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### Factors Affecting the Mortality of Patients Undergoing Open Heart Surgery with Cardiopulmonary Bypass at Dr. M. Djamil General Hospital, Padang, Indonesia

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#### ABSTRACT

**Background:** Morbidity and mortality of patients after cardiac surgery can be influenced in the preoperative, intraoperative, and postoperative periods. This study aimed to explore factors that affect the mortality of patients undergoing open heart surgery with cardiopulmonary bypass at Dr. M. Djamil General Hospital, Padang, Indonesia. **Methods:** This study is an analytical observational research with a cross-sectional approach and uses secondary data obtained from the medical record installation of Dr. M. Djamil General Hospital, Padang, Indonesia. A total of 57 research subjects participated in this study. Univariate, bivariate, and multivariate analyses were carried out using SPSS software. **Results:** The final multivariate modeling results show that the variables that influence patient mortality are EuroSCORE II (p-value=0.003) and duration of CPB (p-value=0.003). With an odds ratio of 37.21 groups, EuroSCORE II high risk had a risk of death 37.21 times higher than the low-risk group (CI 3.325 – 416.324). Meanwhile, increasing the duration of CPB by one minute increased the risk of mortality 1.02 times (CI 1.006 – 1.030). Meanwhile, there is no influence of variables (NYHA, LV function, ACC duration) on the incidence of mortality in patients undergoing open heart surgery with a machine cardiopulmonary bypass at Dr. M. Djamil General Hospital, Padang. **Conclusion:** EuroSCORE II affects the mortality of patients undergoing open heart surgery with CPB. The duration of CPB affects the mortality of patients undergoing open heart surgery with CPB.

#### 1. Introduction

Advances in open heart surgery have occurred due to the growing use of CPB. CPB is a form of extracorporeal circulation that functions to support circulation and breathing as well as temperature regulation to facilitate surgery on the heart and large blood vessels. Although CPB is a standard procedure in cardiac surgery, it can also cause systemic and organ-specific complications, such as heart failure, renal and pulmonary dysfunction, coagulation disorders, and neurological and cognitive dysfunction.

Therefore, it is important for clinicians to assess and modify the patient's condition before, during, and after cardiac surgery. Morbidity and mortality of patients after cardiac surgery can be influenced in the preoperative, intraoperative, and postoperative periods. In a study regarding pre-operative factors that influence patient mortality after cardiac surgery, it was found that a significant risk of mortality after cardiac surgery was related to the following 7 covariates, namely New York Heart Association (NYHA) class IV, congestive heart failure, ejection fraction less than

20%, atrial fibrillation, acute coronary insufficiency, heart problems, and a blood creatinine level of 100 mg/dL.<sup>1-5</sup>

In the study of intraoperative predictors, it was found that longer time under anesthesia, operation time, CPB time, and intubation time were factors that influenced the length of stay/length of stay (LOS) in the ICU. The duration of CPB used during surgery also influences patient mortality after heart surgery. Meanwhile, research related to predictors of postoperative mortality in cardiac surgery patients discusses several things, such as the use of drugs or tools to support body functions as well as post-operative complications. Postoperative use of inotropes such as epinephrine, milrinone, and dobutamine is associated with renal dysfunction and death in cardiac surgery patients.<sup>6-13</sup> This study aimed to explore factors that affect the mortality of patients undergoing open heart surgery with cardiopulmonary bypass at Dr. M. Djamil General Hospital, Padang, Indonesia.

## 2. Methods

This study is an analytical observational research with a cross-sectional approach and uses secondary data obtained from the medical record installation of Dr. M. Djamil General Hospital, Padang, Indonesia. A total of 57 research subjects participated in this study, where the research subjects met the inclusion criteria. The inclusion criteria in this study were patients undergoing open heart surgery using a machine cardiopulmonary bypass at Dr. M. Djamil General Hospital Padang for the period August 2019 – September 2023 and patients having complete medical record data. This study has received approval from the medical and health research ethics committee of Dr. M. Djamil General Hospital, Padang, Indonesia.

Univariate analysis was performed to describe the characteristics of respondents and preoperative factors that influence the morbidity and mortality of patients undergoing open heart surgery. Categorical data is presented in frequency form, while continuous data is presented in frequency form mean/median and

standard deviation/minimum-maximum range. The bivariate analysis used in this research is the Chi-square test/ Fisher Exact test to assess the relationship between categorical-categorical dependent and independent variables, namely analyzing the relationship between NYHA classification, use of mechanical ventilation >24 hours, use of post-operative inotropes and bleeding on the mortality of patients undergoing open heart surgery. A test is said to be meaningful if the p-value <0.05. In this study, bivariate analysis was also carried out with tests T independent/Mann Whitney to assess the relationship between the dependent variable and the categorical-numerical independent, namely EuroSCORE II, right ventricular function, left ventricular function, pulmonary hypertension, CPB duration, ACC duration. Multivariate analysis was used to determine the joint exposure of several factors that influence the mortality of patients undergoing open heart surgery at Dr. M. Djamil General Hospital, Padang. The statistical test used is multiple logistic regression.

## 3. Results

Table 1 shows the patient characteristics. The results of the analysis show that the average age of patients is 36 years, with the lowest age being 6 years and the highest age being 70 years. The gender of the patients was female (50.9%) and male (49.1%). Based on subdivision, most patients were in the CHD subdivision (45.6%), and the fewest were in the tumor and aortic subdivision (1.8%). Then, based on functional class New York Heart Association (NYHA), the majority of patients were in class II (54.4%) and the least in class I (5.3%). The results of the analysis showed that the patients with EuroSCORE II low risk, namely 89.5%, were more than patients with high risk, namely 10.5%. Based on left ventricular (LV) systolic function, the majority of patients had normal function, namely 80.7%, while there were 19.3% of patients with decreased LV function. Based on right ventricular (RV) systolic function, the average TAPSE of patients was 2.02 cm, with the lowest value being 0.9 cm and the

highest value being 4.2 cm. Based on pulmonary hypertension, the average mPAP of patients was 21.71 mmHg, with the lowest value being 5 mmHg and the highest value being 58 mmHg. The average duration of cardiopulmonary bypass (CPB) for the patient was 176.6 minutes, with the lowest value being 53 minutes and the highest value being 465 minutes. Next, the average duration obtained for aortic cross-clamping (ACC) is 118.35 minutes, with the lowest value being

25 minutes and the highest value being 408 minutes. The results showed that the majority of patients were exposed to inotropic drugs post-operatively (80.7%), did not experience postoperative bleeding (96.5%), and did not use a ventilator for >24 hours (66.7%). Then, the results showed that there were 13 patients (22.8%) who were still alive, while 44 patients (77.2%) were still alive.

Table 1. Characteristics of patients undergoing open heart surgery with cardiopulmonary bypass machine at Dr. M. Djamil General Hospital, Padang, Indonesia.

Characteristics	Total (n)	Frequency (%) / (mean $\pm$ SD; min-max)
<b>Age (years)</b>	57	36 $\pm$ 18,45; 6 – 70
<b>Gender</b>		
Male	28	49,1
Female	29	50,9
<b>Subdivision</b>		
CHD	26	45,6
Coroner	11	19,3
Valve	18	31,6
Tumor	1	1,8
Aortic	1	1,8
<b>NYHA classification</b>		
Class I	3	5,3
Class II	31	54,4
Class III	15	26,3
Class IV	8	14,0
<b>EuroSCORE II</b>		
Average value	57	1,18 $\pm$ 1,03; 0,50 – 5,00
Low risk (<2 %)	51	89,5
High risk ( $\geq$ 2 %)	6	10,5
<b>LV function (EF)</b>		
Average value	57	58,54 $\pm$ 11,30; 31 – 75
Normal ( $\geq$ 50%)	46	80,7
Decreased (<50%)	11	19,3
<b>RV function (TAPSE, cm)</b>	57	2,02 $\pm$ 0,57; 0,9 – 4,2
<b>Pulmonary hypertension (mPAP, mmHg)</b>	57	21,71 $\pm$ 12,86; 5,0 – 58,0
<b>CPB duration (minutes)</b>	57	176,60 $\pm$ 88,08; 53 – 465
<b>ACC duration(minutes)</b>	57	118,35 $\pm$ 76,19; 25 – 408
<b>Inotropic use</b>		
Yes	46	80,7
No	11	19,3
<b>Postoperative bleeding</b>		
Yes	2	3,5
No	55	96,5
<b>Ventilator use &gt;24 hours</b>		
Yes	19	33,3
No	38	66,7
<b>Mortality</b>		
Yes	13	22,8
No	44	77,2

Table 2. Multivariate modeling of factors affecting mortality in patients undergoing open heart surgery with cardiopulmonary bypass machine at Dr. M. Djamil General Hospital, Padang, Indonesia.

Variable	Complete modeling			Final modeling		
	P-value	AOR	95% CI	P-value	AOR	95% CI
NYHA (III-IV)	0,681	1,54	0,198 - 11,936	-	-	-
EuroSCORE II ( $\geq 2\%$ )	0,048	17,84	1,021 - 311,78	0,003	37,21	3,325 - 416,324
LV function ( $< 50\%$ )	0,134	4,95	0,611 - 40,05	-	-	-
CPB duration	0,231	1,02	0,987 - 1,055	0,003	1,02	1,006 - 1,030
ACC duration	0,813	0,99	0,959 - 1,033	-	-	-

The final multivariate modeling results show that the variables that influence patient mortality are EuroSCORE II (p-value=0.003) and duration of CPB (p-value=0.003). With an odds ratio of 37.21 groups, EuroSCORE II high risk had a risk of death 37.21 times higher than the low-risk group (CI 3.325 – 416.324). Meanwhile, increasing the duration of CPB by one minute increased the risk of mortality 1.02 times (CI 1.006 – 1.030). Meanwhile, there is no influence of variables (NYHA, LV function, ACC duration) on the incidence of mortality in patients undergoing open heart surgery with a cardiopulmonary bypass machine at Dr. M. Djamil General Hospital, Padang.

#### 4. Discussion

There are five variables (NYHA, LV function, EuroSCORE II, duration of CPB, duration of ACC) with a p-value  $< 0.25$ , and a multivariate test was carried out. In the final results, a p-value  $< 0.05$  was obtained from EuroSCORE II, and the duration of CPB is the strongest factor influencing the mortality of patients undergoing open heart surgery with CPB. Group EuroSCORE II, those at high risk are 37 times more likely to die, but statistically, the CI result (3.325 - 416.324) is very wide, which is possible because the number of high-risk groups is much smaller than those who are alive. A longer CPB duration of 1 minute increased mortality 1.02-fold. This validates the accuracy of EuroSCORE II in the study population and strengthens the evidence for CPB as a factor influencing the mortality of patients undergoing open heart surgery with CPB.<sup>14-18</sup>

#### 5. Conclusion

EuroSCORE II affects the mortality of patients undergoing open heart surgery with CPB. The duration of CPB affects the mortality of patients undergoing open heart surgery with CPB.

#### 6. References

1. Liu PH, Shih HH, Kang PL, Pan JY, Wu TH, Wu CJ. Performance of the EuroSCORE II model in predicting short-term mortality of general cardiac surgery: a single-center study in Taiwan. *Acta Cardiol Sin.* 2022; 38(4): 495-503.
2. Passaroni A, de Moraes Silva M, Yoshida WB. Cardiopulmonary bypass: Development of John Gibbon's heart lung machine. *Braz J Cardiovasc Surg.* 2015; 30(2): 235-45.
3. Moh'd A, Al-Odwan H, Altarabsheh S, Makahleh Z, Khasawneh MA. Predictors of aortic clamp time duration and intensive care unit length of stay in elective adult cardiac surgery. *Egyptian Heart Journal.* 2021; 73(1): 92.
4. Dayan V, Paganini J, Marichal A, Brusich D. On-pump beating/non-beating CABG in stable angina have similar outcomes. *Braz J Cardiovasc Surg.* 2018; 33(2): 183-8.
5. Chen WC, Lin MH, Chen CL, Chen YC, Chen CY, Lin YC, et al. Comprehensive comparisons among inotropic agents on mortality and risk of renal dysfunction in patients who underwent cardiac surgery: a network meta-analysis of randomized controlled trials. *J Clin Med.* 2021;

- 10(5): 1032.
6. Division of Cardiovascular Thoracic Surgery Dr. M. Djamil General Hospital. Open Heart Surgery Operations Data for 2018-2023. Dr. M. Djamil General Hospital Padang.
7. Cohn LH, Adams DH. Cardiac surgery in the adult. 5<sup>th</sup> ed. United States: McGraw-Hill Education; 2018.
8. Pulignano G, Gulizia MM, Baldasseroni S. ANMCO/SIC/SICI-GISE/SICCH executive summary of consensus document on risk stratification in elderly patients with aortic stenosis before surgery or transcatheter aortic valve replacement. *Eur Heart J Suppl.* 2017; 19(Suppl D): D354-D369.
9. Sianos G. The SYNTAX score: an angiographic tool grading the complexity of coronary artery disease. *EuroIntervention: journal of EuroPCR in collaboration with the Working Group on Interventional Cardiology of the European Society of Cardiology.* 2005; 1(2): 219-27.
10. Nashef SA, Roques F, Michel P, Gauducheau E, Lemeshow S, Salamon R. European system for cardiac operative risk evaluation (EuroSCORE). *Eur J Cardiothorac Surg.* 1999; 16(1): 9-13.
11. Hamaji M, Sakaguchi Y, Matsuda M, Kono S. Reinforced closure of the sternum with absorbable pins for high-risk patients. *Interact Cardiovasc Thorac Surg.* 2009; 9(4): 559-61.
12. Sarkar M, Prabhu V. Basics of cardiopulmonary bypass. *Indian J Anaesth.* 2017; 61(9): 760-7.
13. Ismail A, Semien G, Miskolczi SY. Cardiopulmonary bypass. In: *StatPearls. Treasure Island (FL): StatPearls Publishing.* 2023.
14. Bond E, Valadon C, Slaughter M. Cannulation for cardiopulmonary bypass. *Cardiac Surgery Procedures. IntechOpen;* 2020.
15. Wahba A, Milojevic M, Boer C, de Somer F, Gudbjartsson T, van den Goor J, et al. 2019 EACTS/EACTA/EBCP guidelines on cardiopulmonary bypass in adult cardiac surgery. *European Journal of Cardio-thoracic Surgery.* 2020; 57(2): 210-51.
16. Caraballo C, Desai N, Mulder H, Alhanti B, Wilson F, Fiuzat M, et al. Clinical implications of the New York Heart Association Classification. *J Am Heart Assoc.* 2019; 8(23): e014240.
17. Smit-Fun V, Buhre WF. The patient with chronic heart failure undergoing surgery. *Curr Opin Anaesthesiol.* 2016; 29(3): 391-6.
18. Supomo S. Prognostic factors in mitral valve replacement surgery at Dr. Sardjito General Hospital, Yogyakarta-Indonesia. *Bali Medical Journal.* 2018; 7(3): 654-7.