Coll. Antropol. **26** (2002) 1: 23–29
UDC 616.127-005.8-056
Original scientific paper

Metabolic Syndrome X – High Risk Factor for Acute Myocardial Infarction and Its Complications

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A B S T R A C T

Metabolic Syndrome X is a clinical entity which comprises the following factors: diabetes mellitus, arterial hypertension, high levels of triglyceride and/or low levels of HDL cholesterol, central obesity and microalbuminuria (by WHO criteria). The first goal of this study was to determine the frequency of the Metabolic Syndrome X (MSX) in patients with acute myocardial infarction compared with the general population. The second goal of the study was to examine the frequency of heart failure and reinfarction rate in the patients with myocardial infarction, with and without MSX. Furthermore, the relationship between gender and MSX was analyzed. A total of 101 patients with acute myocardial infarction took part in randomized trial (32 women and 69 men). MSX and all of its components were diagnosed according to WHO criteria. To determine statistical significance of our results, we used χ^2 test and t-test for independent samples. From 101 patient 48 had MSX (47.52%), while in the general population incidence of MSX is 3–4%. The reinfarction and the heart failure rate were significantly higher in the group of patients with MSX ($p = 0.0067$ and $p = 0.0217$, respectively). To conclude, the results of the present study confirm that MSX is a high risk factor for myocardial infarction and its complications.

Introduction

Already, in 1950-ties the connection between android type of obesity and high cardiovascular risk was noticed. The term *Metabolic Syndrome* was first used by J. P. Camus (1966) who revealed the connection between diabetes mellitus,

Received for publication February 15, 2001

hyperlipoproteinemia and gout with high cardiovascular risk[1]. Twenty years later Raeven described Syndrome X (diabetes mellitus, dyslipidemia: hypertriglyceridemia with the reduction of HDL cholesterol, arterial hypertension and insulin resistance)[2].

In 1999 WHO introduced the name »Metabolic Syndrome X«, as a distinction to the coronary syndrome X[3,4,5]. In this way MSX was established as a clinical entity.

WHO[3,6,7] diagnostic criteria for MSX are:

1. Diabetes mellitus or glucose intolerance or insulin resistance with positive two or more down mentioned criteria:
2. Arterial hypertension (≥ 160/90 mm Hg),
3. High levels of triglyceride (≥ 1.7 mmol/l, 150 mg/dl) and/or low levels of HDL cholesterol (< 1.0 mmol/l or 39 mg/dl for women and < 0.9 mmol/l or 35 mg/dl for men),
4. Central obesity (men: waist/hip ratio > 0.9, women: waist/hip ratio > 0.85) and/or BMI > 30 kg/m2,
5. Microalbuminuria (≥ 20 μg/min) or albuminuria/creatinuria ≥ 20 mg/g.

Myocardial infarction is necrosis of the myocardium, caused by the decrease or total suppression in blood supply in coronary arteries and is one of the most common complications of ischemic heart disease. It is the most frequent cause of morbidity and mortality in developed countries and as such, one of the most important social-medical problems. The most frequent cause of myocardial infarction is atherosclerosis of coronary arteries with superimposed thrombosis, which results in narrowing of artery and occlusion[8–11].

The aim of this study was to see the frequency of MSX, and its components (WHO criteria) in patients with myocardial infarction, and to compare it with frequency in general population as well as in general hospital population according to literature data[12,13]. Among the patients with myocardial infarction and MSX, we analyzed frequency of MSX according to gender and compared these results with frequency of MSX in general population (according to sex).

We also compared the rate of myocardial infarction complications such as a congestive heart failure and reinfarction in the groups of patients with, and without MSX.

As mentioned above, it is known that MSX is risk for cardiovascular disease [1,6,14,15], but so far there are no data about incidence of MSX (according to new WHO criteria) in patients with myocardial infarction and whether it predisposes to its complications. There are some data that MSX predisposes to ischemic heart disease in middle–aged male group of non -diabetic patients[16].

There are also some data about microalbuminuria as a single factor–predictor for higher morbidity in acute myocardial infarction[17], and there are plenty of data about diabetes mellitus and cardiovascular risk[18–21].

Considering all these, by treating the patients with MSX in time (all elements), myocardial infarction and its complications could be prevented.

Materials and Methods

Subjects

In our study 101 patients (32 women and 69 men) with acute myocardial infarction were included. Patients were selected on random basis, from the Coronary Care Units of »Sveti Duh« General Hospital and »Sestre milosrdnice« University Hospital in the period from 24.11.1999. to 12.07.2000. To all the patients the methods and goals of the study were explained, and they all gave verbal consent.

Metabolic Syndrome X (MSX) was diagnosed according to WHO criteria[3,6,7]: diabetes mellitus or intolerance of glucose or insulin resistance with two or more of the following elements: hypertriglyceridemia or low HDL, arterial hypertension, android type of obesity, or high BMI and microalbuminuria.

Diabetes mellitus was diagnosed by WHO criteria[3] and glucose intolerance was verified by OGGT test.

Blood pressure was measured by a sphingomanometer and expressed in mm Hg. Hypertension was diagnosed by WHO criteria[3]: systolic pressure over 160 mm Hg and diastolic pressure over 90 mm Hg, measured 3 times in intervals of 10 minutes 3 days in the role, if the hypertension was registered for the first time.

Triglycerides, total, HDL and LDL cholesterol were determined from fasting blood samples. By WHO hypertriglyceridemia is 1.7 mmol/l or more triglycerides in blood and low HDL for men is less than 0.9 mmol/l and for women less than 1.0 mmol/l HDL in blood.

Android type of obesity was determined by waist / hip ratio – in men over 0.9 and in women over 0.85 or BMI which must be over 30 kg/m^2.

Microalbuminuria was measured by CLINITEK test bands by Bayer Company. The significant microalbuminuria appeared when the albumines in urine were 20 μg/min or more, or when albuminuria-creatinuria ratio was 20 mg/g or more.

Congestive heart failure was defined by chest radiography, (Doppler) echocardiography and/or physical finding as: ventricular (S3), atrial (S4) gallop, tachyarrhythmia, pulsus alterans-rapid rate and decreased amplitude, dyspnea, fatigue, ascites, peripheral edema, liver enlargement, symptoms of pulmonary edema[9,22].

Previous myocardial infarction was determined by medical history taken by physician and/or previous medical documentations.

Statistics

For the statistical significance of the previous infarction and postinfarction heart failure we used χ^2 test. The same method was used for analysis of the difference in MSX frequency between men and women. Frequency of MSX was expressed as a per cent (%). We also analyzed age, total and LDL cholesterol in the group of patients with and without MSX. To determine if there is a statistically significant difference we used t-test for independent samples.

Results

The 101 patients (32 women and 69 men) with acute myocardial infarction took part in our study. By WHO criteria [3,6,7], MSX was confirmed in 48 out of 101 patients (47.52%). They were aged from 37 to 86 years (mean 63.93 years). A mean age in the group with MSX was 66.1 and in the group without MSX 62.2 years (Table 1). After statistical analysis (t-test for independent samples), we found that there is no statistically significant difference between that two groups ($p = 0.0917$).

From 32 females, 17 had MSX (53.125%) and from 69 males 31 had MSX (44.93%). There were no statistically significant (χ^2 test) differences in occurrence of MSX between men and women.

As shown in Figures 1 and 2 from 48 patients with MSX, 30 had a heart failure as a complication of myocardial infarction (62.5%), while only 21 of 53 without MSX had the same complication (39.62%). That was statistically significant difference (χ^2, $p = 0.0217$). Furthermore, 70 patients suffered from myocardial infarction for the first time. 14 of 27 patients

TABLE 1
COMPARATION OF CONVENTIONAL RISK FACTORS FOR MYOCARDIAL INFARCTION AND FACTORS OF MSX IN PATIENTS WITH AND WITHOUT MSX

Risk factors for myocardial infarction	MSX	Without MSX
Age (years)	66.10	62.20
Mean levels of total cholesterol (mmol/L)	6.33	6.51
Mean levels of LDL cholesterol (mmol/L)	4.86	5.12
Mean levels of triglycerides (mmol/L)	2.84	2.41
Mean levels of HDL cholesterol (mmol/L)	0.89	0.92
Diabetes mellitus or glucose intolrance (%)	100	11.32
Arterial hypertension (%)	85.42	64.15
Obesitas (%)	68.75	54.72
Microalbuminuria (%)	81.25	54.72

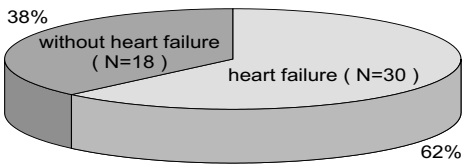

Fig. 1. Heart failure in patients with MSX (N=48).

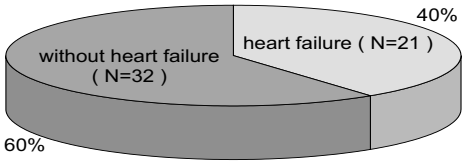

Fig. 2. Heart failure in patients without MSX (N=48).

with MSX and first myocardial infarction (51.85%) had congestive heart failure. From 43 patients without MSX, having myocardial infarction for the first time, 12 of them developed that complication (27.91%). After statistical analysis (χ^2 test) we concluded that heart failure occurs more often in patients with MSX ($p = 0.0436$) even in the group of patients with first myocardial infarction.

We also compared reinfarction rate, and came to the results that in the group of 48 patients with MSX, 21 have already had 1 or more myocardial infarction (43.75%) and from 53 patients without MSX, only 10 of them had previous myocardial infarction (18.87%), all of them having only one previous infarction. These results were also analyzed with χ^2 test. After statistical analysis we could say that patients with MSX had significantly more often myocardial reinfarction ($p = 0.006$).

From 48 patients with MSX, 27 ones had myocardial infarction for the first time and 10 of them (37.04%) didn't have any chest pain and/or diagnosis of angina pectoris previous to infarction.

Levels of total and LDL cholesterol were analyzed separately in each group (with and without MSX) and then compared. Mean value of total cholesterol in patients with MSX was 6.33 and in patients without MSX 6.51 mmol/l (Table 1). There was no statistically significant difference in this parameter between these two groups (t-test for independent samples, $p = 0.61$). Mean value of LDL cholesterol was 4.86 in participants with MSX, and 5.12 mmol/l in participants without MSX (Table 1). The statistically signifi-

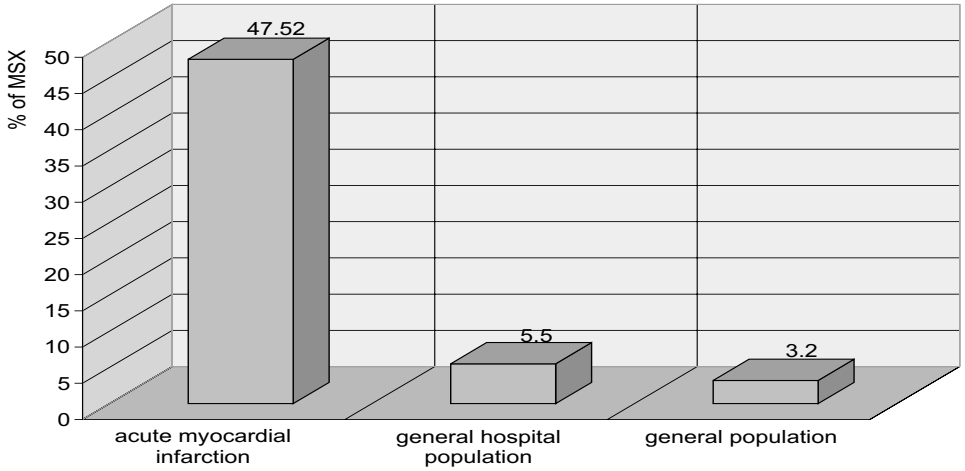

Fig. 3. Frequence of MSX in particular groups.

cant difference wasn't present neither in this case (t-test for independent samples, p = 0.38).

Discussion

It was known that MSX is a risk factor for cardiovascular diseases, but so far, there have not been studies about the incidence of MSX in acute myocardial infarction (according to WHO criteria) and its complications.

In our study we analyzed patients with acute myocardial infarction, incidence of MSX among them and complications in groups with and without MSX. We found that in the group of patients with myocardial infarction there was high incidence of MSX (47.52%), statistically significantly higher than in general population (3.0–3.4%), or in general hospital population (5.5%) according to Trevisan and Cabrijan, respectively[12,13].

To exclude conventional risk factors for myocardial infarction, such as age, level of total and LDL cholesterol, as a factors which contributed to differences in results between groups of patients with and without MSX, we analyzed each group separately and then compared them according to those factors (Table 1).

There was no statistically significant difference in age between that two groups (p = 0.092). The levels of total and LDL cholesterol were even higher in the group without MSX, but not statistically significant (total cholesterol p = 0.61, LDL cholesterol p = 0.38), so cholesterol level as a independent risk factor was of no influence on the differences in complications rate among two groups.

The results indirectly say that MSX is a very high risk factor for myocardial infarction. There was slight, but not statistically significant difference in MSX rate according to gender (31 males or 44.93% vrs. 17 females or 53.125%) – results similar to MTX incidence in general population (slightly higher incidence of MTX in females: 3.4 vrs. 3.0) [12.]

The incidence of heart failure following myocardial infarction, was significantly higher in the group of patients with MSX (62.5%), as well as reinfarction rate (43.75%).

To have more valid results, we excluded patients with the previous myocardial infarction. Even than congestive heart failure appeared to come more often in patients with MSX ($p = 0.044$), so it seems that MSX is high risk factor for cardiac decompensation following myocardial infarction.

There was no statistically significant difference between two groups regarding age (mean 66.1 years in MSX toward 62.2 in non MSX group), so we can exclude this factor as a one contributing to difference in heart failure and reinfarction rate between two groups.

It could be concluded that MSX in myocardial infarction predisposes patients to higher risk of complications (cardiac decompensation following infarction, reinfarction). Therefore, patients comprising MSX criteria, having acute myocardial infarction might need special care and monitoring (for example obligatory hemodynamic surveillance, frequent check -up of cardiac systolic and diastolic function by means of cardiac ultrasound etc.).

Our recommendations could also be, that general practitioners should refer to basic coronary artery disease screening (stress exercise test, or 24 hrs. »Holter« ECG) all patients with elements of MSX, regardless of having symptoms (from 27 patients with MSX, and for the first time having myocardial infarction, 10 ones were without angina-like symptoms before having infarction (37.04%) and the others with angina, probably, also have had periods of »silent ischemia«).

In that way we could intervene, before acute coronary incident occurs–thereby saving patients from suffering the chest pain and other complications and symptoms of acute coronary accident, and on the other side decreasing the expenses for urgent invasive cardiac interventions. Since there are still many patients coming to late for urgent invasive treatment following myocardial infarction, by preventing the same (screening the patients with MSX for ischemic cardiac disease) we could decrease the number of post -infarctional ischemic cardiomyopathies (irreversible damage of myocardium), probably prolonging patients lives, respectively, decreasing medical expenses.

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METABOLIČKI SINDROM X – VISOKI FAKTOR RIZIKA ZA AKUTNI INFARKT MIOKARDA I NJEGOVE KOMPLIKACIJE

S A Ž E T A K

Metabolički Sindrom X je klinički pojam koji obuhvaća slijedeće faktore: šećernu bolest, arterijsku hipertenziju, visoku razinu triglicerida i/ili nisku razinu HDL kolesterola, centralni tip debljine te mikroalbuminuriju (prema kriterijima SZO). Prvi cilj ovog istraživanja bio je odrediti učestalost Metaboličkog Sindroma X (MSX) u bolesnika s akutnim infarktom miokarda te usporediti je s učestalošću u općoj populaciji. Drugi cilj istraživanja bio je odrediti stopu srčanog zatajenja i reinfarkta u pacijenata s infarktom miokarda, sa i bez MSX. Nadalje, analiziran je i odnos spola i MSX. U randomizirano istraživanje bio je uključen 101 bolesnik s akutnim infarktom miokarda (32 žena i 69 muškaraca). MSX kao i sve ostale komponente sindroma su dijagnosticirane prema kriterijima SZO. Za određivanje statističke značajnosti rezultata koristili smo se χ^2 testom i t-testom nezavisnih uzoraka. Od 101 bolesnika 48 je imalo MSX (47.52%), dok je u općoj populaciji incidencija MSX 3–4%. Stopa reinfarkta i srčanog zatajenja bile su signifikantno veće u skupini bolesnika sa MSX ($p = 0.0067$, odnosno, $p = 0.0217$). Zaključno, možemo reći da je MSX čimbenik visokog rizika za infarkt miokarda i njegove komplikacije.