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RELATIONSHIP OF BLOOD SUGAR LEVELS WITH MORTALITY IN ACS PATIENT IN RSUD Dr. H. CHASAN BOESOIRIE

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ABSTRAK

Abstract:
Acute coronary syndrome is a disease process with a collection of symptoms caused by acute myocardial ischemia due to the presence of atherosclerotic plaques. It has become a health problem with the highest mortality rate in the world and high blood glucose levels are associated with poor clinical outcomes and increased risk of death in hospitalised patients. To determine the relationship between blood sugar levels and mortality in patients with acute coronary syndrome in RSUD Dr. H. Chasan Boesoirie in 2018-2023. This type of research is quantitative cross sectional analytical observational with a retrospective approach and using Spearman's rho test. The sample totalled to 131 samples taken using medical record data with simple random sampling technique. Based on bivariate analysis, p-value = 0.003 ($p<0.05$) with a correlation coefficient of 0.261 which means there is a relationship between increased blood sugar levels with mortality with a weak positive correlation. There is a relationship between blood sugar levels and mortality, namely the higher the blood sugar level, the higher the mortality.

***Abstrak*:**
Sindrom koroner akut adalah proses penyakit dengan kumpulan gejala yang disebabkan oleh iskemia miokardium akut karena adanya plak aterosklerotik. SKA menjadi masalah kesehatan dengan angka kematian tertinggi di dunia dan kadar glukosa darah yang tinggi berhubungan dengan luaran klinis yang buruk dan peningkatan risiko kematian pada pasien yang dirawat dirumah sakit. Tujuan penelitian ini untuk mengetahui hubungan kadar gula darah dengan mortalitas pada pasien sindrom koroner akut di RSUD Dr. H. Chasan Boesoirie pada tahun 2018-2023. Jenis penelitian ini adalah kuantitatif secara observasional analitik cross sectional dengan pendekatan retrospektif dan menggunakan uji Spearman's rho. Sampel berjumlah 131 sampel yang diambil menggunakan data rekam medik dengan teknik simple random sampling. Berdasarkan analisis bivariat diperoleh p-value = 0,003 ($p<0,05$) dengan koefisien korelasi 0,261 yang berarti terdapat hubungan peningkatan kadar gula darah dengan mortalitas dengan korelasi positif lemah. Kesimpulan pada penelitian ini yaitu terdapat hubungan antara kadar gula darah dan mortalitas yaitu semakin tinggi kadar gula darah maka semakin tinggi mortalitas.

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INTRODUCTION

Cardiovascular disease is a non-communicable disease that continues to be the leading cause of death in the world. Based on 2019 data, deaths in the world by cardiovascular disease are estimated at 17.9 million lives each year (32% of global deaths, which means the world's biggest killer) and of the 17 million premature deaths (under the age of 70) from non-communicable diseases, 38% are caused by this disease, of which more than three-quarters of deaths occur in low- and middle-income countries[1].

According to the Ministry of Health, the prevalence of heart disease in Indonesia including acute coronary syndrome, is based on doctor's diagnosis, which is 1.5% or weighted 1,071,290 and for North Maluku 1.1% or weighted 4,723 in 2018[2]. Cardiovascular disease in 2019 had a mortality rate of 651,481 residents annually and coronary heart disease reached 245,343 residents (The second highest mortality in Indonesia) for North Maluku ischaemic heart disease is the second-highest cause of death after stroke[3].

Acute coronary syndrome (ACS) is one of the manifestations of CHD which is a major health problem in the world and high blood glucose levels are associated with poor clinical outcomes and increased risk of mortality in hospitalised patients. Patients with hyperglycaemia or diabetes have larger myocardial infarct size and greater microvascular obstruction, prothrombotic state, or endothelial dysfunction resulting in impaired blood nutrition to the ischaemic wall[4].

High blood sugar levels or hyperglycaemia on admission is also associated with acute hyperglycaemia which is a depiction of the acute response of a hyperadrenergic state that can increase the risk of developing heart failure disease and death[5].

There is a close relationship between acute hyperglycaemia and mortality in patients with critical illnesses such as acute coronary syndrome. The results of a study conducted by Jamaluddin in 2015 found that mortality rates were higher in hyperglycaemia ACS patients compared with normoglycaemia ACS patients and hyperglycemia ACS patients had a 3.7 times higher risk of death than normoglycaemia ACS patients. However, there are obstacles in previous studies, namely the limited number of samples and variables so this is the way researchers continue this research[6].

RESEARCH METHOD

This type of research is a quantitative study using an analytical observational research design with a cross-sectional approach. The target population in this study were acute coronary syndrome patients admitted to the CVCU of RSUD Dr H. Chasan Boesoirie Ternate from July 2018 - July 2023.

The data collection process used secondary data in the form of medical records of acute coronary syndrome patients. Samples in this study were taken using a simple random sampling technique that met the inclusion criteria, namely acute coronary syndrome patients with or without a history of DM who were admitted to the CVCU of RSUD Dr. H. Chasan Boesoirie in 2018-2023 and had complete medical record data, especially blood sugar levels when the patient first entered the hospital and exclusion criteria, namely unreadable medical record data.

Data were analysed using univariate analysis techniques to explain the characteristics of the variables studied and bivariate analysis techniques using Spearman's rho correlation test to analyse the relationship between independent variables and dependent variables.

RESULT AND DISCUSSION

Based on the results of research conducted in August-September 2023 regarding the relationship between blood sugar levels and mortality in patients with

acute coronary syndrome at RSUD Dr. H. Chasan Boesoirie in 2018-2023, the number of samples that met the inclusion and exclusion criteria was 131 out of 195 patients. The sample is SKA patients who do blood sugar examinations when they first enter the hospital. The results of the study are as follows:

Table 1.
Characteristics of Acute Coronary Syndrome Patients

Variable (year)	(n)	(%)
Age		
26-35	3	2,3
36-45	19	14,5
46-55	42	32,1
56-65	43	32,8
>65	24	18,3
Gender		
Male	110	84
Female	21	16
ACS		
STEMI	79	60,3
NSTEMI	48	36,6
UAP	4	3,1
DM		
Yes	12	9,2
No	119	90,8
Blood Glucose Level		
<70 mg/dL	2	1,5
70-139 mg/dL	80	61,1
140-199 mg/dL	44	33,6
≥200 mg/dL	5	3,8
Reperfusion Measures		
Yes	24	18,3
No	107	81,7
Length of Treatment		
< 7 Day	100	76,3
≥ 7 Day	31	23,7
Creatinine		
Normal (0,6-1,2 mg/dL)	83	63,4
High (≥1,3 mg/dL)	48	36,6
Complications		
Arrhythmia	17	13
Heart failure	49	37,4
Cardiac arrest	3	2,3
Other complications	43	32,8
No complications	19	14,5
Total	131	100

Table 1 shows the distribution of characteristics of patients with acute cornary syndrome in 2018-2023 at RSUD Dr.H. Chasan Boesorie with a total sample of 131 people. The distribution of SKA patients based on the highest age is 56-65 years old as many as 43 patients (32.8%) followed by 45-55 years old as many as 42 patients (32.1%), age> 65 years. Male gender numbered 110 patients (84%) more than women who numbered 21 patients (16%). The classification of SCA showed that the largest group was STEMI with 79 patients (60.3%). There were 12 patients with DM (9.2%) compared to 119 patients without DM (90.8%). Patients with GDS levels with the most groups are GDS levels 70-139 mg/dL as many as 80 patients (61.1%) and the least is the <70 mg/dL group of 2 patients (1.5%). Creatinine levels in the normal group (0.6-1.2 mg/dL) were 83 patients (63.4%), the highest among the high (≥1.3 mg/dL) and low (≤0.5 mg/dL) groups. There were 24 patients (18.3%) who underwent reperfusion compared to 107 patients (81.7%) who did not. Length of stay <7 days was 100 patients (76.3%) higher than ≥7 days which was 31 patients (23.7%). The number of living SCA patients was 115 patients (87.8%), higher than the number of deceased patients (16 patients (12.2%). The most common complication of SCA was heart failure with 49 patients (37.4%).

Table 2.
Mortality Rate of ACS Patients at RSUD Dr H. Chasan Boesoirie

Blood Glucose	Mortality		(n)
	Live	Died	
< 70 mg/dL	1	1	2
70-139 mg/dL	76	4	80
140-199 mg/dL	37	7	44
≥ 200 mg/dL	1	4	5
Total	115	16	131

Based on the data in Table 2 above, it is known that the mortality rate of the group of patients with GDS levels <70 mg/dL who live and die is the same,

namely 1 patient. Patients with GDS levels of 70-139 mg/dL who lived were 76 patients higher than those who died, namely 4 patients. Patients with GDS levels 140-199 mg/dL who lived were 37 patients higher than those who died, namely 7 patients. Patients with GDS levels ≥ 200 mg/dL who lived were 1 patient lower than those who died, namely 4 patients.

Table 3.
Mean Blood Sugar Levels and Mortality in ACS Patients

Mortality	(n)	Average (mg/dL)
Live	115	126,3
Died	16	180
Total	**131**	**132,9**

Based on the data in table 3 above, it is known that the average blood sugar in the group that died was 180 mg/dL higher than the living group which was 126.3 mg/dL and the average total blood sugar was 132.9 mg/dL.

Table 4.
Analysis of Blood Sugar Levels by Mortality in ACS Patients

Blood Glucose (mg/dL)	Mortality			*P-value*	correlation
	Live	Died	(n)		
< 70	1	1	2		
70-139	76	4	80	0,003	0,261
140-199	37	7	44		
≥ 200	1	4	5		
Total	**115**	**16**	**131**		

Based on the data in table 4 above, it is known that the results of the Spearman's rho test show a p-value of 0,003 (p <0,05) which means that Ha is accepted and H0 is rejected with a correlation coefficient of 0.261 which means that there is a relationship between increased blood sugar levels and mortality in patients with acute coronary syndrome with a weak positive correlation.

Characteristics of ACS Patients

Based on the results of the study, the distribution of ACS patients based on age was highest, namely 56-65 years as many as 43 patients (32.8%) and the least age group was 26-35 years as many as 3 patients (2.3%). The results obtained are in line with research conducted at Raden Mattaher Jambi Hospital on 70 samples of ACS patients with the highest age group of 36-65 years as much as 77.1% [7]. Research conducted at RSUD dr. Zainoel Abidin Banda Aceh on 274 patient samples with the age group with the highest prevalence of ACS [8], namely >45 years as much as 86%. These results are in accordance with the theory that is caused by changes in the structure of blood vessels such as narrowing of the lumen, the walls of blood vessels becomeing stiff and their elasticity decreasesing, causing plaque to accumulate in the arteries as they age in both men and women, increasing the risk of developing ACS [9].

Based on the results of the study, the distribution of ACS patients based on gender, namely men, totalling 110 patients (84%), was more than women, totalling 21 patients (16%). The results obtained are in line with research conducted at the CVCU of Dr. M. Djamil Padang Hospital on 70 samples of ACS patients with a male gender group of 71,43% [10]. Another study conducted at RSUD dr. Zainoel Abidin Banda Aceh on 40 samples of ACS patients was dominated by the male gender group as much as 87.5% [11]. These results are following theory because men are one of the risk factors for ACS and the hormone estrogen has a protective effect on the occurrence of atherosclerosis before menopausal women by protecting blood vessels from damage but the incidence in women will increase after menopause. This is based on changes in body fat distribution, endothelial dysfunction, vascular inflammation, sympathetic tone, and insulin resistance [12].

Based on the results of the study, the distribution of ACS patients based on their type was dominated by STEMI as many as 79 patients (60.3%). The results obtained are in line with research at Sanglah Denpasar Hospital on 109 samples of ACS patients who were dominated by the type of STEMI as many as 66 patients (60.6%) [13]. Another study conducted at Raden Mattaher Jambi Hospital on 70 samples of ACS patients was also dominated by the STEMI type as many as 28 patients (40%) [7].

In contrast to the results of research conducted at RSI Jemursari Surabaya on 68 samples of ACS patients who were dominated by the NSTEMI type as many as 28 patients (41%) [14]. In addition, research was conducted at Peradeniya Sri Lanka Teaching Hospital by Ralapanawa on 300 sample patients with ACS who were dominated by UAP as many as 113 patients (37.7%) [15]. The difference in research results obtained can be caused by the small number of samples in this study so that there are differences in the results of the types of ACS with previous studies. In addition, factors such as distant health facilities, racial differences, lifestyle, and risk factors are owned by the patients themselves [15].

Based on the results of the study, the distribution of ACS patients was dominated by ACS patients who did not have a history of DM as many as 119 patients (90.8%). The results obtained are in line with research at Ulin Banjarmasin Hospital on 51 samples of ACS patients who predominantly did not have a history of DM as many as 35 patients (68.63%) [16]. Another study conducted at Dr M. Djamil Padang Hospital on 60 samples of ACS patients found more patients who did not have a history of DM as many as 40 patients (66.7%) [17]. In contrast to the results of research conducted at RSUD Dr Soetomo Surabaya on 230 samples of ACS patients, 124 patients (54%) were dominated by patients who had a history of DM. Diabetes mellitus is one of the risk factors for ACS, people with diabetes mellitus tend to have an earlier process of degeneration and endothelial dysfunction [18]. According to the Framingham, Multiple Risk Factor Intervention Trial and Minister Heart Study (PROCAM) research, it is known that a person's risk factor for suffering from CHD is determined through the interaction of two or more risk factors including non- modifiable risk factors such as heredity, age, gender and modifiable risk factors such as dyslipidemia, hypertension, smoking, stress and obesity [19].

Based on the results of the study, the distribution of ACS patients was dominated by ACS patients with a GDS group of 70-139 mg/dL as many as 80 patients (61.1%). The results obtained are in line with research at Sanglah Denpasar Hospital on 109 samples of ACS patients found more with normal GDS levels (<200 mg/dL) in as many as 91 samples (83.5%) [13]. Another study conducted at Dr M. Djamil Padang General Hospital by Oktarina (2014) on 70 samples of ACS patients was dominated by patients with normal GDS levels (<200 mg/dL) as many as 45 patients (60%) [20]. Increased glucose levels in acute myocardial infarction patients are associated with increased fatty acid concentrations, insulin resistance and impaired glucose use by the myocardium resulting in increased oxygen consumption and potential for ischaemia. Hyperglycaemia is also associated with microvascular dysfunction, vascular inflammation and endothelial dysfunction. All of these mechanisms may have the potential for myocardial tissue injury [21].

Based on the results of the study, the distribution of ACS patients was dominated by the normal creatinine group (0.6-1.2 mg/dL) as many as 83 patients (63.4%). The results obtained are in line with research conducted at Hermina Bekasi Hospital on 90 samples of ACS patients where most were normal creatinine levels (<1.2 mg/dL) in as many as 55 patients (61.6%) [22]. Another study conducted in

the ICCU of RSUD dr. M.Yunus Bengkulu on 31 samples of ACS patients was dominated by normal creatinine levels (1.2 mg/dl) in as many as 23 patients (74.19%) [23]. Creatinine is associated with kidney function and is also used to calculate LFG values. An increased creatinine value indicates decreased kidney function. This will increase the risk factors for cardiovascular disease, one of which is ACS with increased levels of homocysteine, oxidative stress, cholesterol particles, and ventricular remodelling [22].

Based on the results of the study, the distribution of ACS patients was dominated by living patients, namely 115 patients (87.8%) higher than those who died as many as 16 patients (12.2%). The results obtained are in line with research conducted at RSUD X Surakarta on 68 samples which were dominated by living ACS patients as many as 64 patients (94%) [24]. Another study conducted at Dr Hasan Sadikin Hospital in Bandung on 198 samples was also dominated by living ACS patients as many as 168 patients (84%) [25]. Mortality in patients with ACS is influenced by risk factors both modifiable and non-modifiable risk factors, complications that arise, and the choice of use of therapy given to patients which can also affect patient mortality.

Based on the results of the study, the distribution of ACS patients based on their complications was dominated by heart failure in as many as 49 patients (37.4%). The results obtained are in line with research at Raden Mattaher Jambi Hospital on 30 samples of ACS patients who were dominated by heart failure as many as 20 patients (66.7%) [7]. Another study conducted by Prof. Dr. R. D. Kondou Manado Hospital on 38 patients was also dominated by heart failure complications in as many as 20 patients (52.6%) [26]. ACS occurs due to the accumulation of atherosclerotic plaque in arterial blood vessels so that blood flow to the heart becomes obstructed which can cause myocardial dysfunction, inflammation, metabolic changes, and endothelial dysfunction. This can increase the risk of left ventricular systolic dysfunction or heart failure [27].

Based on the results of the study, the distribution of patients with ACS was dominated by patients who did not take reperfusion measures, namely 107 patients (81.7%). The results obtained are in line with research at Tarakan Jakarta Hospital on 30 samples of ACS patients found not to take reperfusion measures as many as 19 (63%) [28]. Another study conducted at Abdul Wahab Sjahranie Samarinda Hospital on 86 samples was also dominated by ACS patients who did not take reperfusion measures as many as 73 patients (84.5%) [29]. Timely reperfusion of infarct-related coronary arteries in STEMI and NSTEMI either by fibrinolysis or percutaneous coronary intervention (PCI) minimises myocardial damage, reduces infarct size and reduces morbidity and mortality, but the obstacle is that there are patients who still refuse to take action and there are contra-indications for reperfusion [30].

Based on the results of the study, the distribution of ACS patients based on length of treatment was dominated by the < 7-day group as many as 100 patients (76.3%). The results obtained are in line with research at Abdul Wahab Sjahranie Samarinda Hospital on 86 samples found more ACS patients with a length of treatment <7 days as many as 74 patients (86%) [29]. Another study conducted at RSUD Dr Moewardi Surakarta on 68 samples was also dominated by ACS patients with a length of stay of <7 days as many as 52 patients (86%). The length of treatment of patients with ACS is related to the patient's clinical condition, patient prognosis, risk factors, and quality care services [31].

Mortality Rate of Patients with ACS

Based on the results of the study, the mortality rate of the group of patients with GDS levels <70 mg/dL who lived and died

was the same, namely 1 patient. Patients with GDS levels of 70-139 mg/dL who lived were 76 patients more than those who died. Patients with GDS levels 140-199 mg/dL who lived were 37 patients higher than those who died, namely 7 patients. Patients with GDS levels ≥ 200 mg/dL who lived were 1 patient lower than those who died, namely 4 patients. The results obtained are in line with research at H. Adam Malik Medan Hospital on 40 patients with ACS found that elevated blood sugar levels will also increase patient outcomes of dying as many as 37 patients (92.5%) [32]. Another study conducted at RSUD X Surakarta on 68 samples found that ACS patients who had normal blood sugar levels lived as many as 32 (94%) patients than those who died [24].

Analysis of the Relationship between Blood Sugar Levels and Mortality

Based on the results of the study, the mean blood sugar in the group that died was 180 mg/dL higher than the living group which was 126.3 mg/dL and the mean total blood sugar was 132.9 mg/dL. The results obtained are in line with research conducted in Brazil on 362 patient samples found that the average GDS level at hospital admission for ACS patients who lived was 123.1 mg/dL and died was 177.6 mg/dl with an average total GDS level of 128.3 mg/dL[33]. Another study conducted at the Texas Health Academic Centre on 566 samples found that ACS patients who died had an average GDS level at hospital admission of 221.2 mg/dL and those who lived had an average GDS level of 153.6 mg/dL [34].

Based on the results of the study which can be seen in Table 4 regarding the relationship between blood sugar levels and mortality using Spearman's rho correlation test, the p-value is 0.003 ($p<0.05$) with a correlation coefficient of 0.261 so it can be concluded that there is a relationship between increasing blood sugar levels with mortality in patients with acute coronary syndrome with a weak positive correlation. The results obtained are in line with research on 3078 patient samples which mentioned an increase in mortality along with an increase in blood glucose [35]. Patients with glucose levels >200 mg/dL were shown to have a significant association with increased mortality in ACS. Supported by research that elevated blood sugar levels affect mortality in patients with ACS [6]. This can occur because increased sugar levels in patients with ACS cause various disorders in the body such as metabolic disorders (increased serum free fatty acids, decreased insulin secretion, decreased glycolysis), impaired perfusion, associated with prothrombotic conditions such as increased platelet aggregation and coagulation, decreased fibrinolysis. In addition, there is an increase in inflammatory cytokines, chemokines, and an increase in biomarkers of inflammatory markers, then impaired left ventricular function such as decreased ischaemic preconditioning and LV remodelling that will worsen the prognosis of patients with ACS [36]

CONCLUSION

Characteristics of ACS patients based on demographics were mostly in the age group of 56-65 years, male gender, STEMI type of ACS, no history of DM, GDS levels 70-139 mg/dl, normal creatinine levels (0.6-1.2 mg/dl), no reperfusion measures, length of treatment <7 days, living patients, and heart failure complications. The mortality rate of patients with GDS levels < 70 mg/dL who lived and died was 1 patient. Patients with GDS levels of 70-139 mg/dL lived 76 patients and died 4 patients. Patients with GDS levels of 140-199 mg/dL lived 37 patients and died 7 patients. Patients with GDS levels ≥ 200 mg/dL who lived 1 patient and died were 4 patients. There is a relationship between blood sugar levels and mortality, namely the higher the blood sugar level, the higher the mortality.

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