PREDICTORS OF IN-HOSPITAL MORBIDITY AND MORTALITY IN PATIENTS WITH CORONARY ARTERY DISEASE TREATED WITH CORONARY ARTERY BYPASS SURGERY

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Abstract:

Aim of the study: The aim of our study was to identify markers that can predict early morbidity and mortality in patients with coronary artery disease who underwent coronary artery bypass surgery (CABG) for myocardial revascularization.

Material and methods: 749 patients (pts) were enrolled in the study at mean age 55±8 years, 639 male and 119 female. We analyzed pre-operative demographic, clinical, left ventricular morphologic and functional and angiographic variables, per-operative characteristics, and we registered occurrence of hospital complications including cardiac death during the first 30 days after the operation.

Results: Hospital complications were registered in 173 (23,1%) patients, including cardiac death registered in two (3%) patients during the first 30 days after the operation. The most common complications were: pericardial effusion (8,4%), supraventricular arrhythmias (6,3%) and pleural effusion (5,6%), followed by more serious complications like infections, acute renal failure and stroke. Advanced age (≥65 years), coexisting morbidities and risk factors: cerebrovascular disease (CVD), peripheral vascular disease (PVD), chronic obstructive pulmonary disease (COPD), hypertension (HTA), previous myocardial infarction (MI), heart failure before the operation, extensive coronary artery disease (CAD) (angiographicly identified), low left ventricular ejection fraction (LVEF), and high WMSS index were identified as predictors of in-hospital morbidity. Advanced age, Mod Gensini score (as marker of angiographic severity of CAD) and WMSS index were found to be independent predictors of in-hospital morbidity, while advanced age, heart failure before CABG and in-hospital complications were found to be independent predictors of in-hospital mortality.

Conclusion: In patients with coronary artery disease who underwent CABG surgery, preoperative variables and operative technique can predict occurrence of in-hospital morbidity, while early complications can strongly predict in-hospital mortality.

Key words: coronary artery disease, aorto-coronary by-pass surgery, prognosticators, in-hospital morbidity and mortality

INTRODUCTION:

Surgical myocardial revascularisation as a method for treatment of patients with coronary artery disease (CAD) is in use in the last four decades. Many pre-operative clinical, functional, angiographic, as well as many per-operative and post-operative characteristics can predict clinical outcome of patients after surgical revascularisation. Constant introduction of the new diagnostic and surgical therapeutic procedures, as well as new drags leads to the continuous identification of new prognosticators that should be involved in the pre-operative, per-operative and post-operative evaluation of patients with CAD treated with CABG surgery (1-4).

Our these was that there are no differences in characteristics that can predict in-hospital morbidity and mortality in patients with CAD treated with CABG surgery in Republic of Macedonia, in comparison with those that are already identified and incorporated in prognostic models.

The purpose of the study was to identify pre-operative, per-operative and post-operative characteristics that can predict in-hospital morbidity and mortality in patients with CAD treated with CABG surgery in our country.

MATERIAL AND METHODS:

Investigation was performed as retrospective-prospective study on 749 patients treated with CABP surgery for treatment of CAD, first time operated in nearly ten different cardio-surgical centres in Europe in the period from 1981-2002 year. Patient data were collected from Data base (for CAD patients treated with CABG surgery) at the Institute for cardiac diseases. We analysed data from patient's history of the disease, clinical examination and following investigations: basal ECG, laboratory analyses: haemogram, glycaemia, urea, creatin, electrolytes, lipid profile, 24-hour ambulatory ECG monitoring by Holter, 2D and Doppler echocardiography and coronary angiography.

Several groups of characteristics were analysed:

clinical characteristics: age, gender, body mass index (BMI), smoking, previous myocardial infarction (MI), previous percutany coronary intervention (PCI), angina pectoris (AP) classified according to the CCSC (Canadian cardiovascular functional classification), heart failure, co morbidities: CVD, PVD, HOPD, HTA, DM.

left ventricular morphologic and functional characteristics: ejection fraction (measured with the method of Simpson), left ventricular end diastolic and end systolic dimension, segmental wall motion (by using 16-segmental model and five point scoring system), valve function;

angiographic characteristics: anatomical distribution of CAD, number of diseased vessels, localisation and degree of stenosis, calculated PAS and Modified Gensini score;

per-operative characteristics: type of operation (on-pump, or less invasive off-pump method), type and location of conduits that were used, additional surgical procedures: anuloplasty, ventriculoplasty, valve implantation etc;

post-operative characteristics: occurrence of in-hospital morbidity including: infections, acute renal failure (ARF), neurological complications, perycarditis, plevritis, arrhythmias, haemodynamic complications, arterial thrombosis, acute myocardial infarction, and in-hospital mortality were analysed.

Statistical analysis. The data were analysed using SPSS software (version 10,0). Continuous variables were reported as mean ± SD. Categorical variables were reported as counts (percentages) and compared between groups using chi-square test. Continuous variables were examined by a two-tailed t test or Wilcoxon runk-sum test. The Spearman rank correlation coefficient was used to estimate the correlation between variables. For estimation of predictive value of multiple variables in prediction of occurrence of adverse cardiac events, including cardiac death, multiple linear regression analysis was performed and coefficient of regression (R), coefficient of determination of the model (R^2) and statistical significance of predictive variables ware calculated. For all analyses a p value <0,05 was considered statistically significant.

RESULTS:

Pre-operative characteristics. Mean age of the patients at the time of the operation was 55.98±8.95 years, but only 17,7% were at the age ≥65 years, and only 15.9% were female. The most frequent risk factors were hypertension and smoking (52,7% and 50,6%, respectively), obesity was les frequent (20% of patients were with BMI >30), although the mean BMI was high 27.20±3.42, which leads us to the conclusion that patients were predominantly overweight. It was also found that obesity was more common in females (34.28% vs. 33.86% respectively). Co morbidities as cerebral and peripheral vascular disease and chronic obstructive pulmonary disease were rare, but history of previous myocardial infarction was positive in 478 (63,8%) patients. Also history of angina pectoris was fare more frequent before the operation than that for heart failure (80,1% vs. 6,1% respectively). (Table 1)

Table 1 Demographic and clinical characteristics of patients before CABG
Tabela 1 Demografski i klini~ki obele`ja na pacientite pred AKBP

Followed parameters	*values expressed as M± SD or n or %*
age (years)	*55. 98± 8.95*
gender (male/female)	*639 (84.1%) / 119 (15.9%)*
BMI (kg/m2)	*27.20 ±□3.42*
DM	*25.9%*
-no	*554 (74.1%)*
-ID	*46 (6.1%)*
-NID	*149 (19.9%)*
HTA	*52.7%*
smoking	*50.6%*
HLP	*36.4%*
family history	*39.6%*
CVB	*2.5%*
HOPD	*3.1%*
PVD	*4.5%*
old MI	*63.8%*
*LV failure**	*6.1%*
Angina pectoris	*80.1%*
-no	*19.9%*
-stable	*18.3%*
-non stable	*61.8%*

M±SD*=mean value with standard deviation; BMI=body mass index; ID=insulin dependent diabetes; NID=non insulin dependent diabetes; CVD=cerebrovascular disease; HOPD=chronic obstructive pulmonary disease; PVB=peripheral vascular disease; MI=myocardial infarction; LV=left ventricular (* by anamnesis -dyspnoea, oedemas)*

Slight increase in the mean end systolic and end diastolic dimension, and decrease of the left ventricular ejection fraction before the operation was found. Also moderate degree of wall motion abnormalities was present, but mean value of WMSS index had high SD which parameter is a result of the nonhomogenity of the group. There were patients with normal, as opposite to those with severe wall motion abnormalities（table 2）. At third table we can see the distribution of patients according to the values of the LVEF. LV dysfunction determined as LVEF <40% was

registered in 198 (26,4%) patients, and normal LV function with LVEF ≥65% was present in 249 (32,7%) patients.

Table 2. Distribution of patients according to their left ventricular morphological and functional characteristics measured pre-operatively
Tabela 2. Prikaz na raspredelbata na pacientite spored levokomornite morfolo{ki i funkcionalni karakteristiki odredeni predoperativno

Followed parameters	*Values expresed as M± SD or %*	*minimum/ maximum*
LVEDd (mm)	*56.19 ± 7.94*	*40 / 83*
LVEDs (mm)	39.23 ± 9.02	*21 / 71*
EF (%)	*48.81 ±16.18*	*12 / 85*
WMSS	*1.38 ±1.93*	*1.00 / 3.06*
MR	*16.2%*	
AoR	*4.8%*	
TR	*3.1%*	
PAH	*2.4%*	

LVEDd=left ventricular end diastolic dimension; LVEDs=left ventricular end systolic dimension; EF=ejection fraction; WMSS=wall motion summed score; MR=mitral regurgitation; AoR=aortic regurgitation; TR=tricuspid regurgitation; PAH=pulmonary artery hypertension;

Table 3. Distribution of patients according to the values of EF measured pre-operatively
Tabela 3. Distribucija na pacientite spored vrednosta na EF proceneta predoperativno

EF (%)	*nr of patients (n) and percents (%)*
0-40%	*198 (26,4)*
41-50%	*212 (28,3)*
61-60%	*94 (12,6)*
>60%	*245 (32,7)*
total	*749 (100)*

Operatively treated CAD patients most frequently had multivessel disease, with 80 (10,7%) having one-vessel, 266 (35,6%) two-vessel and 402 (53,7%) having three-vessel disease (table 4). Most often diseased vessels were left anterior descending artery (LAD) in 93,3% and right coronary artery (RCA) in 83.4% of patients, and less often left circumflex artery only in 64.3% of patients (Graphic 1). Left main disease was present in 175 (23,4%) patients, 86 (11,4%) of whom had >80% stenosis, and were candidates for urgent CABG. Calculation of angiographic scores as parameters of the extent and severity of the disease was performed. Mean Modified Gensini score was 19,62±7,71, which leads to the conclusion that patients who underwent surgical revascularisation had moderate to extensive CAD. Mean PAS score index was 4,54□±1,93. Proximal distribution of the disease threw coronary arteries was predominant. Proximal LAD stenosis (PAS score index 3) as solitary abnormality was present in 100 (13,4%) patients, in combination with proximal RCA or LCx disease (PAS score index 5) in 237 (31,7%) patients, and in combination with both main coronary arteries and/or left main disease (PAS score index 7) in 184 (24,6%) patients.

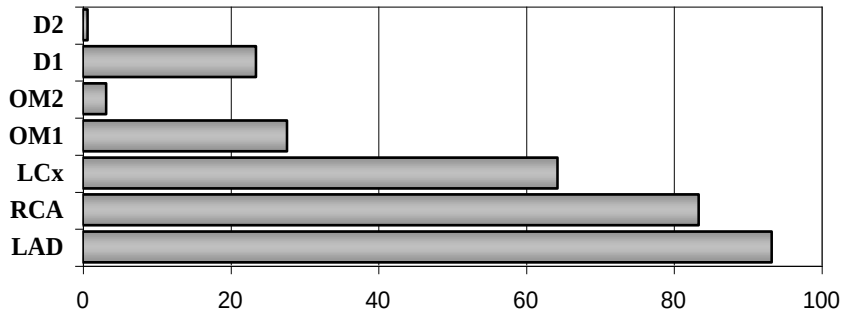
Isolated left main disease (PAS score index 6) was found in 39 (5,2%) patients (table 4).

Table 4. Coronary angiography findings
Tabela 4. Naodi od koronarnata angiografija

Followed parameters	*Values expressed as M± SD or n or %*
N-r of CA	*2.43 ± 0.68*
one	*80 (10.7%)*
two	*266 (35.6%)*
three	*402 (53.7%)*
Left main	*23.4%*
PAS score indeks	*4,54±1,93*
Modified Gensini score	*19.62 ± 7.71*
EF	*50.13 ± 13.63*
LV aneurism	*8.2%*
LV thrombus	*0.8%*
MR	*6.8%*
AoR	*1.9%*
Aortic stenosis	*0.5%*
Aortic aneurism	*1.1%*
PCI before CABG	*9,2%*
Urgent CABG	*11.4%*

CA-coronary arteries; PAS=proximal artery segment score; EF=ejection fraction; LV=left ventricle; MR=mitral regurgitation; AoR=aortic regurgitation; PCI=percutany coronary intervention; CABG=coronary artery bypass graft surgery;

Graphic 1. Graphical presentation of the distribution of atherosclerosis threw coronary arteries
Grafikon 1. Grafi~ki prikaz na procentualnata zastapenost na tipovite na koronarni arterii so ateroskleroti~ni promeni



Surgical revascularization was performed in patients with proximal multivessel CAD, which means patients with extensive CAD and those with >80% left main disease were candidates for urgent CABG.

Per-operative characteristics. On-pump bypass surgery was statistically significantly more often used operative technique (p=0,007). 671 (89,6%) patients underwent on-pump bypass, and only 78 (10,4%) patients were treated with off-pump or minimal invasive operative technique. These techniques were reserved for patients ≥65 years of age. The most often was combination of LIMA (left internal mammary

artery) and vein conduits applied in 442 (59%) patients, just vein conduits in 171 (22.8%) patient and just arterial ones (LIMA alone or with radial artery) in 96 (12,8%) patients (table 5).

Table 5. Distribution of patients according to the type and number of conduits that ware applied

Tabela 5. Raspredelba na pacientite spored vidot i brojot na aplicirani graftovi

Type of conduit	*n-r of patients and percent (%)*	*n-r of conduits*	*n-r of patients and percent (%)*
IMAr	*3 (0,4)*	*1*	*78(10,4)*
IMAl	*57 (7,6)*	*2*	*186(24,8)*
IMAl + v	*442 (59,0)*	*3*	*356(47,5)*
IMAl+arad	*39 (5,2)*	*4*	*111(14,9)*
IMAI+r	*11 (1,5)*	*5*	*14(1,9)*
IMAl+r+arad	*3 (0,4)*	*6*	*3(0,4)*
IMAl+d+v	*17 (2,3)*	*7*	*1(0,1)*
IMAl+v+arad	*6 (0,7)*		
vein	*171 (22,8)*		
total	*749 (100)*	*total*	*749(100%)*

***IMAr**=right mammary artery; **IMAl**=left mammary artery; **IMAl+v**=left mammary artery+vein conduit; **IMAl+arad**=left mammary artery+radial artery; **IMAl+r**=left and right mammary artery; **IMAl+r+arad**= left and right mammary artery+ radial artery; **IMAl+r+v**=left and right mammary artery+vein conduit; **IMAl+v+arad**=left mammary artery+vein graft+ radial artery*

The mean number of applied conduits per patient was 2,74±0,94, predominantly three or two conduits were applied (in 47.5% vs. 24,5% respectively) (table 5). In 20% of patients surgical myocardial revascularisation was combined with some other operative procedure. Most often it was aneurismectomy by Dor, and LV repair by Batista, performed in 30 (4,0%) and 37 (4,9%) patients respectively. Interventions that involve valves (anuloplasty and/or valve implantation) were performed in 53 (7,4%) patients, 30 of which on the mitral valve. These interventions were statistically significantly (p=0,0001) more often performed in patients with LV dysfunction (LVEF <40%). Endarterectomies were performed in 64 patients mostly as intervention on one coronary artery (RCA predominantly). This method was significantly (p=0,048) more often applied in patients with three-vessel disease (table 6).

Table 6. Type and frequency of performance of other operative procedures in CABG patients

Tabela 6. Tip i ~estota na izveduvawe na ostanati operativni proceduri kaj pacientite so AKBP

Type of the procedure	*N-r of patients and percent (%)*
aneurismectomy	*30 (4.0%)*
LV repair by Batista	*37 (4.9%)*
extirpation of thrombus in LV	*3 (0.4%)*
endarterectomy	*64 (8.5%)*

anuloplasty of MV	*27 (3.6%)*
anuloplasty of TV	*9 (1.2%)*
mitral valve protesis implantation	*3 (0.7%)*
aortic valve protesis implantation	*14 (1.9%)*
aortic protesis implantation	*6 (0.8%)*
endarectomy of carotid arteries	*8 (1.1%)*
thrombendarterectomy of peripheral arteries	*2 (0.3%)*

LV= left ventricle; MV= mitral valve; TV= tricuspide valve;

Post-operative characteristics . 173 (23,1%) patients have had complications during the hospitalisation, mostly in the first 24 to 48 hours after the operation. The most frequent were pericardial effusion in 63 (8,4%), pleural effusion in 42 (5,6%) and arrhythmias in 47 (6,3%) patients. Serious complications as infections were rare, only in 26 (3,5%) patients expressed as pneumonia, mediastinitis and/or sepsis. Same number of patients experienced acute renal failure, and 22 (2,9%) had haemodynamic complications, clinically manifested as pulmonary oedema or shock cardio genes. Arterial thrombosis, cerebrovascular insult and acute myocardial infarction and/or non stable angina pectoris were registered in 7 (0,9%), 5 (0,7%), 5 (0,7%) and 4 (0,5%) patients respectively.

Occurrence of complications was significantly associated with advanced age (p=0,014), with the mean risk of complications of 1,68. Unfavourable events were also significantly associated with previous CVD (p=0,002), peripheral vascular disease (p=0,001), chronic pulmonary obstructive disease (p=0,001), hypertension (p=0,001), heart failure (p=0,0001) and previous myocardial infarction (p=0,01). Patients with more extensive CAD (higher Mod Gensini score) had greater incidence of complications, with p=0,049. On-pump CABG was significantly associated with higher complications rate (p=0,007), although 10% of off-pump treated patients also have had complications. Arterial conduits applied alone or in combination with veins or radial artery were most frequently associated with unfavourable events (table 7), as well as LV repair by Batista (p=0.01) and anuloplasty of mitral valve (p=0.001). Risk of complications in patients with LV repair and/or mitral anuloplasty as compared with patients without these procedures was 2,39 and 3,80 respectively.

Statistically significant correlation coefficients of the means were found for age (r=-0,162, p=0,0001), CVD (r=0,073, p=0,047), PVB (r=0,089, p=0,018), HOPD (r=0,082, p=0,029), hypertension (r=0,085, p=0,023), heart failure (r=0,128, p=0,001), Mod Gensini score (r=-0,099, p=0,007), WMSS (r=-0,116, p=0,044) and LVED dimension (r=-0,164, p=0,012). More often present or bigger values lead to increased complications rate. LVEF was positively correlated (r=0,082, p=0,024), which means higher EF is associated with better clinical outcome during hospital stay. Analysing influence of operative techniques, we found that LIMA applied alone or in combination is significantly correlated with more complications (r=0,114, p=0,002), which was also registered for LV repair by Batista (r=0,084, p=0,021).

Table 7 . Frequencies of complications, as function of type of the conduits that were used
Tabela 7. ^estota na komplikacii vo zavisnot od tipot na upotreben graft

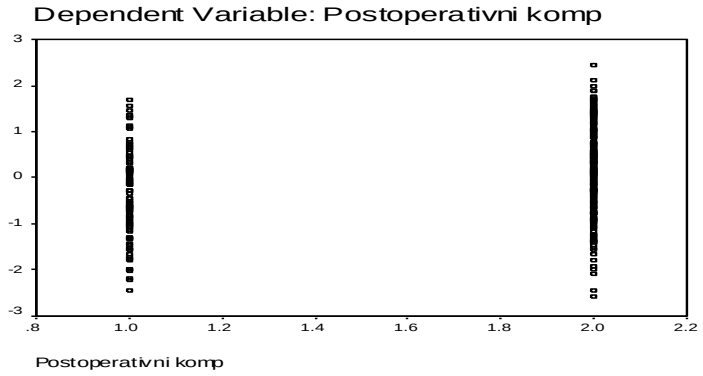
Type of conduit	*Post-operative complications*		
	***Yes** n-r and %*	***No** n-r and %*	***total** n-r and %*
IMAr .	*1(0,6)*		*1(0,2)*
IMAl	*13(7,6)*	*44(7,7)*	*57(7,6)*
IMAl + v	*111(64,5)*	*331(57,6)*	*442(59,2)*
IMAl+arad	*17(9,9)*	*22(3,8)*	*39(5,2)*
IMAI+r	*1(0,6)*	*10(1,7)*	*11(1,5)*
IMAl+r+arad	*1(0,6)*	*2(0,3)*	*3(0,4)*
IMAl+d+v	*2(1,2)*	*15(2,6)*	*17(2,3)*
IMAl+v+arad	*2(1,2)*	*3(0,5)*	*5(0,7)*
vein	*25(13,8)*	*149(25,8)*	*174(22,9)*
total	*173(100)*	*576(100)*	*749(100)*

***IMAr**=right mammary artery; **IMAl**=left mammary artery; **IMAl+v**=left mammary artery+vein conduit; **IMAl+arad**=left mammary artery+radial artery; **IMAl+r**=left and right mammary artery; **IMAl+r+arad**= left and right mammary artery+ radial artery; **IMAl+r+v**=left and right mammary artery+vein conduit; **IMAl+v+arad**=left mammary artery+vein conduit+ radial artery*

Lineal regression analysis of variables that were found to be significantly associated with complications, as independent predictors identified age (p=0,005), Mod Gensini score (p =0,027) and WMSS index (p =0,030), with regression coefficient R 0,258 and determination coefficient R^2 0,067, which means that only in 6,7% of patients with statistical significance of p=0,034, these three variables can predict in-hospital morbidity (graphic 2).

Graphic 2. Graphical presentation of the regression predictive value for prediction of in-hospital morbidity

Grafikon 2. Grafi~ki prikaz na regresionata prediktivna vrednost za predviduvawe na bolni~kiot morbiditet

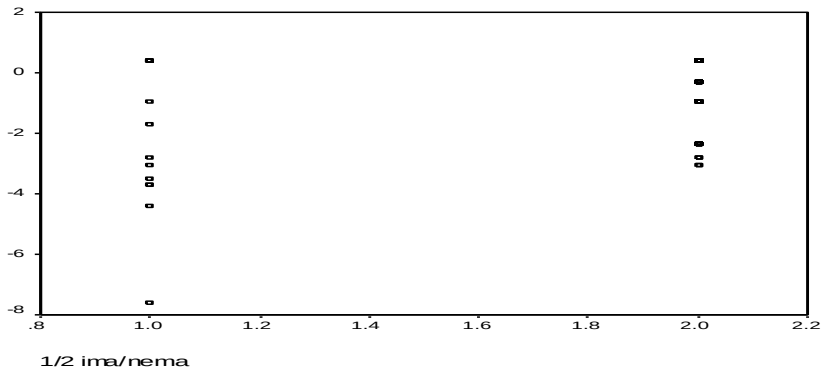


In-hospital mortality was registered in 17 (2,3%) patients. Statistically significant negative correlations were found with age, PVB (p=0,01), heart failure (p=0,0001), LVES (p=0,0002) and LVED (p=0,0001) dimension, while LVEF and PAS score index were found to be significantly positively (the bigger they are the smaller is incidence of in-hospital mortality) correlated (p=0,025 and p=0,0001 respectively) with in-hospital mortality. Proximal distribution of the disease doesn't determinate worse clinical outcome post-operatively. Operative technique of LV repair by Batista, and Dor's aneurismectomia were found to be strongly predictive for in-hospital mortality

p=0,0008 and p=0,027 respectively. Any complication in early post-operative period is highly predictive for in-hospital mortality (p=0,0001).

Lineal regression analysis of variables that were found to be significantly associated with in-hospital mortality, as independent predictors identified heart failure preoperatively (p=0,0001), haemodinamic complications (p=0,0001), thrombosis of peripheral arteries (p=0,0001) and infections (p=0,023), with regression coefficient R 0.673 and determination coefficient R^2 0.452, which means that almost in 45% of patients with statistical significance of p=0,0001, these four variables can predict in-hospital mortality (graphic 3).

Graphic 3. Graphical presentation of the regression predictive value for prediction of in-hospital mortality
Grafikon 3. Grafi~ki prikaz na regresionata prediktivna vrednost za predviduvawe na bolni~ki mortalitet



DISCUSSION:

During the decision making about the treatment of CAD patient with surgical myocardial revascularisation, we have to be aware about the risk of complications including death, and to be able to predict such a risk, sow we can help the patient treatment. Analyse of large series of patients in data bases and from uni and multicenter studies, identified so cold *seven core variables* as the most powerful predictors of post-operation clinical outcome. These variables are: urgency of the operation, age, previous CABG surgery, gender, LVEF, percent of stenosis of left main and number of big coronary arteries with >70% luminal stenosis. If these variables are incorporated in predictive model, they can predict individual risk of each patient with the great degree of probability. The predictive power of the model can additionally be improved by adding another thirteen variables, so coaled *"level one variables*": body high and weight, PCI before the operation, resent MI (<1 week), angina pectoris, heart failure, ventricular arrhythmias, mitral valve regurgitation, and co morbidities: diabetes, CDV, PVD, renal dysfunction, and creatin level. (1-4) *Application of internal mammary artery as conduit* reduces the risk of complications including death, and authors like Loop and Lytle, identifies it as independent predictor of long life survival after CABG surgery (1). *Institutional factor* and work volume of the cardio-surgical centre is also a strong predictor of clinical outcome. Data indicates that high volume centres (>200 operations per year), have smaller incidence of early and late morbidity and mortality in high risk, and what is more important in low risk patients. (3)

It is imperative that the predictive models have to be periodically updated (with new predictors incorporated into the model) and adapted to the regional characteristics of the population where they are applied. That is why this study was undertaken.

Age is very powerful independent prognosticator, the older the patient is, the higher is the risk of per and post-operative complications and death. If patient aged <65 years have relative risk 1, it is 2,07 for patients 65-75 years and 3,84 for patients over 75 years, but older patients have higher benefit from the operation than younger, and better long life prognosis. (1-4) although patients aged ≥65 years in our study were rare, advanced age was isolated as independent predictor of in-hospital morbidity. ***Female gender*** is associated with higher in-hospital morbidity and mortality compared with males, (2,7% vs. 1,8% respectively), or the relative risk in females is 1,5-2 times higher as compared with males. But what is more important this advantage is lost several years after the operation, and females have excellent long life prognosis and benefit from the operation. (1-8) In our study we failed to identify such differences, because of the small number of female patients. ***Left ventricular ejection fraction (EF),*** or ***systolic dysfunction*** and symptoms of ***heart failure*** before the operation are powerful predictors of higher in-hospital morbidity and mortality. Mortality rate in patients with preserved LV function is 2,6%, while in patients with LVEF <35% is increasing to 6.6%. Operative risk is 1,5 times higher in patients with LVEF >40%, and 3,4 times higher in patients with LVEF <20%. (1, 2, 4, 9) In our study patients with symptoms of heart failure pre-operatively, patients with increased LVED dimension, low LVEF and high WMSS had statistically significantly higher in-hospital morbidity and mortality. Angiographic variables such as higher percent left main stenosis and more principal coronary arteries with >70% stenosis are associated with higher per/post operative morbidity and mortality. (1, 2, 4, 10) Higher incidence of postoperative complications was also found in our study in patients with angiographic characteristics like before mentioned. Even thought there is well known association between risk factors for CAD and co morbidities and unfavourable prognosis in CABG patients (1,2,4,11-13), in our study we only succeed to find statistically significant correlation between cerebrovascular disease, peripheral vascular disease, chronic obstructive pulmonary disease, hypertension and previous myocardial infarction and increased risk for complications. We failed to identify obesity, increased BMI and diabetes as predictors of worse clinical outcome early after the operation.

Per-operative characteristics are powerful predictors of post-operative complications. Significantly higher incidence of complications was registered in on-pump CABG patients, which correlates with the literature data. Off-pump CABG patients have shorter length of hospitalisation, low complication rate, but on-pump patients have lower rate of re-operations, and similar if not better long life prognosis. (1, 2, 14, 15) As for the type of conduit, surprisingly, in our study higher complication rate (although without statistical significance) was found in patients with arterial conduits, alone or in combination with radial artery or with vein conduits. This finding is in contradiction with the literature data (1, 2), because application of mammary artery is identified as independent predictor of good clinical outcome and long life prognosis. One of the possible explanations is institutional factor. In our study group patients in whom arterial conduits were applied were operated in two cardio-surgical centres from ten centres in total. But jet we weren't able to compare the institutions because patients operated in other centres were operated in time when off-pump technique were not widely used, and vein conduits were applied more often than arterial ones. Operative procedures performed together with CABG surgery, as LV repair by Batista method and anuloplasty of mitral valve were associated with worse clinical outcome. Patients in

whom such procedures were performed had odds ratio of 2,39 and 3,80 respectively for in-hospital morbidity and mortality when compared with patients with only CABG surgery performed. This finding is a result of the fact that these interventions are performed in patients with severe left ventricular dysfunction which by it self is powerful predictor of worse clinical outcome. (1,2,9) As ***independent predictors of in-hospital morbidity*** in our study were identified advanced age, angiographicaly determined more extensive CAD and higher WMSS, as parameter of more severe segmental left ventricular dysfunction.

Post-operative complications were registered in 23,1% of patients, without differences with the literature data. Acute renal failure occurred in 3,5% (literature data are around 7,7%), neural complications (CVI) in 0,7% (literature data ranges from 1,6 to 3%) and infections were registered with higher incidence than literature data, 3,5% versus 1% respectively. (1,2,11)

In-hospital mortality in our patients was 2,3%, which is low mortality rate and is near to that referred from high volume centres (around 3%, from 2.9 to 3.2%). Mortality rate in low volume centres is some what higher about 5% per year. (1-4)

As ***independent predictors of in-hospital mortality*** we identified: advanced age, symptoms of heart failure before the operation and post-operative complications. It was found out that complications registered in early postoperative period are highly predictive for in-hospital mortality. Haemodinamic complications, cerebrovascular insult and especially infections and acute renal failure are complications with high percent of lethal outcome once they appear. (1, 2)

LIMITATION OF THE STUDY:

Small number of female patients, and patients treated with off-pump operative techniques were included in the study, what probably influenced our results.

We also didn't include in the analyse influence of myocardial viability detected pre-operatively and some per-operative techniques (completeness of myocardial revascularisation, time of exposure to extra-corporal circulation, need for applying intra-aortic balloon pump, etc) for which variables, there are evidences that can predict in-hospital morbidity and mortality, and also long term prognosis of patients with CAD treated with CABG surgery. (1,2,15)

CONCLUSION:

In patients with coronary artery disease treated with CABG surgery, pre-operative variables that describe age, anatomical distribution of the CAD and LV dysfunction (global and/or segmental) can predict patient's outcome in early postoperative period or in-hospital morbidity.

Patients treated with CABG surgery for treatment of CAD in our country have low in-hospital mortality which is comparable with that referred in high volume centres. Advanced age, LV failure preoperatively and occurrence of early complications after the operation, can predict in-hospital mortality in such patients.

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REFERENCES:

1. Eagle KA, Guyton RA, Davidoff R, et al. ACC/AHA 2004 Guideline Update for Coronary Artery Bypass Graft Surgery: A report of the American College of Cardiology/ American Heart Association task force on Practice Guidelines (Committee to update the 1999 Guidelines for Coronary Artery Bypass Graft Surgery). J Am Coll Cardiol; 34:1262-347.

2. Georgievska-Ismail Lj., Borozanov V. (2002): Klinicka evaluacija, sledenje, prognoza i kvalitet na ziveenje po uspesna revaskularizacija so aorto-koronarna bajpas hirurgija kaj pacientite so koronarna arteriska bolest. Izvestaj od Naucen proekt br 40079798/0, Ministerstvo za obrazovanie i nauka na Republika Makedonija, Skopje 2002.

3. Glance L., Dick A., Mukamel D., Osler T. (2003): Is the Hospital Volume-Mortality Relationship in Coronary Artery Bypass Surgery the Same for Low-Risk Versus Hing-Risk Patients? Ann Thorac Sugr Vol 76; 1155-62.

4. Tu JV, Sykora K, Naylor CD. (1997): Assessing the outcomes of coronary artery bypass graft surgery: how many risk factors are enough? Steering Committee of the Cardiac Care Network of Ontario. J Am Coll Cardiol;30:1317-23.

5. Brandrup-Wognsen G, Berggren H, Hartford M, et al. (1996): Female sex is associated with increased mortality and morbidity early, but not late, after coronary artery bypass grafting. Eur Heart J;17:1426-31.

6. Czajkowski SM, Terrin M, Lindquist R, et al. (1997): Comparison of preoperative characteristics of men and women undergoing coronary artery bypass grafting (the Post Coronary Artery Bypass Graft [CABG] Biobehavioral Study). Am J Cardiol;79:1017-24.

7. Findlay I.N. (1994): Coronary bypass surgery in women. Curr Opin Cardiol;9:650-7.(27).

8. Jaglal SB, Tu JV, Naylor CD. (1995) Higher in-hospital mortality in female patients following coronary artery bypass surgery: a population-based study: Provincial Adult Cardiac Care Network of Ontario. Clin Invest Med;18:99-107.

9. Georgievska-Ismail Lj, Vavlukis M, Borozanov V. (2005): Predictive value of left ventricular function on prognosis in patients undergoing coronary artery bypass surgery. Macedonian academy of sciences and arts, Contributions XXVI 1; 103-21.

10. O'Connor NJ, Morton JR, Birkmeyer JD, et al. (1996): Effect of coronary artery diameter in patients undergoing coronary bypass surgery: Northern New England Cardiovascular Disease Study Group. Circulation;93:652-5.

11. Antunes P, Prieto D, Oliveira J.F, Antunes M. (2004): Renal dysfunction after myocardial revascularisation. European Journal of Cardio-Thoracic surgery Vol 25; 597-604.

12. Marchant B, Stevenson R, Vaishnav S et al. (1994): Influence of the autonomic nervous system on circadian patterns of myocardial ischemia: Comparison of stable angina with the early post infarction period. Br Heart J (1994); 71: 329-33.

13. Shimonagata T, Ishida Y, Hayashida K et al. (1995): Scintigraphic assessment of silent myocardial ischemia after early infarction using myocardial SPECT imaging with Tl-201 and J-131-MIBG. Nucl Med Commun;16:893-900.

14. Onorati F, De Feo M, Mastroroberto P, Cristodoro L., Pezzo F., Renzulli A., et all. (2005): Determinants and Prognosis of Myocardial Damage After Coronary Artery Bypass Grafting. Ann Thorac Surg; 79; 837-45.
15. Racz M.J, Hannan E., Isom O.W., Subramanian V.A., Jones R., Golr J. et all.(2003) A Comparison of Short-and Long-Term Outcomes After Off-Pump and On-Pump Coronary Artery Bypass Graft Surgery With Sternotomy. JACC, Vol 43, No 4; 557-64.

Rezime

PREDIKTORI NA BOLNI^KIOT MORBIDITET I MORTALITET KAJ PACIENTITE SO KORONARNA ARTERISKA BOLEST TRETIRANI SO AORTO-KORONARNA BAJPAS HIRURGIJA

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Cel na trudot be{e da se identifikuvaat obele`jata koi go predviduvaat raniot morbiditet i mortalitet kaj pacientite so koronarna arteriska bolest (KAB) podlo`eni na aorto-koronarna bajpas hirurgija (AKBP).

Materijal i metodi: Vo studijata bea vklu~eni 749 pacienti podlo`eni na AKPB hirurgija vo periodot od 1981 do 2002 godina, na vozrast od 55±8 godini, od koi 639 (84,1%) ma`i i 119 (15,9%) `eni. Bea analizirani predoperativnite demografski, klini~ki, levokomorni morfolo{ki, funkcionalni, angiografski i perioperativni obele`ja, odnosno pojavata na rani komplikacii (bolni~ki morbiditet) i smrt vo tek na prvite 30 dena.

Rezultati: Postoperativni komplikacii bea registrirani kaj 173 pacienti (23,1%), a 2,3% od vkupniot broj operirani imaa letalen ishod. Naj~esta be{e pojava na izliv vo perikardnata kesa (8,4%), pretkomorni aritmii (6,3%), plevralen izliv (5,6%), a potoa sleduvaa infekciite, akutnata bubre`na slabost i mozo~niot udar. Naprednatata vozrast (≥65godini), prisustvoto na pridru`ni zaboluvawa i rizik faktori: cerebrovaskularen insult, periferna vaskularna bolest, hroni~na obstruktivna belodrobna bolest, hipertenzivnata bolest, prethoden miokarden infarkt i levokomorna slabost, angiografski poekstenzivna KAB, poniska istisna frakcija i povisok indeks na abnormalno yidno dvi`ewe, bea identifikuvani kako predoperativni obele`ja koi bea statisti~ki zna~ajno povrzani so pojavata na bolni~ki morbiditet. Kako nezavisni prediktori na bolni~kiot morbiditet se izdvoija samo naprednatata vozrast, poekstenzivnata KAB i zgolemeniot YAD skor indeks, dodeka kako nezavisni prediktori na bolni~kata smrtnost se izdvoija naprednatata

vozrast, prisustvoto na levokomorna slabost pred operacija i pojavata na postoperativni komplikacii.

Zaklu~ok: Kaj pacientite podlo`eni na AKBP za tretman na KAB analizata na predoperativnite obele`ja i operativnata tehnika vo golema mera mo`e da go predvidi klini~kiot tek vo raniot postoperativen (bolni~ki) period, dodeka pak, pojavata na rani komplikacii so visoka verojatnost predviduva pojava na smrt.

Klu~ni zborovi: koronarna arteriska bolest, aorto-koronarna bajpas hirurgija, obele`ja vo prognoza, bolni~ki morbiditet i smrtnost

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