective Urban Epidemiological Study) that was conducted in 2012, the prevalence of MetS was found to be 49.9% in general, 46.9% in men and 51.7% in women. Onat and Sansoy (2002) found in their study the prevalence of MetS to be 53% in their sample with CAD. Yılmaz et al. (2005) reported in their study that the prevalence of MetS was 49% in patients with acute coronary syndrome (ACS) (63% in women and 44% in men). Birsel et al. (2007) found in their study that the rate of MetS was 45.4% in the patients who had MI with acute ST-segment elevation and who presented to the hospital in ≤ 12 hours and underwent a primary percutaneous coronary intervention (PCI). In their study, Danciu et al. (2012) found the MetS prevalence to be 26% in 212 patients aged under 50 who were hospitalized due to ACS for the first time. Jover et al. (2011) found that the MetS prevalence was 50.9% in patients with ACS. While some studies show that MetS prevalence is higher in males, there are also studies with results contrary to this (17-19). Novak et al. (2013) reported in their study that males had more MetS than females at middle age. In our study, 41.8% of the patients who were administered CA due to myocardial ischemia met the MetS diagnosis criteria. Although male gender came first among the patients who underwent CA, the prevalence of MetS did not show a statistically significant correlation with gender.

The adverse effects of smoking on health primarily with respect to MetS, cardiovascular diseases and cancer are well known (21). Smoking has been found to lower the HDL level and elevate the LDL and triglyceride levels (22). However, there are also studies showing that there is no relationship between smoking and MetS (23, 24). We found in our study that smoking did not have any impact on the increase in MetS risk.

People with metabolic syndrome often have obesity, impaired glucose tolerance, diabetes and HT and hypertriglyceridemia and dyslipidemia characterized by decreased HDL are seen in their laboratory tests (25). The insulin resistance and glucose metabolism disorder that develop in the period prior to the emergence of obvious type 2 DM are the two important pathologies underlying MetS (26). In addition to MetS itself being a major CAD risk factor, it also paves the way to type 2 DM and this suggests that the components that form MetS should be dealt with more carefully. Novak et al. (2013) stated in their study that HT is a greater risk factor for MetS in women than in men. Tartan et al. (2007) reported in their study that except in glucose and triglyceride levels, no significant difference was seen between the groups with severe CAD and mild CAD with respect to HDL-cholesterol and hypertension. In the same study, the rate of type 2 DM was 24.6% in the severe CAD group and 11.2% in the mild CAD group; the LDL, HDL, triglyceride, total cholesterol, glucose levels and type 2 DM were found significantly higher in the high MetS score group than in the low MetS score group; and CAD prevalence and severity had a slight significant correlation with duration of type 2 DM, glucose and presence of type 2 DM and a moderate significant correlation with MetS score in the positive direction. In the study of Nurkalem et al. (2007), waist circumference and triglyceride level were found higher, HDL level significantly lower, HT higher, FBS level similar, and postprandial glucose level higher in patients with MetS. The prevalence of HT and DM were also significantly higher in the patients who met the MetS criteria in our study. The mean values of FBS, HDL, triglyceride and cholesterol were also higher in the patients who met the MetS criteria.

The prevalence of obesity exhibits a global increase in parallel with changes in lifestyle. In the 2012 follow-up results of the PURE Project, the proportion of those who had a BMI of 30 and over was 54.4% in Turkey (10). Yusuf et al. (2005) showed in their study with 27000 patients from 52 different countries that obesity was an independent risk factor for developing MI. Delibaşı et al. (2007) found in their study that in Turkey the rate of obesity was 22.1% in women over 18 years of age. In the study of Sanisoğlu et al. (2006), the rate of obesity was 41.32% in women over 30 years of age. While 26.26% of all the patients in our study group had a BMI of over 30 kg/m^2, the mean BMI was 30.57±4.77 kg/m^2 in the MetS group.

In a meta-analysis where 87 clinical studies and 951.083 patients were included, it was shown that MetS increased the risk of cardiovascular disease 2.35 times, cardiovascular mortality 2.40 times, all-cause mortality 1.58 times, MI risk 1.99 times and stroke risk 2.27 times (32). Timóteo et al. (2012) did not find any correlation between the prevalence of CAD and MetS in their study. Jover et al. (2011) found in their study that MetS prevalence was 50.9% in patients with ACS. In our study, the number of patients for whom PTCA+stent and CABG were decided in the patient group who met the MetS criteria was proportionally larger than the group whose CA result turned out normal or for whom medical treatment was proposed. The MetS prevalence was 46.52% in the patients for whom PTCA+stent and CABG was decided.

5. CONCLUSIONS

The prevalence of MetS found in our study is similar to those found in the other studies performed in Turkey. Developing individual MetS treatment strategies is important for developing different approaches for the treatment of CAD and risk factors. In metabolic syndrome that occurs due to the impact of environmental factors, not due to genetic characteristics, the primary approach should be to reorganize the lifestyle. The objective is to prevent diabetes and cardiovascular diseases. Weight loss achieved with proper nutrition and an exercise program will have a reversing effect on all the disorders seen in metabolic syndrome.

CONFLICT OF INTEREST: NONE DECLARED.

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