




Systolic Blood Pressure, Blood Glucose, and Mortality of Patients with Acute Coronary Syndrome

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Abstract

BACKGROUND: Acute coronary syndrome (ACS) is a cardiovascular disease causing a high number of patient mortality in the world as well as Indonesia. Systolic blood pressure (SBP) and blood glucose (BG) are suspected to be important indicators for determining the risk stratification and prognostic information of ACS.

AIM: This study aims to evaluate blood pressure and BG alongside the mortality of patients with ACS.

METHODS: This was a quantitative study conducted using a retrospective survey method and the secondary data used were obtained from the medical records in Dr. Iskak Hospital between January and December 2020. The study sample consists of 110 respondents selected with a proportionate stratified random sampling. Meanwhile, the independent variables were SBP (X_1) and BG (X_2) while the dependent variable was mortality in ACS patients (Y).

RESULTS: The multivariate analyses results with logistic regression show that SBP is associated with mortality with $p = 0.008$ and an odds ratio of 0.673. Furthermore, the BG was slightly higher in the multivariate model which has an odds ratio of 3.052 and was associated with mortality having $p = 0.000$.

CONCLUSION: Based on the result, a low SBP and high BG lead to ACS patient mortality, consequently, serious attention is needed on the SBP and blood sugar.

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Introduction

Cardiovascular disease cases are increasing daily and this is supported by the results of RISKESDAS 2018 which showed that approximately 1.5% of Indonesia's population (1.01729 million) is suffering from heart diseases caused by the change of behavior and lifestyle of the community [1]. Coronary heart disease comes with many complications which are usually life threatening such as the acute coronary syndrome (ACS) [2].

ACS is a non-communicable disease caused by pathological changes or abnormalities in the wall of the coronary arteries which leads to myocardial ischemia, unstable angina pectoris (UAP), and acute myocardial infarction such as non-ST-segment elevation MI (NSTEMI) and ST-segment elevation MI (STEMI) [3]. It is also caused by the sudden interruption of coronary blood flow to the myocardium due to atherosclerosis [4].

ACS is a spectrum from UAP, NSTEMI, and STEMI with 90% of the cases which is caused by the

dissolution of atherosclerotic plaques, leading to platelet aggregation and coronary thrombus formation [3]. The exact cause of ACS is unknown, although it is influenced by many risk factors which are categorized into two groups namely modifiable and not modifiable factors. The unmodifiable factors include age, gender, and family history while the modifiable factors are blood pressure, blood sugar level, cholesterol level, smoking, and obesity [5], [6], [7]. Recently, blood pressure has been recognized as a high-risk factor for ACS alongside high blood glucose (BG) level which aggravates the condition [6], hence, the presence of both conditions increases the risk of ACS [8].

Blood pressure is an important indicator for determining the prognosis of ACS and plays a huge role in the management of cardiovascular diseases [9]. Moreover, it is an element in the GRACE score used to determine patient mortality during hospitalization [8], [10]. Meanwhile, most studies show that low systolic blood pressure (SBP) is associated with mortality [9] while some show a contribution of hypertension to mortality in ACS patients [11]. BG level also predicts mortality in hospitalized patients [12].

Therefore, this study aims to determine the relationship between SBP, BG level, and mortality in ACS patients.

Methods

This is a quantitative study conducted using a retrospective survey method and the population consists of 151 hospitalized patients confirmed with ACS in the intensive care unit (ICU) of Dr. Iskak Hospital. The sampling frame was a collection of research unit data that will be taken and investigated. The sampling frame was prepared by selecting cases of heart disease treated at the hospital, only patients with ACS and with a history of care start from emergency department to ICU. The study sample was 110 patients selected with a proportionate stratified random sampling technique, the instrument used was notes designed by the researcher based on secondary data obtained from medical records of the hospital from January until December 2020.

Table 1: Characteristics of the study subjects

Characteristics	n = 110
Sex categories, n (%)	
Male	73 (66.4)
Female	37 (33.6)
Age, n (%)	
Mature	9 (8.2)
Elderly	68 (61.8)
Old elderly	33 (30.0)
Marital status, n (%)	
Married	83 (75.5)
Not married	9 (8.2)
Widow	12 (10.9)
Widower	6 (5.5)
Educational status, n (%)	
Primary school	66 (60.0)
Junior high school	19 (17.3)
High school	15 (13.6)
Bachelor	10 (9.1)
Job experience, n (%)	
Private company	21 (19.1)
PNS (government employees)	7 (6.4)
Farmer	32 (29.1)
Entrepreneur	13 (11.8)
Non-job	37 (33.6)
Type of ACS, n (%)	
STEMI	73 (66.4)
N-STEMI	32 (29.1)
UAP	5 (4.5)

Source: Secondary data of medical records, 2021.

Subsequently, the independent variables were the SBP and BG level while the dependent variable was mortality. The data analysis was then conducted using descriptive and inferential analysis. The descriptive analysis was carried out with frequency distribution while the inferential used logistic regression analysis to determine the correlation between SBP, BG, and ACS patient mortality. This study was approved after an ethical review by RSUD Dr. Iskak with reference number 070/2417/407,206/2021.

Results

Table 1 shows that most of the respondents were male which was 66.4% of the sample population

Table 2: Characteristics of variable in the study

Variables (n = 110)	Result
Systolic blood pressure (mmHg), mean (SD)	124.48 (SD 32.482)
Optimal (<119 mmHg) (n, %)	46 (40.7)
Normal (120–129 mmHg) (n, %)	10 (8.8)
Normal-high (130–139 mmHg) (n, %)	21 (18.6)
Hypertension Grade 1 (140–159 mmHg) (n, %)	24 (21.2)
Hypertension Grade 2 (160–179 mmHg) (n, %)	4 (3.5)
Hypertension Grade 3 (> = 180 mmHg) (n, %)	8 (7.1)
Blood glucose (mg/dL), mean (SD)	179.99 (SD 77.258)
Ideal (80–144 mg/dl)	44 (38.9)
Adequate (145–180 mg/dl)	27 (23.9)
Poorly (> 180 mg/dl)	42 (37.2)

Source: Secondary data of medical records, 2021.

and this agrees with the previous study which showed that male patients are more prone to the condition [13], [14], [15]. Majority of respondents were above 45 years (91.8%), married (75.5%), primary school (60%), unemployed (33.6%), and experienced STEMI (66.4%).

Table 2 shows that the mean SBP was 124.48 mmHg and most of the values were < 119 mmHg. Meanwhile, the average BG level was 179.99 mg/dl and 37.2% of the patients had a poor glucose level.

Table 3: Characteristics of systolic blood pressure and blood glucose with patient mortality

Variable (n = 110)	Mortality		Total	p-value
	Life	Death		
SBP (mmHg), (n, %)	32 (28.3)	81 (71.7)	113 (100)	0.009*
Optimal (<119 mmHg) (n, %)	7 (15.2)	39 (84.8)	46 (100)	
Normal (120–129 mmHg) (n, %)	4 (40)	6 (60)	10 (100)	
Normal-high (130–139 mmHg) (n, %)	4 (19)	17 (81)	21 (100)	
Hypertension Grade 1 (140–159 mmHg) (n, %)	9 (37.5)	15 (62.5)	24 (100)	
Hypertension Grade 2 (160–179 mmHg) (n, %)	3 (75)	1 (25)	4 (100)	
Hypertension Grade 3 (> = 180 mmHg) (n, %)	5 (62.5)	3 (37.5)	8 (100)	
BG (mg/dL), (n, %)	32 (28.3)	81 (71.7)	113 (100)	0.000*
Ideal (80–144 mg/dl)	22 (50)	22 (50)	44 (100)	
Adequate (145–180 mg/dl)	6 (22.2)	21 (77.8)	27 (100)	
Poorly (> 180 mg/dl)	4 (9.5)	38 (90.5)	42 (100)	

*Chi-square test.

Table 3 shows the results of the Chi-square test carried out between SBP and patient mortality, and $p = 0.009$ (<0.05) was obtained, this indicates that there is a relationship between SBP and patient mortality, hence, patients with blood pressure less than 119 mmHg (84.8%) died. Furthermore, the results of the Chi-square test carried out between GB levels and patient mortality shows $p = 0.000$ (<0.05), this indicates that there is a relationship between BG levels and patient mortality. Moreover, 90.5% of patients with poor glucose levels >180 mg/dl died.

Table 4 shows that the SBP has an effect on mortality in ACS patients with $p = 0.008$ and adjusted odds ratio of 0.673. However, the BG was slightly higher in the multivariate model which also has an effect on the mortality with $p = 0.000$ and odds ratio of 3.052.

Table 4: Effect of systolic blood pressure and blood glucose on mortality in acute coronary syndrome patients

Variable (n = 110)	B	p-value	Odds ratio
Constant	1.450	0.951	1.043
SBP	-0.395	0.008	0.673
BG	1.116	0.000	3.052

p-value and odds ratio, logistic regression.

Discussion

SBP is an important part of primary prevention in ACS patients and is also an element in cardiovascular management in hospitals, low values are associated with poor prognosis of the patients [9]. Furthermore, there is a negative correlation between SBP and mortality in ACS patients [16] because low SBP leads to mortality. Therefore, it is an important predictor for the prognosis of ACS patients [17].

A decrease in blood pressure indicates an imbalance between cardiac output and total peripheral retention caused by myocardial infarction which decreases the ventricular function due to loss of contractile power by the necrotic muscles and impaired contractility of ischemic muscles around it. Furthermore, a decrease in blood pressure is an indicator of cardiogenic shock. The next phase is due to these compensatory mechanisms which lead to heart failure and weakening of contractions that lowers the blood pressure, consequently, only the systolic pressure is observed. Usually, the heart rhythm becomes irregular and eventually causes cardiogenic shock which leads to death [16].

Many studies assessing hypertension as the prognosis of ACS have inconsistent results [11], this agrees with this study which shows that most of the hypertensive patients survived while some died, hence, this indicates inconsistency. Furthermore, the result shows that hypertension is not suitable as a predictor of mortality in ACS patients while others with a low SBP all passed away and this indicates that it is a strong predictor.

The previous studies reported that high glucose levels are closely related to mortality in ACS patients [2], [12], [18] and as such an increase in glucose level in the first 24 h of hospitalization is assumed to be a predictor of death within 30–180 days [12]. It is also described as an acute response to a hyperadrenergic state with an increased risk of thrombosis which worsens the condition of ACS patients and finally leads to death [19]. Meanwhile, hyperglycemia is a condition characterized by increased BG due to increased gluconeogenesis, glycogenolysis, and hormone stress (adrenaline, cortisol, etc.) [20].

Hyperglycemia worsens the state of the myocardium and the prognosis of ACS patients due to induction of oxidative stress caused by free radicals which eventually leads to heart cells injury. It also increases cardiac contractility and reduces end-diastolic volume alongside the stroke volume to reduce oxygenation [2], [18].

Limitations of study

This study used a cross-sectional retrospective approach that collected data from medical records but

no confirmation was carried out to ascertain that the data in the record were SBP and BG. Furthermore, the care given to patients was uncontrollable and not all the risk factors were recorded.

Conclusion

This study shows that a low SBP and high BG are associated with ACS patient mortality.

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