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Age, Gender, and Preoperative LVEF Influence on ICU Length of Stay After CABG

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Abstract

Coronary artery bypass graft (CABG) surgery is a surgical therapy for coronary artery disease (CAD) patients who cannot be solely treated using pharmacological therapy. Patients undergoing CABG surgery require careful postoperative monitoring in the intensive care unit (ICU). This leads to the need for careful selection of patients due to the limited number of ICU beds available. A prolonged stay in ICU could delay surgery for other patients. This retrospective study analyzed how preoperative factors such as age, gender, and preoperative left ventricular ejection fraction (LVEF) may influence patient's length of stay (LOS) in the ICU. For this study, subjects were patients undergoing isolated CABG in Dr. Hasan Sadikin General Hospital Bandung, Indonesia, during the period of January 2019–December 2020 who were selected using the simple random sampling method. The subjects were categorized into <65 years old and ≥65 years old age groups; man and woman gender; preoperative LVEF of <40% and ≥40%; and prolonged ICU LOS (>96 hours) and non-prolonged ICU LOS (<96 hours). Deceased patients in the ICU were excluded. Results of the bivariate and multivariate analyses showed that age was the only factor (p-value of 0.017) that increased the risk of prolonged ICU LOS (OR of 3.34) after CABG surgery that was statistically significant. This study concluded that patient of old age (>65 years old) is at a higher risk of having prolonged ICU LOS after CABG; thus, a careful scheduling of patients for CABG surgery by age is important to prevent prolonged ICU LOS after CABG.

Keywords: Coronary artery bypass surgery, coronary artery disease, intensive care unit

Introduction

Coronary artery disease (CAD) has the highest mortality rate among cardiovascular diseases. The current management for CAD is pharmacological dan surgical intervention. Those who failed to be treated with solely pharmacological intervention were given options for surgical intervention or coronary artery bypass graft (CABG). The study also showed that five years-survival rates in patients exclusively treated with pharmacological intervention is 5% and increased to 82% in those receiving a surgical intervention. Nearly 500.000 patients undergo CABG every year in the United States. Similar trends were shown in Gatot Subroto Hospital Indonesia; approximately 1500 were diagnosed with CAD in 2017, and 50 were undergone CABG, the following year, the number of CABG patients increased to 67.[1–3]

The patient who had undergone CABG needs to be admitted to the ICU postoperatively for intensive monitoring due to various risks of complications. Unfortunately, these ICU beds are often in limited numbers. Length of stay in ICU after CABG may vary from 4–14 days, prolonged LOS (>96 hours) in ICU may become a problem which calls for careful patient selection and early recognition of risk factors in the preoperative period may avoid too many prolonged ICU LOS in one period which could result in CABG cancellation and higher cost of care. Prolonged ICU LOS also contributes to a higher mortality rate after CABG due to complications such as bleeding, prolonged ventilation, and low cardiac output syndrome (LCOS). These postoperative complications may occur under the influence of perioperative factors, which are divided into three stages: preoperative, intraoperative, and postoperative. Old age, gender, and

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preoperative LVEF are among preoperative factors; cardiopulmonary bypass (CPB) time and intraoperative use of inotropic agents are among intraoperative factors; prolonged intubation, postoperative bleeding, and the use of intra-aortic balloon pump (IABP) are among postoperative factors. This study will solely focus on age, gender, and preoperative LVEF as the preoperative factors that can be identified during preoperative screening. Early detection of prolonged ICU risk might help in scheduling future patients to prevent too many long ICU cases in one period.[4–6]

Age, gender, and preoperative LVEF are easily identified in preoperative screening for patient CABG scheduling. Patient with old age is at risk due to changes in their anatomy and physiology, exposing this population to a higher risk of complications during intraoperative or postoperative, hence the prolonged ICU LOS. Women are also at risk of more extended ICU stay due to presenting symptoms and intervention at an older age and often have more severe symptoms than the male population. Low preoperative LVEF, which is also common in a patient undergoing CABG, these populations are also at higher risk of mortality and complication after CABG due to deprivation of cardiac function. Hopefully, this study could provide data on which preoperative factors may contribute to the risk of prolonged ICU LOS after CABG in Dr. Hasan Sadikin General Hospital Bandung during 2019–2020.

Methods

The study design is retrospective-analytic. The subject of this study is the medical records of isolated CABG patients who were admitted to ICU Dr. Hasan Sadikin General Hospital Bandung, Indonesia, from January 2019 to December 2020. The inclusion criteria of this study were patients undergoing isolated CABG aged 18 years above, and the exclusion criteria were incomplete medical record data and patients with heart valve disease or procedure involved; the dropout criteria were subjects who deceased during ICU care after CABG. After approval from the Health Research Ethics Committee of Dr. Hasan Sadikin General Hospital Bandung, Indonesia, number LB.02.01/X.6.5/30/2022, all data on the subject was collected, including age, gender, preoperative LVEF, and ICU LOS after CABG. Subjects are picked using a simple random sampling method; 104 subject data were collected after exclusion and dropout. The data includes the age, gender, preoperative LVEF, and ICU LOS of each patient. Age is divided into two groups, <65 years old and ≥65 years old. Gender is divided into male and female, while preoperative LVEF is divided into <40% and ≥40%. Each independent variable was analyzed using bivariate analysis. The variable with a p-value <0.25 were analyzed further using the logistic regression method to find the most influential factor on ICU LOS. All these data will be displayed in a distributive and analytic table with statistical explanations accompanied by a discussion on the theoretical basis that has been found previously. Data processing and analysis were done using Windows's Statistical Product Service Solution (SPSS) version 25.0.

Results

Of 104 subjects involved in this study, the median age for subjects with <96 hours ICU LOS was 57, subject's ages ranged from 39–76 years old, while the median age for subjects with ≥96 hours ICU LOS was 61 with age ranged from 44–75 years old. Subjects that are admitted into ICU <96 hours are majority aged <65 years old (83.13%), and 16.86% were admitted ≥96 hours. In the≥65 age group, 54,14% were admitted <96 hours, and 42,86% were admitted ≥96 hours. Statistics show that age is statistically significant in influencing ICU LOS after CABG (p-value=0.017). Although more women have prolonged ICU LOS (42.86%) than males (18.88%), the gender variable did not show a significant influence statistically (p-value=0.077). Preoperative LVEF also did not show a significant influence statistically (p-value = 1.000). Both groups showed similar results. There is no significant difference in ICU LOS in subjects with preoperative LVEF <40% and ≥40%.

The final multivariate analysis model on three variables shows that the only factor influencing ICU LOS is Age because it has a p-value of 0.219. The P-value required for further analysis is <0.25. The p-value of age in the final model of multivariate analysis is 0.038, and it also shows that subjects with older age (≥65 years old) 3 times at higher risk of prolonged ICU LOS after CABG (OR 3.340).

Discussion

This study is aimed to see the influence of three preoperative factors that might influence ICU

Table 1 Bivariate Analysis of Preoperative Factors Influence on post-CABG ICU LOS

Variable	ICU LOS		P Value
	<96 hours	≥96 hours	
Age			0.017*
Median	57.00	61.00	
Range (min-max)	39,00–76,00	44,00–75,00	
<65 y.o	69 (83.13%)	14 (16.86%)	
≥65 y.o	12 (57.14%)	9 (42.86%)	
Genders			0.077
Male	73 (81.1%)	17 (18.88%)	
Female	8 (57.14%)	6 (42.86%)	
Preoperative LVEF			1.000
Median	60.00	55.00	
Range (min-max)	20.00–81.00	35.00–73.00	
<40%	13 (81.25%)	3 (18.75%)	
≥40%	68 (77.27%)	20 (22.73%)	

Note: Categorical data is presented with number/frequency and percentage, while numerical data is presented with mean, median, standard deviation, and range

LOS after CABG. Patients who have undergone CABG should be admitted to the ICU for close monitoring regarding complications after surgery. The period of ICU care after CABG usually ranged from 24 hours to ≤5 days. The previous study used 96 hours as the cut-off for prolonged ICU LOS because of the risk of complications such as ventilator-associated pneumonia (VAP). Hence, this study grouped the subject into two categories of ICU LOS, <96 hours and ≥96 hours.[5,6]

This study analyzed three preoperative factors to determine how much these factors can influence ICU LOS after CABG. Of the three factors in this study, age is the only factor influencing ICU LOS. The result showed that age is significant statistically (p-value=0,017) using bivariate analysis. Further analysis using logistic regression also showed that CABG patients with older age are at risk of prolonged ICU LOS (OR 3.34). Patient at an older age is known to have more comorbidities and often present with more severe symptom due to physiological and anatomical changes. The recovery period might be challenging in this population. Similar data were obtained in a previous study where CABG patients with older age are two times at higher risk of prolonged ICU LOS. Prolonged LOS varies around 20–30% longer than in younger patients. The previous study also found that the prolonged period can be up to 14 days. Anatomical and physiological changes in CABG patients with older age can affect the recovery phase, myocardial recovery can take longer, and it can also delay mechanical ventilation weaning and recovery in general. The reduced muscle mass and tone are the main reason for this delay. Decreased muscle tone, in general, would affect the recovery; myocardium in patients with old age will take longer to recover, resulting in the

Table 2 Multivariate Analysis on Preoperative Factors of Post CABG Subject in ICU

Variable	Coefficient B	p-value	OR	CI 95%	
				Lower	Upper
Age	1.046	0.219	2.845	0.537	15.066
Gender	0.420	0.589	1.522	0.331	6.994

Note: Multivariate analysis using biner logistic regression. The Independent variable included in the logistic regression must have a p-value <0.25

need for inotropic support, mechanical support such as IABP, and prolonged ventilation. Older patients are also more likely to have a longer period of respiratory muscle recovery. This could expose patients to ventilator-related infection, possibly increasing LOS and even higher mortality risk.[1,4,6–8]

The result of this study is that gender statistically does not influence prolonged ICU LOS (p-value=0.077), but the result shows that the percentage of females with prolonged ICU LOS is higher than males (42.86% and 18.88%). Though it cannot be said that gender is statistically significant in influencing ICU LOS, the percentage shows that there is more female patient in prolonged ICU care than male patient. In theory, gender is shown to influence CABG patients' ICU LOS but. Female patients are shown to have longer ICU LOS. This is due to the physiological protection of the estrogen hormone; females at a younger age are protected from CAD, so women often experience the symptom of CAD in older age, often with more comorbidities due to deteriorating physical and physiological status. This result may have been because other perioperative factors influencing the outcome of CABG in the ICU are not included in this study. Factors such as comorbidities, intraoperative intervention, and postoperative documented complications can contribute to patient recovery in general, thus may affecting ICU LOS.[9–11]

Patient with low preoperative LVEF is at higher risk of intraoperative and postoperative mortality. Low preoperative LVEF could lead to postoperative low cardiac output syndrome (LCOS). Patients with LCOS will require hemodynamic support such as inotropes or an intra-aortic balloon pump (IABP). Surgical intervention such as CABG may contribute to better myocardial preservation and recovery due to revascularization on the myocard than pharmacological therapy alone. Preoperative LVEF is also shown not to influence prolonged ICU LOS (p-value=1.000). A similar result is shown in the previous study; there is no significant difference in patients with isolated CABG with low preoperative LVEF and those who are not. Successful revascularization of the blood vessel and myocardium can elevate cardiac function significantly, leading to a successful recovery and higher survival rate. This condition may be different in a patient with valvular involvement where a patients is myocard function is worse and recovery may take longer, resulting in delayed ICU discharge.[12]

This study concludes that among all of the preoperative factors in this study, age is the only factor that influences and elevates the risk of prolonged ICU LOS after CABG. The limitation of this study is that many factors could influence the result of the CABG procedure in the perioperative period. However, these factors are not all included in this study. Another limitation of this study is the exclusion of deceased subjects during ICU care. The subject with these preoperative factors and prolonged ICU care is not included.

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