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EUROSCORE II VALUE AS A PREDICTOR FOR MAJOR ADVERSE CARDIOVASCULAR EVENTS DURING ADMISSION IN PATIENTS UNDERGOING CORONARY ARTERY BYPASS SURGERY IN HAJI ADAM MALIK GENERAL HOSPITAL MEDAN

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Abstract

Background : Coronary heart disease is one of the causes of high rates of care and mortality in hospitals. Coronary artery bypass surgery (CABG) is one of the intervention therapy of coronary heart disease. EuroSCORE II is a scoring system that is often used in predicting mortality rates in patients undergoing cardiac surgery procedures, its role in predicting Major Adverse Cardiac Events (MACE) in cases of coronary artery bypass surgery is still very rare, especially in Indonesia.

Objective : To determine the relationship between EuroSCORE II value as a predictor of major adverse cardiac events during admission in patients undergoing coronary artery bypass surgery.

Methods : This study is a retrospective of 75 CHD patients who underwent CABG at H. Adam Malik General Hospital from June 2019 to June 2020. All subjects who will undergo CABG are counted for EuroSCORE II, then observed during hospitalization. The output that was monitored was MACE incidents during hospitalization. Statistical analysis was performed to assess the ability of EuroSCORE II to predict MACE during hospitalization.

Results : From 75 patients who underwent CABG, 12 patients (16%) had MACE and 63 other patients (84%) did not experience MACE. The MACE assessed were death, cardiogenic shock, acute heart failure, malignant arrhythmias, and stroke. Through the analysis of the ROC curve, it was found that the intercept value for EuroSCORE II was 3.31 (AUC 0.976, IK95% 0.944-1.00, $p < 0.001$). Score ≥ 3.31 can predict MACE during treatment with a sensitivity of 91.7% and a specificity of 88.9%. The value of EuroSCORE II are low scores $< 2\%$, intermediate scores 2-5%, and high scores $> 5\%$ for MACE. There was a statistically significant relationship with EuroSCORE II value on each MACE which are mortality, malignant arrhythmias, cardiogenic shock, and acute heart failure with p value < 0.05 .

Conclusion : EuroSCORE II value can be used as a predictor of MACE during hospitalization in patients undergoing coronary artery bypass surgery.

Introduction

Coronary heart disease (CHD) is one of the major causes of high rates of care and mortality in hospitals. Based on WHO data in 2015, coronary heart disease ranks first as a cause of death worldwide. (WHO, 2017). Data from *Kementerian Kesehatan* in 2017 reported that the death rate caused by coronary heart disease has increased by 12.9% of the total population. (Kemenkes RI, 2017).

Coronary artery bypass surgery (CABG) is one of the management interventions of coronary heart disease by creating an alternative route through a narrowed or blocked coronary artery (Feryawati, 2005). Over the last few decades, an increasing number of patients undergoing primary percutaneous intervention have led to significant changes in the profile of patients referred for coronary artery bypass surgery (Baran, 2019).

Over the last decades, several risk scores have been developed to estimate postoperative cardiac outcome. (Prins, 2012) The risk model is an objective assessment of surgical indications in patients by taking into account the benefits and risks of cardiac surgery (Kolh, 2006). The focus of the predictive risk model for preoperative cardiac surgery is mortality. (Prins, 2012) Whereas the ability to predict only postoperative mortality is not an adequate method for determining postoperative outcome, since Major Adverse Cardiac Events (MACE) are more common than deaths. (Prins, 2012; Granton, 2008)



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The European System for Cardiac Operative Risk Evaluation (EuroSCORE) II is a risk stratification model that has been widely used to estimate the risk of mortality and morbidity after coronary artery bypass surgery (Chee-Fah, 2003; Zhang GX, 2013). Although the role of EuroSCORE II has been widely studied and is the most model frequently used in predicting mortality rates in patients undergoing cardiac surgery procedures, its role in predicting Major Adverse Cardiac Events (MACE) in cases of coronary artery bypass surgery is still very rare, especially in Indonesia.

In this study, the authors aimed to examine the role of EuroSCORE II as a predictor in predicting MACE during hospitalization in patients undergoing coronary artery bypass surgery.

Methods

Study population

The data of this study were taken from CAD patients who were going to undergo coronary artery bypass surgery at Haji Adam Malik Hospital using consecutive sampling method. The study involved 75 CAD patients who were willing to be research subjects, observations were made during hospitalization after undergoing surgical procedures. Patients who had a history of previous coronary artery bypass surgery (Re-CABG) and underwent heart valve surgery at the time of sampling were excluded from the study subjects.

EuroSCORE II Assessment

This study is a retrospective study. After data were recorded through medical records, observations were made for MACE. For patients treated before study time, clinical course during treatment and MACE were viewed through medical record data. For patients who were treated during the study, observations were made during treatment (30 days or more if the patient was on ongoing treatment) and MACE that occurred until the patient was discharged or died. Examinations were carried out in accordance with the criteria for the EuroSCORE II variable and the data was processed into the EuroSCORE II calculator.

Statistical analysis

The data were analyzed using the SPSS program. For categorical variables, the bivariate analysis used the Chi-square test for normally distributed data or Fisher's test for non normal distribution data. While for numerical variables, it used Student's t-test for normally distributed data or the Mann-Whitney test for data not normally distributed. Correlation test was performed to assess the level of strength of the relationship expressed by Pearson. Multivariate analysis will be carried out using logistic regression. The p value < 0.05 was said to be statistically significant. Independent variables with significant relationship will be analyzed using ROC analysis to determine the cut-off value, sensitivity, and specificity.

Results

There were 75 patients with CAD who underwent CABG surgery. A total of 12 patients (16%) had a Major Adverse Cardiovascular Event (MACE) and 63 other patients (84%) had no MACE. Acute heart failure was the highest MACE during hospitalization with 4 incidents (33.3%), followed by 3 deaths (25%), 3 cardiogenic shock events (25%), and 2 malignant arrhythmias (16.7%). The characteristics and basic data parameters of the results from the examination of patients undergoing CABG are presented in table 1.

The mean age of the patients was 56 years, patients who experienced MACE were older than those who did not experience MACE. All 12 patients who experienced MACE were male.

Table 1. Baseline Characteristics

Parameter	MACE		Total	p value
	Yes (n=12)	No (n=63)		
Age, years	61,25±4,88	54,61±5,08	55,68±5,58	<0,001
Sex				
Male	12 (17,4)	57 (82,6)	69 (92,0)	0,581
Female	0 (0,0)	6 (100,0)	6 (8,0)	
SBP	130 (100-140)	130 (100-150)	130 (100-150)	0,668
DBP	80 (60-80)	70 (60-90)	80 (60-90)	0,459
HR	72 (67-90)	74 (56-94)	72 (56-94)	0,514



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Hb	13,0±1,95	13,57±1,75	13,48±1,78	0,312
Ht	39,12±6,11	40,41±5,43	40,20±5,516	0,463
Leucocyte	9890 (7430-13760)	8410 (5370-14560)	8640 (5370-14560)	0,048
Thrombocyte	270750 ±99929	250841±67628	254026 ±73282	0,392
Ureum	38,85(21-92)	28(11-89)	30 (11-92)	0,032
Creatinine	1,58±0,40	1,19±0,39	1,25±0,422	0,003
CrCl	44,5 (32-75)	62 (32-264)	58 (32-264)	<0,001
Natrium	138,91±7,02	138,55±4,78	138,61±5,15	0,826
Kalium	4,6 (3,5-5,1)	4,1 (3,5-5,6)	4,1 (3,5-5,6)	0,029
Chloride	107,08±9,18	106,22±6,77	106,36±7,14	0,705
NYHA class				
I	0 (0,0)	7 (100,0)	7 (9,3)	<0,001
II	3 (6,3)	45 (93,8)	48 (64,0)	
III	8 (42,1)	11 (57,9)	19 (25,3)	
IV	1 (100,0)	0 (0,0)	1 (1,3)	
Recent MI				
Yes	11 (36,7)	19 (63,3)	30 (40,0)	<0,001
No	1 (2,2)	44 (97,8)	45 (60,0)	
LV Function	41,66±10,07	54,49±11,81	52,44±12,42	0,001
LM	54,5 (0,0-90)	30,0 (0,0-99,0)	40,0 (0,0-99,0)	0,151
LAD	94,5 (0,0-100,0)	90,0 (0,0-100,0)	90,0 (0,0-100)	0,302
LCx	90 (0,0-100)	90 (0,0-100)	90,0 (0,0-100)	0,883
RCA	100 (80-100)	90 (0,0-100)	90,0 (0,0-100)	0,006
CTR	59 (48-100)	55 (0,0-100)	57 (0,0-100,0)	0,101
Weight of isolation				
Isolated CABG	11 (15,1)	62 (84,9)	73 (97,3)	0,296
2 procedures	1 (50,0)	1 (50,0)	2 (2,7)	
MACE, Yes				
Acute heart failure	4 (33,3)	0 (0,0)	4 (33,3)	-
Cardiogenic shock	3 (25,0)	0 (0,0)	3 (25,0)	-
Mortality	3 (25,0)	0 (0,0)	3 (25,0)	-
Malignant arrhythmia	2 (16,7)	0 (0,0)	2 (16,7)	-
Stroke	0 (0,0)	0 (0,0)	0 (0,0)	-
Amount of graft	3,5 (2-4)	3 (2-6)	3 (2-6)	0,542
EuroSCORE II	5,42 (3,29-28,92)	1,45 (0,5-3,90)	1,63 (0,5-28,92)	<0,001
Score <2%	0 (0,0)	39 (100,0)	39 (52,0)	<0,001
Score 2-5%	5 (17,2)	24 (82,8)	29 (38,7)	
Score >5%	7 (100,0)	0 (0,0)	7 (9,3)	
Extracardiac arteriopathy				
Yes	0 (0,0)	0 (0,0)	0 (0,0)	-
No	12 (16,0)	63 (84,0)	75 (100,0)	
Poor mobility				
Yes	11 (14,9)	63 (85,1)	74 (98,7)	0,160
No	1 (100,0)	0 (0,0)	1 (1,3)	
Previous cardiac surgery				
Yes	0 (0,0)	0 (0,0)	0 (0,0)	-
No	12 (16,0)	63 (84,0)	75 (100,0)	
Chronic lung disease				
Yes	8 (30,8)	18 (69,2)	26 (34,7)	0,019



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No	4 (8,2)	45 (91,8)	49 (65,3)	
Active endocarditis				
Yes	0 (0,0)	0 (0,0)	0 (0,0)	-
No	12 (16,0)	63 (84,0)	75 (100,0)	
Critical preoperative state				
Yes	0 (0,0)	0 (0,0)	0 (0,0)	-
No	12 (16,0)	63 (84,0)	75 (100,0)	

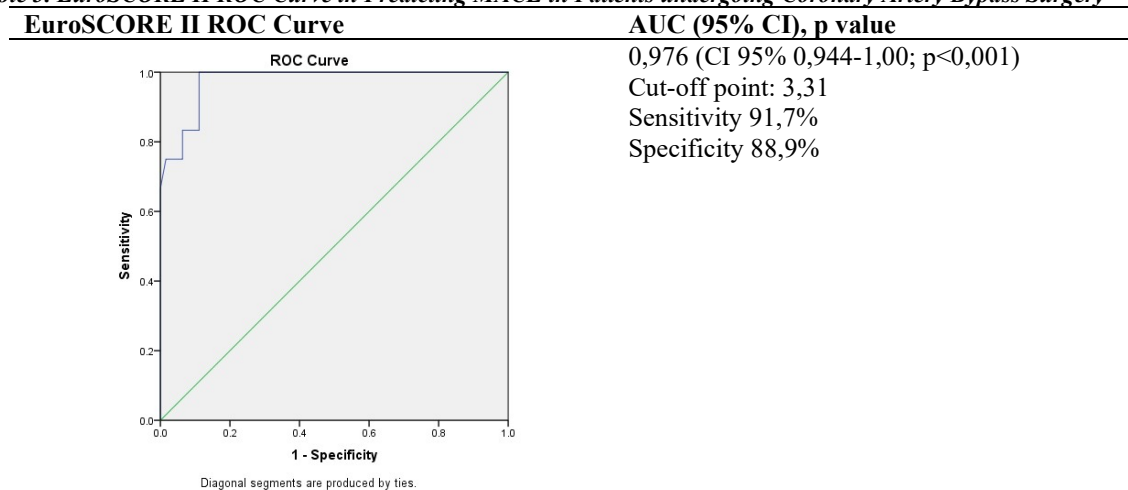
Table 2 shows the multivariate analysis used to determine which factors predict the incidence of MACE in patients undergoing coronary artery bypass surgery. The MACE assessed were death, cardiogenic shock, malignant arrhythmias, acute heart failure, and stroke. The variable resulting from the bivariate analysis which has a value of $p < 0.25$ is included in the logistic regression analysis on the incidence of MACE, obtained until the last stage, namely the CTR and EuroSCORE II variables. In the analysis, it was found that the EuroSCORE II variable alone was a predictor factor that was statistically significant (OR 63.76, 95% CI, $p < 0.001$, constant -23.605).

Table 2. Multivariate Analysis of MACE Risk Factors in Patients who Underwent Coronary Artery Bypass Surgery

Variable	Coefficient	p value	OR	95% CI (Min-max)	
Step 16					
CTR	0,115	0,086	1,122	0,984	1,280
EuroSCORE II	4,155	0,048	63,76	1,039	3914,55
Constant	-23,605				

To determine the cut-off value percentage of EuroSCORE II which can estimate the incidence of MACE in patients undergoing coronary artery bypass surgery, the ROC analysis was performed as presented in Table 3. EuroSCORE II has a very strong correlation strength (AUC 0.976) and statistically significant ($p < 0.001$).

Table 3. EuroSCORE II ROC Curve in Predicting MACE in Patients undergoing Coronary Artery Bypass Surgery



The visualization to determine the optimal cut-off point of EuroSCORE II for the incidence of MACE in patients with coronary artery bypass surgery is presented in Figure 1. The EuroSCORE II cut-off point for the incidence of MACE was obtained at 3.31%. Thus, patients with EuroSCORE II $\geq 3.31\%$ are more likely to experience MACE.

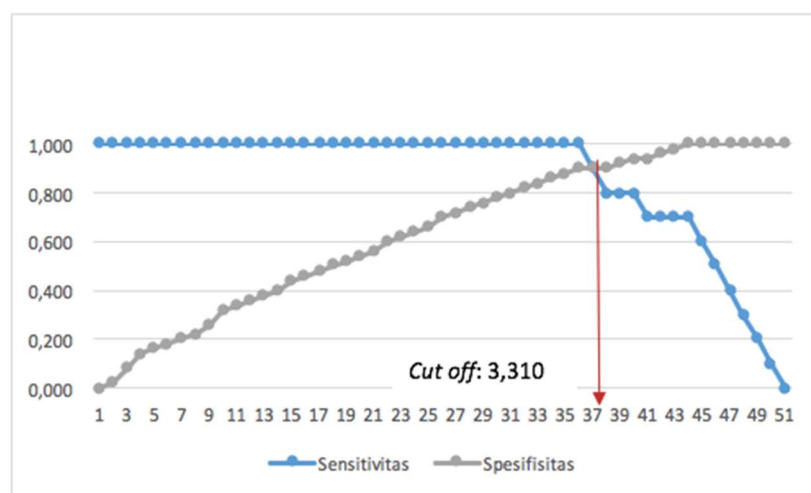


Figure 1. Optimal Cut-off Point of EuroSCORE II for The Incidence of MACE in Coronary Artery Bypass Surgery Patients

EuroSCORE II stratification (low score <2%, intermediate score 2-5%, and high score >5%) on the incidence of MACE are presented in table 4-7. There was a statistically significant relationship between EuroSCORE II stratification and the primary end points, including death, malignant arrhythmias, and cardiogenic shock, and acute heart failure as the secondary end point ($p < 0.05$).

Table 4. EuroSCORE II Stratification on Mortality in Coronary Artery Bypass Surgery Patients

EuroSCORE II	MORTALITY		p value
	Positive	Negative	
Score <2%	0 (0,0)	39 (100,0)	0,003
Score 2-5%	1 (3,4)	28 (96,6)	
Score >5%	2 (28,6)	5 (71,4)	

Table 5. EuroSCORE II Stratification for Malignant Arrhythmias in Coronary Artery Bypass Surgery Patients

EuroSCORE II	MALIGNANT	ARITMIA	p value
	Positive	Negative	
Score <2%	0 (0,0)	39 (100,0)	0,045
Score 2-5%	1 (3,4)	28 (96,6,0)	
Score >5%	1 (14,3)	6 (85,7)	

Table 6. EuroSCORE II Stratification for Cardiogenic Shock in Coronary Artery Bypass Surgery Patients

EuroSCORE II	CARDIOGENIC	SHOCK	p value
	Positive	Negative	
Score <2%	0 (0,0)	39 (100,0)	0,003
Score 2-5%	1 (3,4)	28 (96,6)	
Score >5%	2 (28,6)	5 (71,4)	

Table 7. EuroSCORE II Stratification for Acute Heart Failure in Coronary Artery Bypass Surgery Patients

EuroSCORE II	HEART	FAILURE	p value
	Positive	Negative	
Score <2%	0 (0,0)	39 (100,0)	0,004
Score 2-5%	2 (6,9)	27 (93,1)	
Score >5%	2 (28,6)	5 (71,4)	

Discussion

Myocardial revascularization with CABG surgery improves survival rate in patients with coronary artery disease (Ranjan, 2019; Correa-Rodríguez, 2020). However, surgical revascularization itself, as well as some perioperative



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characteristics, could affect the rate of Major Adverse Cardiovascular Events (MACE) (Askari, 2019; Dalen, 2019; Elsisy, 2020).

This study reported that 16% post-CABG patients experienced MACE. Similar to the cohort study by Gurbuz et al. who reported that the number of post-CABG patients who showed the MACE incidence rate was 11.6%. CABG is associated with the incidence of MACE (OR: 1.46, 95% CI: 1.05–2.04; $p = 0.03$) (Bundhun et al., 2016). The average incidence of MACE in the hospital is death, non-fatal MI, heart failure, cardiac arrhythmias especially acute atrial fibrillation, stroke, gastrointestinal bleeding and kidney failure (Nalysnyk, 2003; Sousa, 2015; Gennari, 2017).

For the progression of MACE after CABG, risk factors can be categorized into patient-related, intraoperative and postoperative factors. Among the demographic variables showed that gender, history of CVS (%), low ejection fraction, and older age at surgery were significantly associated with MACE (Hussein-Kamel, 2018).

This study proves that EuroSCORE II is a predictor of morbidity in post-operative CABG patients with MACE, with a cut off-point value of 3.31 (sensitivity: 91.7% and specificity 88.9%) with a very strong relationship (AUC 0.976, CI 95% 0.944-1.00; $p < 0.001$). In the multivariate analysis it was also found that the EuroSCORE II variable alone was a statistically significant predictor of the incidence of MACE (OR: 63.76, 95% CI 1.039-3914.55, $p = 0.048$). EuroSCORE II has a fair calibration of up to 30% of the predicted value (Barili, 2012). The accuracy of EuroSCORE II is acceptable in isolated coronary operations, and good or very good in other operations (Di Dedda, 2013).

A study by Fukui et al. evaluated 412 isolated CABG patients for the use of EuroSCORE II as a predictor of short and long term prognosis, in a multivariate analysis found that high EuroSCORE II (≥ 1.41) was an independent predictor of post-operative MACE (OR: 4.154; $p = 0.030$) and an independent predictor for further mortality (OR: 4.673; $P = 0.016$). The risk factors for respondent characteristics that significantly affects the high EuroSCORE II score (≥ 1.41) are old age (72.0 ± 8.9), female (21.8%), mean EuroSCORE II score (4.9 ± 5.9), ACS (36.9%), recent MI (38.8%), history of CHD (21.4%), history of stroke (13.1%), and eGFR (60.5 ± 26.9) ml/min/1.73 m³ (Fukui, 2014).

Conclusion

There was a statistically significant relationship between EuroSCORE II value and the primary end points, which includes death, malignant arrhythmias, cardiogenic shock, and the secondary end point, acute heart failure ($p < 0.05$). Of the total 75 patients who undergo coronary artery bypass surgery at Haji Adam Malik Hospital Medan, 12 people (16%) experienced Major Adverse Cardiovascular Events (MACE) during admission. The cut-off value of EuroSCORE II in the prediction of MACE in patients undergoing coronary artery bypass surgery was 3.31 with a sensitivity of 91.7% and a specificity of 88.9%. Thus, patients with EuroSCORE II $\geq 3.31\%$ are more likely to experience MACE. EuroSCORE II can be used as a predictor of MACE during hospitalization in patients undergoing coronary artery bypass surgery.

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