Left Ventricle Ejection Fraction as a Predictor of Cardiogenic Shock in Patients with ST Elevation Myocardial Infarct at Dr. Sardjito General Hospital Yogyakarta

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Abstract. Cardiogenic shock is a complication that often occurs in patients with STEMI. The prevalence of cardiogenic shock in STEMI patients treated in cardiovascular intensive care is 14-16% with a mortality rate of between 30-60%. Left ventricular ejection fraction is one of the predictor factors for the incidence of cardiogenic shock in STEMI patients. This study aims to determine whether left ventricular ejection fraction is a predictor of cardiogenic shock in STEMI patients treated at the ICCU at Dr. Sardjito General Hospital Yogyakarta. This study is an observational study with a prospective cohort approach to determine whether left ventricular ejection fraction is a predictor of the incidence of cardiogenic shock in STEMI patients treated at the ICCU at RSUP Dr. Sardjito Yogyakarta. There were 403 subjects who met the inclusion criteria as research subjects from 501 subjects with STEMI who were treated at the ICCU of RSUP Dr. Sardjito Yogyakarta during the period May – December 2023. Based on the ROC test, the cut point value for LVEF was 44.5% with an AUC value of 66.8%, p-value 0.001. A chi square test was carried out to determine the relationship between LVEF and cardiogenic shock and obtained a p-value of 0.001 to 2.889 (CI 95% 1.569-5.356). Left ventricular ejection fraction can be used as a predictor of the incidence of cardiogenic shock in STEMI patients treated at the ICCU at Dr. RSUP. Sardjito Yogyakarta.

Keywords: Left ventricular ejection fraction, cardiogenic shock, ST Elevation Myocardial Infarct

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INTRODUCTION

Cardiogenic shock is a life-threatening condition caused by a decrease in cardiac output resulting in hypoxia, tissue hypoperfusion and multi-organ failure[1]. The mortality rate for cardiogenic shock is quite high, ranging from 30-50% of patients treated in intensive care[2]. Acute myocardial infarction is the main cause of cardiogenic shock and is the main cause of death during treatment in the cardiovascular intensive care unit[3,4]. Patients with acute ST-segment elevation myocardial infarction have a significantly higher mortality rate from cardiogenic shock compared with acute non-ST-segment elevation myocardial infarction[5]. Cardiogenic shock occurs in 74% of subjects diagnosed with STEMI within the first 24 hours[6]. Cardiogenic shock is the main cause of death in patients treated at Dr. Sardjito Hospital, however there has been no research that predicts the incidence of cardiogenic shock in patients with STEMI during treatment. Left ventricular ejection fraction is one of the predictor factors for the incidence of cardiogenic shock in STEMI patients.

METHOD

Study design and Subject

This study is an observational study with a prospective cohort approach to determine Left ventricular ejection fraction is one of the predictor factors for the incidence of cardiogenic shock in STEMI patients. This research was carried out in May – December 2023 in the Intensive Cardiovascular Care Unit (ICCU) Dr. Sardjito Hospital, Yogyakarta. The subjects in this study were STEMI patients treated at the ICCU at Dr. Sardjito Hospital from May to December 2023 who met the inclusion and exclusion criteria. The inclusion criteria were [1] patients with a diagnosis of STEMI who were treated at the ICCU at Dr. Sardjito Hospital, [2] the patient's age was more than 18 years and [3] willing to take part in the research. The exclusion criteria are [1] patients with cardiogenic shock (with criteria according to SCAI B, C, D and E) at the time of admission to the emergency room at RSUP Dr. Sardjito Yogyakarta, [2] patients who died before arriving at the ICCU (died during the journey to the catheterization laboratory to undergo the PCI procedure or died during the PCI procedure), [3] patients

who died before the first 24 hours of observation in the ICCU with a cause of death that was not due to cardiogenic shock, [4] patients with a history of congenital heart defects, [5] patients with primary heart valve abnormalities, [6] patients with normocoronary images after coronary angiography and [7] patients with a diagnosis of malignancy.

Data collection

Patients who were diagnosed with STEMI at Dr. Sardjito Hospital were analyzed for factors that were predictors of cardiogenic shock when the patient first entered the hospital's emergency room. Demographic, clinical, laboratory data, echocardiography and coronary angiography data were analyzed to determine whether they were predictors of the incidence of cardiogenic shock in subjects treated at the ICCU at Dr. Sardjito. Cardiogenic shock was assessed based on SCAI criteria, physical and laboratory examinations. Echocardiography assest the hemodynamics profile while the subject was being treated in intensive care which was carried out in the first 24 hours upon admission to the ICCU. Data collection in this research was from primary data.

Statistics analysis

Basic characteristic data in the form of demographic, clinical and laboratory profiles are presented in the form of mean±standard deviation or median (min-max) for numerical data while categorical data is presented in the form of numbers and percentages. Testing the hypothesis of factors that are predictors of cardiogenic shock on numerical data using the unpaired T test if the data distribution is normal, if the data distribution is not normal then the mean-Whitney as alternative test. Categorical data is analyzed using Chi-square analysis, if it does not meet the requirements then we use the Fisher exact test. The relationship between variables is analyzed using logistic regression to find out the relationship. The p-value <0.25 was entered into the multivariate model and then logistic regression analysis used the backward stepwise method where all variables.

RESULTS

Subject recruitment

The total population of this study was 501 who were diagnosed with STEMI for May to December 2023 period. Subjects who met the inclusion criteria but were excluded due to SCAI B, C, D and E cardiogenic shock were 86 subjects during hospital emergency room admission, 9 subjects were normocoronary after Coronary angiography was performed and 3 subjects died before entering the ICCU.

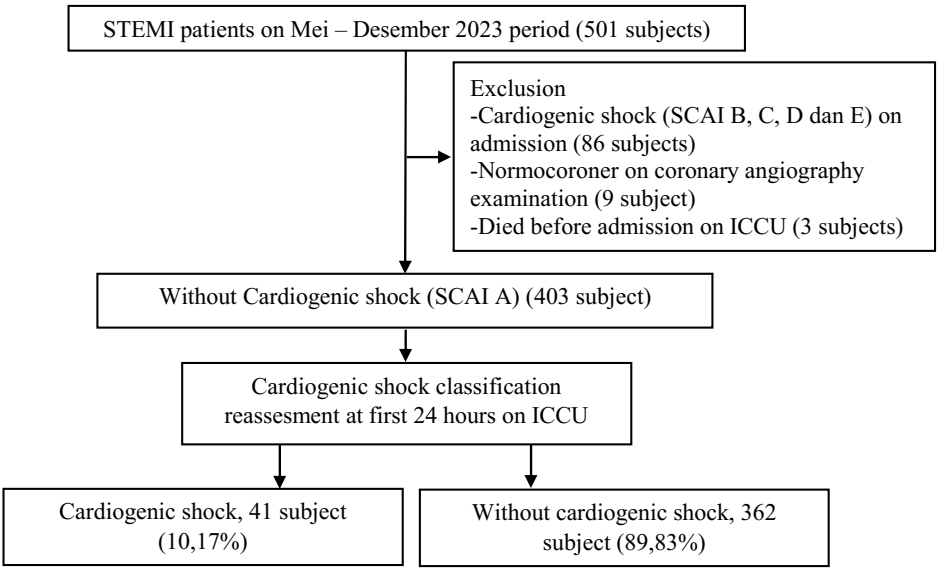


Fig 1. Flowchart of subject recruitment

Based on **Fig** 2, cardiogenic shock based on SCAI criteria was found in subjects with cardiogenic SCAI A 362 subjects (89.83%) and subjects with cardiogenic shock SCAI B 12 subjects (2.98%), SCAI C 29 subjects (7.19%) and SCAI D and E 0 subjects.

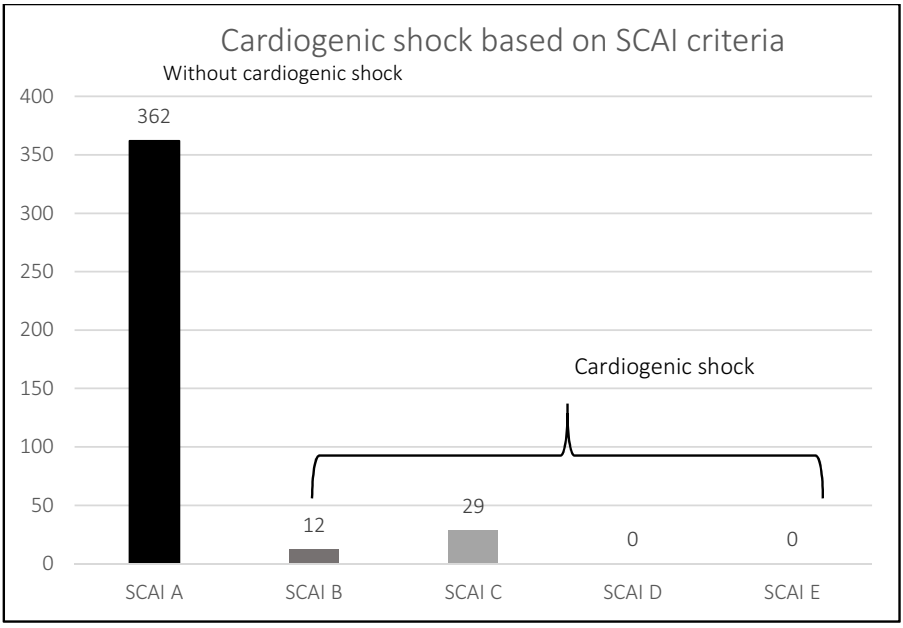


Fig 2. Cardiogenic shock based on SCAI criteria

Basic characteristics of subjects (Univariate analysis)

Demographic characteristics in this study included age and gender as well as atherosclerosis risk factors including DM, hypertension, dyslipidemia and history of CHD and smoking history. Patient clinical characteristics included onset of chest pain, Killip classification, TIMI risk and GRACE score. Laboratory characteristics include hemoglobine, leukocytes, platelets, BUN, creatinine, glomerular filtration rate, blood glocuse and HbA1C. Hemodynamic characteristics were cardiac outcome, cardiac index, systemic vascular resistance, LVEF and TAPSE. The location of STEMI is divided into anterior, anteroseptal, anterior extensive, anterolateral, lateral, inferior, inferolateral, infero-dextra, infero-dextra-posterior, inferoposterior and isolated

posterior which are then categorized into 2 groups as anterior and non-anterior. Characteristics of reperfusion procedures during hospital admission include primary PCI and fibrinolysis with the location of coronary culprit lesions including LAD, LCx and RCA with the number of coronary lesions of single vessel disease or multivessel disease.

Table 1. Basic characteristic of subjects

Basic characteristic	Total : 403 subject	
	N (%)	Mean+SD/Median(min-max)
Demography		
Age		59,8±11,14
Male	322 (79,9)	
Female	81 (20,1)	
Risk factor of atherosclerosis		
Diabetes Mellitus	112 (27,79)	
Hypertension	216 (53,6)	
Dyslipidemia	94 (23,32)	
Smoker	227 (56,33)	
Clinical feature		
Chest pain onset (hour)		17 (1-60)
Killip		
I	328 (81,39)	
II-III	75 (18,61)	
Ventricular arrhytmia		53 (13,15%)
TIMI Risk score		5 (1-13)
GRACE score		124,38±31,53
Laboratory		
Hemoglobin (g/dl)		13,43±2,13
Leucocyte (10^3/µL)		13,97±5
Thrombocyte (10^3/µL)		273,94±87,9
BUN (mg/dL)		16 (5-113)
Creatinine (mg/dL)		1,09 (0,46-7,39)
GFR (mL/menit/1,73m^2)		50,5±21,45
RBG (mg/dL)		137 (61-749)
HbA1C (%)		6 (4,6-15,1)
hs-Troponine T (ng/dL)		1.076 (9,25-35.405)
Hemodynamic echocardiography		
Cardiac output (L/menit)		1,5 (1,7-7,3)
Cardic index (L/menit/kgbb/m^2)		2,1 (0,98-4,5)
SVR (dyne/detik/cm^{-5})		1871(606-4653)
LVEF (%)		49 (20-75)
TAPSE (mm)		18 (10-28)
STEMI location		

Anterior	88 (21,84)
Anteroseptal	35 (8,68)
Anterior extensive	63 (15,63)
Anterolateral	5 (1,24)
High lateral	7 (1,74)
Inferior	86 (21,34)
Inferior lateral	2 (0,49)
Inferior dextra	33 (8,19)
Inferior dextra posterior	26 (6,45)
Infero posterior	43 (10,67)
Isolated posterior	5 (1,24)
Reperfusion on admission	
Yes	
PCI Primer	244 (60,55)
Full dose fibrinolysis	115 (28,54)
Half dose fibrinolysis	12 (2,98)
None	
Conservative	16 (3,97)
Back to baseline	9 (2,23)
No pain	7 (1,74)
Culprit lession	
LAD	176 (49,03)
LCx	27 (7,52)
RCA	151 (42,06)
MINOCA	5 (1,39)
Amount of culprit	
Non-MVD	153 (42,63)
MVD	206 (57,37)
Therapy	
ACE-I/ARB	214 (53,10)
Betablocker	192 (47,64)

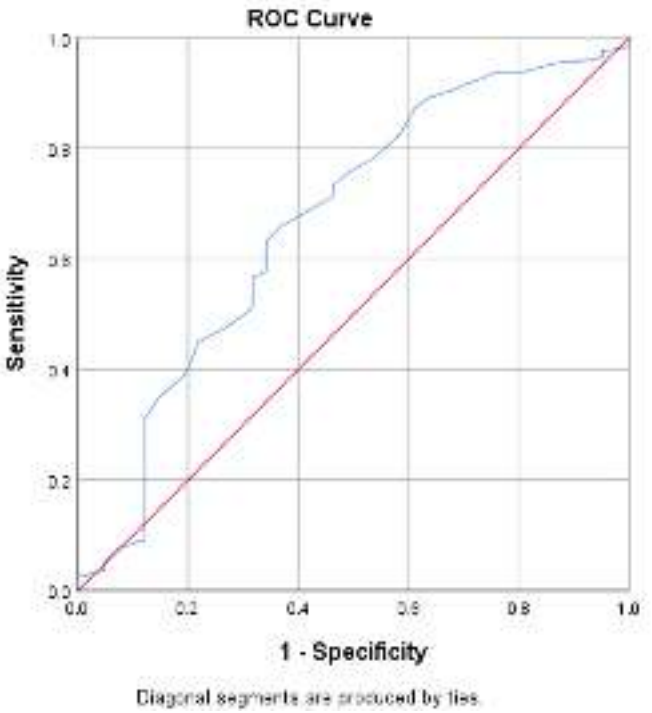
Note: SD: standard deviation, CAD: Coronary heart disease, GRACE: Global Registry of Acure Coronary Events, LVEF: Left ventricle ejection fraction, RBG: Random blood glocose, hs-Troponin T: high sensitive troponin T, SVR: Systemic vascular resistance, TAPSE: Tricuspid annular plane systolic excursion, STEMI: ST elevation myocard infact, PCI: Percutaneous coronary inflamation,GFR: Glomerular filtration rate, MVD: multivessel disease, ACE-I: Angiotensin converting enzyme-inhibitor, ARB: Angiotensin receptor blocker

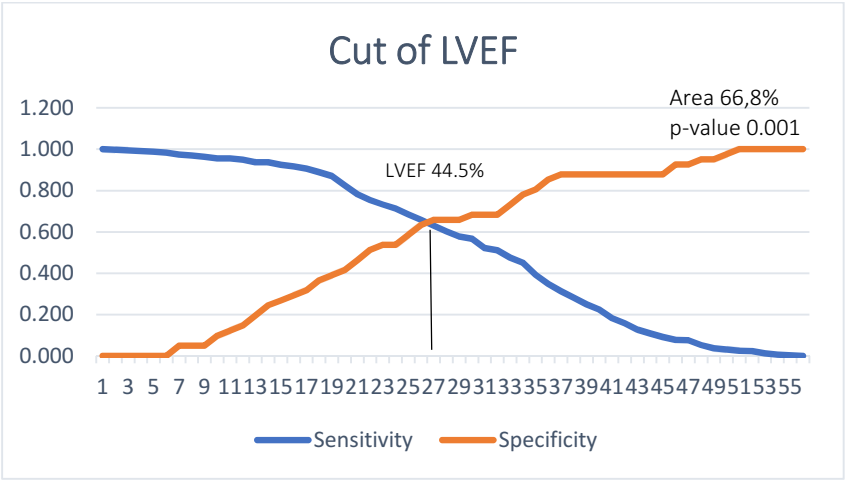
In this study, 403 subjects were observed during the research period. The average age of the subjects was 59 years with the most male subjects in this study being 79.9%

compared to women. The highest risk factors for atherosclerosis in subjects were smoking history 56.33%; followed by hypertension 53.6%; DM 27.79%; dyslipidemia 23.32% and family history of CHD 14.14%. The onset of chest pain was found to be a median of 17 hours. The clinical presentation of Killip I was 81.39% and Killip II-III was 18.61%. The TIMI risk score obtained a median value of 5 and the average GRACE score was 124. Ventricular arrhythmias during observation were found in 53 subjects (13.15%). The average hemoglobin level in this study was 13.43 g/dl. The average leukocyte level in this study was 13.97 x103/µL. Average platelet levels were 273.94+87.9x103/µL. The median BUN value was 16 mg/dL and creatinine was 1.09 mg/dL. Decreased kidney function was assessed by calculating the glomerular filtration rate (GFR), which showed an average of 50.5 mL/minute/1.73m2. Blood glucose at time was found to be 137 mg/dL with a median HbA1C value of 6% and plasma troponin T level of 1,076 ng/dL. Based on hemodynamic parameters, in this study the median cardiac output value was 1.5 L/minute with a cardiac index of 2.1 L/minute/kgbb/m2. Peripheral vascular resistance 1871 dyne/second/cm-5. Left ventricular function based on the LVEF value obtained a median LVEF value of 49% and right ventricular function based on the TAPSE value with a median value of 18mm.

The location of STEMI based on the ECG image showed that anterior STEMI was the most common location at 21.84%. In this study, there were 371 subjects who underwent reperfusion (92.07%) and 32 subjects who did not reperfuse (7.94%). Reperfusion performed with primary PCI was 60.55%; full dose fibrinolysis 28.54% and partial dose fibrinolysis 2.98%. 3.97% of subjects who did not undergo reperfusion underwent conservative management; Reperfusion was not carried out because the back to baseline ECG picture was 2.23% and chest pain was not found in 1.74% at presentation of the subject admitted to the emergency room at Dr. Sardjito Hospital. In subjects who underwent coronary angiography, the location of most coronary culprit lesions was in the LAD 49.03%; RCA 42.06%, LCx 7.52% and MINOCA 1.39% with the number of MVD coronary lesions 57.37%. ACE-I/ARB class vasodilator drugs were given to 53.10% of subjects, while beta blocker drugs were given to 47.64%.

Left ventricle ejection fraction and cardiogenic shock





Based on the ROC test, the cut point value for LVEF was 44.5% with an AUC value of 66.8%, p-value 0.001.

Correlation of LVEF with Cardiogenic shock

LVEF	Cardiogenic shock				P -value	RR (CI 95% min-max)
	Yes		No			
	N	%	N	%		
<44.5%	27	16.77	134	83.23	0.001	2.889 (1.569-5.356)
>44.5%	14	5.79	228	94.21		
Total	41	10.17	362	89.83		

A chi square test was carried out to determine the relationship between LVEF and cardiogenic shock and obtained a p-value of 0.001 to 2.889 (CI 95% 1.569-5.356). Subjects with LVEF <44.5% were twice as likely to experience cardiogenic shock compared to subjects with LVEF >44.5%

DISCUSSION

In this study, it was found that 10.24% of men and 9.88% of women experienced cardiogenic shock. In statistical tests, it was found that there were no significant differences between genders and cardiogenic shock. In line with other studies, it was also found that there was no relationship between gender and cardiogenic shock [7]. The risk factor for atherosclerosis in subjects was the highest with a history of smoking, followed by hypertension, DM, dyslipidemia and family history of CHD. However, the risk factors for patients with DM have a higher incidence of cardiogenic shock. This study shows that the total number of DM patients reached 27.79% of the total subjects studied. This shows that DM does not dominate compared to people who do not DM. In contrast to studies which show that DM is an independent risk factor for cardiogenic shock in AMI [8]. The SHOCK study involving many DM sufferers showed that the mortality of DM sufferers in hospitals with cardiogenic shock was higher than non-DM sufferers. The study also showed that revascularization was beneficial for DM patients compared to non-DM patients [7]. There were also no significant differences in other vascular disease factors, so vascular disease risk factors were not a predictor of cardiogenic shock [8]

In this study, it was found that chest pain onset of more than 12 hours resulted in 13.33% cardiogenic shock compared to 8.05% of chest pain onset less than 12 hours, p value 0.083. In line with other studies, cardiogenic shock is often found in STEMI

patients with chest pain onset >12 hours [9]. At the onset of chest pain 12-48 hours there is quite extensive myocardial death consistent with coronary blood vessel involvement. When the onset of chest pain is more than 48 hours, complaints of chest pain have gradually disappeared due to myocardial death [10].

In this study, the STEMI location had a 2.8 times chance of cardiogenic shock during treatment in the cardiovascular intensive care unit. However, based on the results of statistical tests, there was no significant relationship with a p value of 0.256. In contrast to the results of research conducted, it was found that anterior STEMI results were associated with the incidence of cardiogenic shock [11]. Decreased left ventricular function increases the incidence of cardiogenic shock, so that anterior STEMI is responsible for left ventricular function associated with the incidence of cardiogenic shock [12]. Based on the killip criteria during the initial physical examination on admission to hospital, this study explains that Killip II-III can be a predictor of cardiogenic shock during hospitalization with a significant 3 times risk. In line with research by Hatori et al. who received the results of patients with kilip III had a high risk of cardiogenic shock and increased mortality during hospitalization [13]. Killip criteria are used to assess left ventricular function in acute heart failure associated with AMI. In STEMI patients with decreased left ventricular function it will cause pulmonary edema and even cardiogenic shock [14]. In this study, it was found that subjects with LVEF below 44.5% had a significant 2.8 times risk of cardiogenic shock. Cardiogenic shock is most often caused by acute myocardial infarction with left ventricular dysfunction 78.5% of cardiogenic shock occurs in patients with low LVEF below 40% [25]. Another study found that a decrease in LVEF below 40% was associated with the incidence of cardiogenic shock and increased mortality in STEMI patients [26].

Study limitation

This research is a prospective observational study without any intervention while the subjects are being observed so that clinical variables and reperfusion measures vary between subjects. Not all coronary angiography is performed on subjects related to clinical conditions. In subjects presenting with chest pain for more than 48 hours

without chest pain, the subjects were not willing to undergo coronary angiography after the fibrinolosis procedure, causing the coronary profile to not be identified, both the identification of culprit lesions and the number of significant coronary stenoses, even though statistical tests were not found in the subjects who underwent coronary angiography significant relationship.

CONCLUSION

Left ventricular ejection fraction can be used as a predictor of the incidence of cardiogenic shock in STEMI patients treated at the ICCU at Dr. RSUP. Sardjito Yogyakarta.

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