METABOLIC SYNDROME AND OUTCOME IN PATIENTS WITH ACUTE MYOCARDIAL INFARCTION

Zdravko Babić[1], Marin Pavlov[1], Nikola Bulj[1], Vjeran Nikolić Heitzler[1], Veselin Mitrović[2], Christian Hamm[2] and Michael Weber[2]

[1]Department of Cardiology, Sestre milosrdnice University Hospital Center, Zagreb, Croatia; [2]Department of Cardiology, Kerckhoff Heart Center, Bad Nauheim, Germany

SUMMARY – The impact of the metabolic syndrome/insulin resistance syndrome (MS/IRS) on the severity and prognosis of acute ST elevation myocardial infarction (STEMI) treated with primary percutaneous coronary intervention (PCI) was assessed using the American Association of Clinical Endocrinologists and American College of Endocrinology (AACE/ACE) definition from 2003. A total of 385 patients having suffered acute STEMI and treated with primary PCI over a two-year period were divided into two groups (with and without MS/IRS) and compared according to the parameters of severity (clinical, laboratory, echocardiography, coronary angiography parameters and complications) and prognosis using major adverse cardiovascular events (MACE) during the six-month follow-up of acute STEMI. In comparison with control group, the MS/IRS group of patients had worse or similar results of almost all study parameters of severity (hospital days 6.5 *vs*. 6.5, cardiogenic shock 2.9% *vs*. 2.6%, cardiac arrest 6.8% *vs*. 5.2%, reinfarction 0.5 *vs*. 1.6%) and prognosis (total MACE 30.7 *vs*. 30.7%), however, none of the differences reached statistical significance. It is concluded that the unexpected lack of such differences in MS/IRS could be due to the absence of waist-to-hip ratio in the definition and other open questions in metabolic syndrome in general.

Key words: *Metabolic syndrome X; Myocardial infarction*

Introduction

The concurrence of metabolic risk factors for endothelial dysfunction and atherosclerotic cardiovascular disease, which include abdominal obesity, hyperglycemia, dyslipidemia, and hypertension, suggests the existence of metabolic syndrome. Other names used for this constellation of findings are syndrome X, insulin resistance syndrome, 'deadly quartet', or obesity dyslipidemia syndrome[1,2]. According to a recent paper by Mottillo *et al*.[3], the metabolic syndrome is associated with a 2-fold increase in cardiovascular outcomes and 1.5-fold increase in all-cause mortality. Studies are needed to investigate whether or not the prognostic significance of the metabolic syndrome exceeds the risk associated with the sum of its individual components. Furthermore, additional studies should elucidate the mechanisms by which the metabolic syndrome increases cardiovascular risk. The overall prevalence of metabolic syndrome is estimated to be around 20% with an age-dependent increase and increase over time[4].

There are several definitions of the metabolic syndrome[1-3,5]. The criteria provided for the definition of the metabolic syndrome/insulin resistance syndrome (MS/IRS) according to the American Association of Clinical Endocrinologists/American College of Endocrinology (AACE/ACE)[6,7] are:

Correspondence to: *Zdravko Babić, MD, PhD*, Coronary Care Unit, Sestre milosrdnice University Hospital Center, Vinogradska c. 29, HR-10000 Zagreb, Croatia
E-mail: zbabic@net.hr

Received December 2, 2010, accepted July 18, 2011

1) triglycerides >1.69 mmol/L,
2) HDL cholesterol <1.04 mmol/L in men and <1.29 in women,
3) elevated blood pressure (≥130/85 mm Hg),
4) 2-hour post-glucose challenge >7.78 mmol/L and fasting glucose between 6.11 and 7.00 mmol/L,
5) overweight/obesity (body mass index ≥25 kg/m^2), and
6) other risk factors including:
   - family history of type 2 diabetes, hypertension, or CVD,
   - polycystic ovary syndrome,
   - sedentary lifestyle,
   - advancing age, and
   - ethnic groups having high risk for type 2 diabetes or cerebrovascular disease.

Diagnosis depends on clinical judgment with two or more of the first four criteria listed above. This definition has been designed to help physicians predict and prevent serious complications from a number of related conditions grouped in the cluster, even if the underlying pathophysiology may not be completely understood. The differences from other definitions may be summarized as follows: 1) the MS/IRS is used to describe the cluster of abnormalities that are more likely to occur in insulin resistant/hyperinsulinemic individuals; 2) the MS/IRS is differentiated from type 2 diabetes; 3) body mass index, rather than waist circumference, is used as the index of obesity, and viewed as a physiological variable that increases insulin resistance, rather than as a criterion for the diagnosis of MS/IRS; 4) ethnicity is introduced as an important risk factor for insulin resistance, and non-Caucasian ancestry identified as an increasing risk of MS/IRS; 5) other factors have been identified that increase the risk of developing MS/IRS, including family history of type 2 diabetes, hypertension, cerebrovascular disease, polycystic ovary syndrome, gestational diabetes, and acanthosis nigricans; and 6) fasting plasma glucose concentrations are used to identify individuals with type 2 diabetes, and the plasma glucose concentration 2 h after 75-g oral glucose load is introduced as a more sensitive measure of the risk of MS/IRS.

Using the AACE/ACE[6,7] definition for MS/IRS, the main objectives of this study were:

- to calculate the incidence of MS/IRS among consecutive patients with acute ST-elevation myocardial infarction (STEMI) treated with primary percutaneous coronary intervention (PCI) and to compare the results with literature data;
- to evaluate the severity of heart disease and acute STEMI in patients with MS/IRS and to compare the results with patients without the syndrome; and
- to evaluate the prognosis of acute STEMI in patients with MS/IRS and to compare the results with patients without the syndrome.

Patients and Methods

Study population

This retrospective study included 385 consecutive patients having suffered acute STEMI and treated with primary PCI in Kerckhoff Heart Center, Bad Nauheim, Germany, over a two-year period. Data were collected from hospital registry. The diagnosis of STEMI was established and primary PCI performed using the European Cardiac Society criteria[8,9]. In brief, patients with an episode of chest pain within the last 48 hours and ST-elevation on electrocardiography (ECG) in at least two consecutive leads were included.

Methods

After primary PCI patients were hospitalized at cardiology department with continuous monitoring including clinical, ECG, laboratory and echocardiography. Six months after discharge, the authors collected data on major adverse cardiovascular events (MACE) (restenosis, reinfarction, cardiac and non-cardiac rehospitalization, mortality, coronary artery bypass graft (CABG) and cerebrovascular insult (CVI rate)) during patient examination, by checking medical documentation or by telephone contact with patient family members or family physicians.

Using the AACE/ACE[6,7] definition of MS/IRS, study patients were divided into two groups (with and without MS/IRS) and compared according to the severity of their heart disease and prognosis. The severity of heart disease and acute STEMI were estimated

using clinical findings (angina pectoris before primary PCI, dyspnea, all ECG verified rhythm abnormalities, heart failure, cardiogenic shock, cardiac arrest and artificial respiration), cardiac laboratory marker values (creatine phosphokinase (CPK), cardiac troponin T (cTnT)), echocardiography (left ventricular ejection fraction (LVEF)) and coronarography findings (culprit vessel, number of significantly narrowed coronary arteries, diameter and length of stents) and number of hospital days. The prognosis was estimated using intrahospital reinfarction and re-PCI, as well as MACE during six-month follow-up.

Angiography and PCI were performed by the standard technique on a monoplane system (Axiom Artis, Siemens, Erlangen, Germany) as recommended in current guidelines[9]. Patients received 70 IE/kg unfractionated heparin, 500 mg aspirin, a loading dose of 600 mg clopidogrel and in most cases a GPIIb/IIIa inhibitor. Serum biomarkers were assessed as commercially available. Echocardiography was performed according to the clinical standard and in accordance with recommendations related to current echocardiography guidelines[10].

Statistical analysis

Statistical analysis was performed by using the SPSS for Windows 15 software. Nominal (categorical) variables were analyzed by using Pearson χ^2-test and Fisher's exact test, and quantitative variables by using Mann-Whitney test. The level of significance was set at $P<0.05$.

Ethical standards

The study was performed in accordance with ethical standards laid down in the Declaration of Helsinki and was approved by the appropriate institutional review committee.

Results

The mean age of study patients was 63.0 years and 70.3% of them were male. The anterior myocardial wall was affected in 41.1% and inferior wall in 58.9% of study patients. Out of 385 patients, 192 patients fulfilled the criteria for MS/IRS (men 50.9% and women 37.5%), while 193 patients did not meet these

Table 1. Severity of acute ST-elevation myocardial infarction

Finding	Characteristics	Metabolic syndrome	No metabolic syndrome	*P*
Clinical presentation	Angina pectoris (%)	95.1	93.3	0.172
	Dyspnea (%)	3.9	8.8	0.065
	Hospital days	6.48 (±4.31)	6.48 (±4.59)	0.709
Intrahospital complications	Rhythm abnormalities (%)	3.9	3.6	0.785
	Heart failure (%)	1.0	1.0	1.000
	Cardiogenic shock (%)	2.9	2.6	1.000
	Cardiac arrest (%)	6.8	5.2	0.990
	Mechanical ventilation (%)	8.7	5.7	0.325
	Reinfarction (%)	0.5	1.6	0.623
	Re-PCI* (%)	2.1	2.1	1.000
Laboratory	Mean maximal cardiac troponin T (ng/mL)	4.00 (±3.40)	4.46 (±3.21)	0.657
	Mean maximal creatinine phosphokinase (U/L)	1619.7 (±1475.4)	1928.7 (±2166.3)	0.399
Echocardiography	Mean LVEF** (%)	45.65 (±9.79)	45.69 (±9.53)	0.991
Coronarography	Mean number of stenosed vessels	1.69 (±0.87)	1.74 (±0.92)	0.619
	Mean stent diameter (mm)	3.28 (±0.40)	3.21 (±0.39)	0.118
	Mean stent length (mm)	14.39 (±4.93)	14.96 (±4.51)	0.214

*Re-PCI = repetition of percutaneous coronary intervention; **LVEF = left ventricular ejection fraction

Table 2. Prognosis of acute ST-elevation myocardial infarction

Finding	Characteristics	Metabolic syndrome	No metabolic syndrome	*P*
MACE*	Reinfarction (%)	1.4	1.6	0.623
	Restenosis (%)	17.5	13.3	0.382
	Rehospitalization (cardiac) (%)	27.1	25.9	0.624
	Rehospitalization (non-cardiac) (%)	7.2	6.7	0.527
	Cerebrovascular insult (%)	1.9	0.5	0.372
	Urgent CABG**	1	0	–
	Mortality (%)	6.3	6.2	0.990
	Total (%)	30.7	30.7	1.000

*MACE = major adverse cardiovascular events; **CABG = coronary artery bypass graft

criteria. There were no statistically significant age or sex differences between the two patient groups.

Data on the severity of acute STEMI and prognosis in both patient groups are shown in Tables 1 and 2, respectively. Patients with MS/IRS had similar or worse results on all severity parameters except for the incidence of dyspnea, reinfarction rate, cardiac laboratory markers (cTnT and CK), and the number and length of coronary artery stenosis. The same held for the parameters of prognosis except for the reinfarction rate. None of these differences reached statistical significance.

Discussion

Most people with metabolic syndrome suffer thrombotic complications superimposed to atherosclerotic and inflammatory arterial vascular lesions. Altered cardiac remodeling together with altered adhesion and coagulation mechanisms appears suitable to explain decreased functional performance of infarcted organs, and decreased success of acute (reduced fibrinolytic response, no reflow phenomenon) and long term intervention strategies for vessel patency (PCI, CABG) in these patients. That is why studies revealed high incidence of metabolic syndrome in patients with acute myocardial infarction (AMI), as well as more serious findings and prognosis of AMI in these patients[11,12]. Investigators mostly used criteria for metabolic syndrome established by the National Cholesterol Education Program expert panel on detection, evaluation, and treatment of high blood cholesterol in adults (Adult Treatment Panel III) (NCEP ATP III)[5]. There are no reports evaluating AACE/ACE definition[6,7] using coronary artery disease.

Using NCEP ATP III criteria, patients with metabolic syndrome had two- to threefold increased risk of subclinical or clinically overt cardiovascular disease. Using these criteria, Yilmaz *et al.*[13] and Zeller *et al.*[14] found metabolic syndrome in 49% and 46% of AMI patients without ST-elevation and unselected population of AMI patients, respectively, significantly more common in women. Two thirds of young patients with premature myocardial infarction had metabolic syndrome[15]. Similar incidence of MS/IRS was found in the present study, with a slightly higher incidence in men.

Patients with metabolic syndrome had increased infarct size, more extensive coronary artery disease, and poor myocardial perfusion grade[13,16-18]. Bohmer *et al.*[19] found no association of the presence of metabolic syndrome with related biomarkers or the size of myocardial infarction. In this study, lower cohort serum concentrations of cardiac markers (cTnT, CK) and less extended coronary artery disease were recorded in patients with MS/IRS, however, without statistical significance. According to Piatti *et al.*[18], insulin resistance is an independent predictor of early in-stent restenosis, which was not found in the present study (the same incidence of early in-stent restenosis). However, a higher incidence of late in-stent restenosis was found in patients with MS/IRS. According to literature data[20,21], metabolic syndrome is also a strong predictor of recurrent ischemic coronary events, but without correlation with either early or re-infarction during follow up in the present study. Metabolic

syndrome appeared to be associated with worse in-hospital complications and outcome, especially with a higher risk of severe heart failure[14,21,22]. Results of the present study suggested a higher incidence of rhythm abnormalities, cardiogenic shock, and cardiac arrest in MR/IRS group (without statistical significance), while the incidence of heart failure and the mean left ventricular ejection fraction were the same in both patient groups.

Using metabolic score as a simple metabolic risk marker, Raposo *et al.*[23] found a statistically significant relation between this score and outcome at one-year follow up after non-ST elevation acute coronary syndromes. Using the NCEP ATP III[5] definition of metabolic syndrome, Iribaren *et al.*[24] conclude that the presence of this syndrome imparts a high risk of early-onset clinical coronary disease, but the prognostic information associated with the syndrome is not greater than the sum of its parts. The authors of this article found the same incidence of MACE in general in the two groups of study patients during six-month follow up, with nonsignificant differences in some components.

Using the AACE/ACE definition for MS/IRS, the authors did not find the expected significant influence of this syndrome on the severity and prognosis during six-month period in patients having suffered acute STEMI and treated with primary PCI. From the interventional cardiologists' point of view, one of the explanations could be that early invasive treatment of acute STEMI attenuates the risk of metabolic syndrome. However, there are several open questions in metabolic syndrome in general, i.e. the lack of clarity of definition, multiple different patient phenotypes, the lack of consistent evidence base, unclear pathogenesis uniting the syndrome components, and the fact that cardiovascular risk associated with the syndrome is not greater than the sum of its individual components[24-27]. Among all these issues, anthropometry as an additional problem seems to be one of the major ones in the AACE/ACE definition[6,7] Body mass index used in this definition is an inferior anthropometric parameter in comparison to waist circumference or waist-to-hip ratio in verification of abdominal obesity and cardiovascular risk[28,29]. That is why it is necessary to emphasize the importance of the waist and hip circumference measurement in all patients with coronary disease, especially in risk stratification of patients with AMI. Also, the MS/IRS diagnosis dependence on clinical judgment may result in lower accuracy and investigation of different patient populations in different studies.

In conclusion, evaluating the AACE/ACE[6,7] definition for MS/IRS in patients with acute STEMI treated with primary PCI, the authors found no statistically significant differences in the severity and prognosis between patients with and without the syndrome. The main reasons for such unexpected results may lie in many open questions in this definition (primarily the absence of waist-to-hip ratio) and metabolic syndrome in general.

References

1. ECKEL RH, GRUNDY SM, ZIMMET PZ. The metabolic syndrome. Lancet 2005;365:1415-28.
2. GRUNDY SM, BREWER HB JR, CLEEMAN JI, SMITH SC Jr, LENFANT C; National Heart, Lung, and Blood Institute; American Heart Association. Definition of metabolic syndrome: Report of the National Heart, Lung, and Blood Institute/American Heart Association Conference on scientific issues related to definition. Circulation 2004;109:433-8.
3. MOTTILLO S, FILION KB, GENEST J, JOSEPH L, PILOTE L, POIRIER P, RINFRET S, SCHIFFRIN EL, EISENBERG MJ. The metabolic syndrome and cardiovascular risk – a systematic review and meta-analysis. J Am Coll Cardiol 2010;56:1113-32.
4. KOH KK, HAN SH, QUON MJ. Inflammatory markers and the metabolic syndrome insights from therapeutic interventions. J Am Coll Cardiol 2005;46:1978-85.
5. National Cholesterol Education Program (NCEP) expert panel on detection, evaluation, and treatment of high blood cholesterol in adults (Adult Treatment Panel III). Third report of the National Cholesterol Education Program (NCEP) expert panel on detection, evaluation, and treatment of high blood cholesterol in adults (Adult Treatment Panel III). Final report. Circulation 2002:106:3143-3421.
6. EINHORN D, RAEVEN GM, COBIN RH, *et al.* American College of Endocrinology position statement on the insulin resistance syndrome. Endocr Pract 2003;9:237-52.
7. American Association of Clinical Endocrinologists. New position statement reaffirms the American College of Endocrinology/American Association of Clinical Endocrinologists definition of insulin resistance syndrome. Available at: http://www.aace.com/newsroom/press/2005/index.php?r=20051014. Accessed 03 March 2009.
8. Van de WERF F, ARDISSINO D, BETRIU A, *et al.* Management of acute myocardial infarction in patients presenting

with ST-segment elevation. The Task Force on the Management of Acute Myocardial Infarction of the European Society of Cardiology. Eur Heart J 2003;24:28-66.

9. SILBER S, ALBERTSSON P, FERNANDEZ-AVILÈS F, *et al*. Guidelines for percutaneous coronary interventions. Eur Heart J 2005;26:804-47.
10. CHEITLIN MD, ARMSTRONG WF, AURIGEMMA GP, BELLER GA, BIERMAN FZ, DAVIS JL. ACC/AHA/ASE 2003 Guideline Update for the Clinical Application of Echocardiography: Summary article. **Circulation 2003;108:1146-62.**
11. LEE MG, JEONG MH, AHN Y, CHAE SC, *et al*. Impact of the metabolic syndrome on the clinical outcome of patients with acute ST-elevation myocardial infarction. J Korean Med Sci 2010;25:1456-61.
12. MORRIS PJ, PACKIANATHAN CI, van BLERK CJ, FINER N. Moderate exercise and fibrinolytic potential in obese sedentary men with metabolic syndrome. Obes Res 2003;11:1333-8.
13. YILMAZ MB, GURAY U, GURAY Y, ALTAY H, DEMIRKAN B, CALDIR V, *et al*. Metabolic syndrome is associated with extension of coronary artery disease in patients with non-ST elevation acute coronary syndromes. Coronary Artery Dis 2005;19:287-92.
14. ZELLER M, STEG PG, RAVISY J, LAURENT Y, JANIN-MANIFICAT L, L'HUILLIER I, *et al*. Observatoire des Infarctus de Côte-d'Or Survey Working Group. Prevalence and impact of metabolic syndrome on hospital outcomes in acute myocardial infarction. Arch Intern Med 2005;165:1192-8.
15. ZARICH S, LUCIANO C, HULFORD J, ABDULLAH A. Prevalence of metabolic syndrome in young patients with acute MI: does the Framingham Risk Score underestimate cardiovascular risk in this population. Diab Vasc Dis Res 2006;3:103-7.
16. CLAVIJO LC, PINTO TL, KUCHULAKANTI PK, TORGUSON R, CHU WW, SATLER LF, *et al*. Metabolic syndrome in patients with acute myocardial infarction is associated with increased infarct size and in-hospital complications. Cardiovasc Revasc Med 2006;7:7-11.
17. CELIK T, TURHAN H, KURSAKLIOGLU H, IYISOY A, YUKSEL UC, OZMEN N, *et al*. Impact of metabolic syndrome on myocardial perfusion grade after primary percutaneous coronary intervention in patients with acute ST elevation myocardial infarction. Coronary Artery Dis 2006;17:339-43.
18. PIATTI P, Di MARIO C, MONTI LD, FRAGASSO G, SGURA F, CAUMO A, *et al*. Association of insulin resistance, hyperleptinemia, and impaired nitric oxide release with in-stent restenosis in patients undergoing coronary stenting. Circulation 2003;108:2074-81.
19. BØHMER E, SELJEFLOT I, ARNESEN H, HOFFMANN P, ABDELNOOR M, HALVORSEN S. The association between metabolic syndrome and infarct size in patients with acute myocardial infarction. Scand J Clin Lab Invest 2010;70:287-93.
20. SCHWARTZ GG, OLSSON AG, SZAREK M, SASIELA WJ. Relation of characteristics of metabolic syndrome to short-term prognosis and effects of intensive statin therapy after acute coronary syndrome: an analysis of the Myocardial Ischemia Reduction with Aggressive Cholesterol Lowering (MIRACL) trial. Diabetes Care 2005;28:2508-13.
21. KRANJČEC D, PINTER A, BIRTIĆ T, ČABRIJAN T, HALLE J, TOMIČIĆ D, *et al*. Metabolic syndrome X – high risk factor for acute myocardial infarction and its complications. Coll Antropol 2002;26:23-9.
22. INGELSSON E, ARNLOV J, SUNDSTROM J, ZETHELIUS B, VESSBY B, LIND L. Novel metabolic risk factors for heart failure. J Am Coll Cardiol 2005;46:2054-60.
23. RAPOSO L, FERREIRA J, AGUIAR C, GONCALVES Pde, COUTO R, SEABRA GOMES R. Metabolic score – a simple risk marker in non-ST elevation acute coronary syndromes. Rev Port Cardiol 2006;25:155-71.
24. IRIBAREN C, GO AS, HUSSON G, SIDNEY S, FAIR JM, QUERTERMOUS T, *et al*. Metabolic syndrome and early-onset coronary artery disease: is the whole greater than its parts? J Am Coll Cardiol 2006;48:1800-7.
25. MENTE A, YUSUF S, ISLAM S, MCQUEEN MJ, TANOMSUP S, ONEN CL, RANGARAJAN S, GERSTEIN HC, ANAND SS; INTERHEART Investigators. Metabolic syndrome and risk of acute myocardial infarction: a case-control study of 26,903 subjects from 52 countries. J Am Coll Cardiol 2010;55:2390-8.
26. GRUNDY SM, CLEEMAN JI, DANIELS SR, DONATO KA, ECKEL RH, FRANKLIN BA, *et al*. Diagnosis and management of the metabolic syndrome: an American Heart Association/National Heart, Lung, and Blood Institute Scientific Statement. Circulation 2005;112:2735.
27. SUNDSTROM J, VALLHAGEN E, RISERUS U, BYBERG L, ZETHELIUS B, BERNE C, LIND L, INGELSSON E. Risk associated with the metabolic syndrome *versus* the sum of its individual components. Diabetes Care 2006;29:1673-4.
28. SONMEZ K, AKCAKOYUN M, AKCAY A, DEMIR D, DURAN NE, GENCBAY M et al. Which method should used to determine the obesity in patients with coronary artery disease? (body mass index, waist circumference or waist-to-hip ratio). Int J Obes Relat Metab Disord 2003;27:341-6.
29. DOBBELSTEYN CJ, JOFFRES MR, MACLEAN DR, FLOWERDEW G. A comparative evaluation of waist circumference, waist-to-hip ratio and body mass index as indicators of cardiovascular risk factors. The Canadian Heart Health Surveys. Int J Obes Relat Metab Disord 2001;25:652-661.

Sažetak

METABOLIČNI SINDROM I ISHOD U BOLESNIKA S AKUTNIM INFARKTOM MIOKARDA

Z. Babić, M. Pavlov, N. Bulj, V. Nikolić Heitzler, V. Mitrović, Ch. Hamm i *M. Weber*

Istraživao se utjecaj metaboličnog sindroma/sindroma inzulinske rezistencije (MS/SIR) koristeći definiciju *American Association of Clinical Endocrinologists* i *American College of Endocrinology* (AACE/ACE) iz 2003. na težinu i prognozu akutnog infarkta miokarda s elevacijom ST spojnice (STEMI) liječenog primarnom perkutanom intervencijom (pPCI). Ukupno 395 bolesnika koji su preboljeli akutni STEMI i bili liječeni pomoću pPCI u dvogodišnjem razdoblju podijeljeno je u dvije skupine (s MS/SIR i bez njih) i uspoređeno prema parametrima težine (klinički, laboratorijski, ehokardiografski, koronarografski, komplikacije) i prognoze koristeći velike neželjene kardiovaskularne događaje (MACE) tijekom šestomjesečnog praćenja akutnog STEMI. Skupina bolesnika s MS/SIR u usporedbi s kontrolnom skupinom imala je uglavnom lošije ili jednake rezultate težine (dani u bolnici 6,5:6,5, kardiogeni šok 2,9%:2,6%, srčani zastoj 6,8%:5,2%, reinfarkt 0,5%:1,6%) i prognoze (ukupno MACE 30,7%:30,7%), no niti jedna od razlika nije dosegla statističku značajnost. Zaključuje se kako bi izostanak takvih očekivanih razlika u MS/SIR mogao biti posljedica isključenja omjera struka i kukova iz ove definicije i ostalih otvorenih pitanja u metaboličnom sindromu uopće.

Ključne riječi: *Metabolični sindrom X; Infarkt miokarda*