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The Relationship between Pre Discharge Left Ventricle Diastolic Dysfunction and 30 days And 6 Months Rehospitalization in Patients with Heart Failure with Reduced Ejection Fraction (HFrEF) at Haji Adam Malik General Hospital Medan

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ABSTRACT

Introduction: Heart failure (HF) is a complex clinal manifestation that cause abnormality of structural and/or functional of the heart. HF is due to diastolic dysfunction and systolic dysfunction of the left ventricle (LV). The aim of this study is to assess the relationship between grading of pre-discharge LV diastolic dysfunction and readmission at 30 days post discharge and 6 months post discharge.

Method: This is a cohort retrospective study in HFrEF patients which are treated at Pusat Jantung Terpadu RSUP H. Adam Malik Medan on January 2021 until December 2021. Pre discharge echocardiography has been done to assess LV diastolic dysfunction and the we do the follow up of readmission at 30 days and 6 months by phone.

Results: From 93 patients, there are 40 patients (43%) with grade I LV diastolic dysfunction, 22 patients (23,7%) with grade II LV diastolic dysfunction and 31 patients (33,3%) with grade III LV diastolic dysfunction. There are 34 patients (26,6%) with readmission at 30 days and 21 patients (26,6%) readmission at 6 months. There is a significant relationship between grading of pre-discharge LV diastolic dysfunction and readmission at 30 days post discharge (p value 0,000), but not at 6 months post discharge (p value 1,000).

Conclusion: Grading of pre-discharge LV diastolic dysfunction on HFrEF patient is correlated with readmission at 30 days post discharge.

Keywords

LV diastolic dysfunction, HFrEF, Readmission.

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INTRODUCTION

Heart failure is a complex clinical syndrome caused by a decrease in the structural and functional ability of the ventricles to fill or eject blood [1]. A person with heart failure has the appearance of symptoms of heart failure (shortness of breath, fatigue, swollen feet), typical signs of heart failure (increased jugular venous pressure, moist basal crackles, peripheral edema) and objective evidence of a structural or functional disturbance of the heart at rest and/or during activity resulting in increased intracardiac pressure and/or inadequate cardiac output [2,3].

Heart failure is a very common cardiovascular disease worldwide with high morbidity and mortality rates. An estimated 26 million people worldwide suffer from heart failure, resulting in increased health care costs worldwide [4]. The World Health Organization (WHO) describes that the increasing number of heart failure in the world, including in Asia, is due to the increasing number of smokers, levels of obesity,

dyslipidemia and diabetes. The incidence of heart failure also increases with age. According to a study conducted by Framingham, the annual incidence of men with heart failure (per 1000 events) increased from 3 at the age of 50-59 years to 27 at the age of 80-89 years, while women had a third lower incidence of heart failure than man.

The incidence of heart failure in developed countries, by overall age, tends to increase with age: from approximately 1% for those aged <55 years, to >10% for those aged 70 years and over. Currently, the incidence of heart failure in Europe is approximately 3/1000 persons per year (all age groups) or approximately 5/1000 persons per year in adults. The prevalence of heart failure appears to be 1-2% in adults. Because studies usually include only diagnosed cases of heart failure, true prevalence is likely to be higher [3,4].

Based on 2018 RISKESDAS data, the prevalence of heart failure in Indonesia based on a doctor's diagnosis is 1.5% or around 1,017,290 residents. Seeing the prevalence of heart failure cases above, it is known that the number of heart diseases is increasing day by day as well as the incidence of re-hospitalization and death. One of the efforts needed to reduce the prevalence and reduce the rate of rehospitalization in heart failure patients is by optimizing health status, by changing lifestyles and carrying out cardiac rehabilitation.

Heart failure can be caused by structural abnormalities of the heart, functional abnormalities, and other triggering factors. Most cases are due to coronary artery disease and myocardial infarction. Over time, coronary artery disease and diabetes mellitus have become major predisposing factors for heart failure. Other structural causes of chronic heart failure include hypertension, valvular heart disease, uncontrolled arrhythmias, myocarditis, and congenital heart disease.

Classification of heart failure can be divided into two categories, namely structural abnormalities of the heart or based on symptoms related to functional capacity from the New York Heart Association (NYHA). Based on the systolic function of the heart, heart failure can be classified as heart failure with decreased systolic function (ejection fraction) and impaired diastolic function but normal systolic function (ejection fraction), which will hereinafter be referred to as Heart Failure with Reduced Ejection Fraction (HFrEF) and Heart Failure with Preserved Ejection Fraction (HFpEF) [2,5].

Left ventricular diastolic dysfunction results from impaired left ventricular relaxation with or without decreased restoring forces (and initial diastolic suction) and increased left ventricular chamber stiffness which will increase left ventricular filling pressure (LV filling pressure). Left ventricular filling pressure can be assessed invasively or non-invasively using echocardiography. The combination of the parameters E velocity, A velocity, E/A ratio, deceleration time (DT), isovolumic relaxation time (IVRT), and tissue Doppler imaging (TDI) can evaluate left ventricular diastolic function as a whole. The parameter e' obtained from the TDI examination and the ratio E/e' >15 is a predictor of an increase in left ventricular diastolic pressure [6].

Data on the prognosis of heart failure patients with diastolic dysfunction is still small compared to data on heart failure with systolic dysfunction. The prevalence of diastolic dysfunction is more in the older age group. The incidence of diastolic dysfunction is also present in the group of patients with chronic obstructive pulmonary disease (COPD). Diastolic dysfunction is also associated with mechanical ventilation weaning failure as indicated by an increased E/e' ratio. In sepsis patients, diastolic dysfunction is more common than systolic dysfunction and diastolic dysfunction is associated with increased mortality in septic patients. In patients undergoing cardiac surgery, diastolic dysfunction is associated with increased mortality, duration of mechanical ventilation, and length of ICU stay and is independent of the patient's systolic dysfunction. Perioperative diastolic dysfunction is an independent predictor of cardiovascular outcome in patients undergoing noncardiac surgery [7].

Quality of life, clinical symptoms, readmission frequency and 6-month mortality in patients with heart failure were the same in the group of patients with systolic dysfunction and the pure diastolic dysfunction group [8]. At the end of the first year, left ventricular diastolic dysfunction is the only echocardiographic predictor in rehospitalization of patients with acute coronary syndrome [9]. The study by Ren et al stated that the mortality and rehospitalization rates were higher in the group with impaired left ventricular diastolic function as assessed by a dominant diastolic pulmonary venous flow pattern [10]. The study by Temporelli et

al stated that the pattern of left ventricular filling can change within a few days of the incident of ACS and reversible restrictive filling during pre-discharge is associated with six-month remodeling whereas persistent restrictive filling is an independent predictor of left ventricular dilatation and patient mortality [11]. Based on these thoughts, researchers are interested in examining the relationship between the degree of left ventricular diastolic dysfunction during pre-discharge and rehospitalization 30 days and 6 months in patients with Heart Failure with Reduced Ejection Fraction at H. Adam Malik General Hospital Medan.

METHOD

This research is a retrospective cohort study. Researchers will examine all research subjects with a diagnosis of heart failure with reduced ejection fraction (HFrEF) at Haji Adam Malik General Hospital Medan and see if the patient has been rehospitalized within 30 days and 6 months since the last hospitalization. The inclusion criteria for this study were subjects with heart failure with EF <40% who were treated at the Integrated Heart Center at H. Adam Malik Hospital. Meanwhile, poor echocardiographic features cannot assess diastolic function. Patients with organic valvular heart defects, patients with congenital heart disease, and patients with arrhythmias and pacemaker use are included as exclusion criteria.

Before the research started, the researchers asked for information on passing the ethical review (ethical clearance) to the Standing Committee for Research Ethics Assessment, Faculty of Medicine, University of North Sumatra.

All samples of this study were patients with a diagnosis of heart failure with reduced ejection fraction (HFrEF) who were treated at the Integrated Heart Center of Haji Adam Malik General Hospital Medan in January 2021-December 2021 who met the inclusion and exclusion criteria. The diagnosis of heart failure was made based on the heart failure guidelines from ESC and PERKI. Collecting samples using the total sampling method.

Patients with a diagnosis of heart failure underwent pre-discharge echocardiography to assess diastolic function. Diastolic function is assessed using the ratio E/A, average ratio E/E', TR velocity, LA volume index, and deceleration time. Then the degree of diastolic dysfunction was assessed using the 2016 American Society of Echocardiography (ASE) guidelines concerning Evaluation of Left Ventricular Diastolic Function. Based on the ASE guidelines regarding the evaluation of diastolic function, the degree of diastolic dysfunction is divided into 3, namely, grade I dysfunction, grade II dysfunction, and grade III dysfunction. The degree of dysfunction is then grouped according to LA filling pressure, where grade I dysfunction has normal LA filling pressure, and grade II and III dysfunction has increased filling pressure. Based on this, the population with diastolic dysfunction will be divided into 3 groups, namely the group with Grade I diastolic dysfunction, the group with Grade II diastolic dysfunction, and the group with Grade III diastolic dysfunction. Echocardiographic examination will be carried out with GE Healthcare VIVID S60N and GE Healthcare VIVID e9 BT13 machines and carried out by residents participating in the education specialist program for heart and blood vessels who are currently at the Non-Invasive Cardiology Imaging stage and the results of the examination have been validated by two cardiologists and specialists in heart and vessels echocardiography consultant blood.

The patient will be followed up by means of telecommunications and asked whether the patient experienced rehospitalization due to heart failure within 30 days and 6 months after being hospitalized. The data collected was then carried out the chi square test. Statistical data analysis using computer statistical tools, p value <0.05 is said to be statistically significant.

RESULT

Description Characteristics Sample

This study was studies cohort retrospective with patient undergoing *heart failure with reduced ejection fraction* (HFrEF) at the Heart Center Integrated RSUP Haji Adam Malik Medan started January 2021 to December 2021 as subject research . Of the total 110 subjects entered in this study, only 93 subjects fulfilled

criteria inclusion and exclusion as well as have complete echocardiographic data and can contacted through telecommunication. Whole subject study experience dysfunction diastolic. Characteristics observed samples was age, type sex, comorbid (CAD, HHD, DM, cardiomyopathy), fraction ejection ventricle left (LV EF), *mitral inflow*, *tissue doppler imaging* (TDI), degrees dysfunction diastolic ventricle left, *left atrial volume index* (LAVI), contractility ventricle (TAPSE) and 30 days rehospitalization as well as 6 months .

Table 1. Characteristics demographic subject study

Variable	N=93
Age	54.26 ± 13.23 years
Sex	
Man	80 (86%)
Woman	24 (14%)
Comorbid	
CAD	83 (89.2%)
HHD	32 (34.4%)
DM	19 (20.4%)
CKD	14 (15.1)
Cardiomyopathy	8 (8.6%)
LV EF	28.72 ± 7.6 %
Mitral inflow (E/A)	1.81 ± 1.26
TDI (E/e')	15.85 ± 6.83
TRV max	2.71 ± 0.9m/s
LAVI	39.82 ± 21.88 ml/m ^{2}
TAPSE	16.94 ± 3.64 mm
dysfunction pre discharge diastolic	
Grade I	40 (43%)
Grade II	22 (23.7%)
Grade III	31 (33.3%)
Rehospitalization	
30 days	34 (36.6%)
6 months	21(26.6%)

Based on type gender, majority subject study is male (86%) with average age 54.26 ± 13.23 years. Majority subject study had comorbid disease heart coronary (CAD) about 83 people (89.2%) from 93 subjects research. This obtained average function parameter values diastolic in a echocardiography examanination was mitral inflow (E/A) 1.81 ± 1.26; TDI (E/e') 15.85 ± 6.83; TR Vmax 2.71 ± 0.9 m/s, LAVI 39.82 ± 21.88 ml/m^2 (table 1).

Table 2. Characteristics subject based on Degrees dysfunction Diastolic

	dysfunction Grade I diastolic (N= 40)	dysfunction Grade II diastolic (N= 22)	dysfunction Grade III diastolic (N=31)
Age	57.6 ± 10.3	59.2 ± 9.1	46.4 ± 15.7
Sex			
Man	35 (87.5%)	18 (81.8%)	27 (87%)
Woman	5 (1.25%)	4 (18.2%)	4 (13%)
Comorbid			
CAD	39 (97.5%)	17 (77.2%)	27 (87%)
HHD	15 (37.5%)	8 (36.3%)	9 (29%)
DM	10 (25%)	4 (18.1%)	5 (16.1%)
CKD	7 (17.5%)	3 (13.6%)	4 (12.9%)
Cardiomyopathy	2 (5%)	2 (9%)	4 (12.9%)
LV EF	30.8 ± 8.24	29.1 ± 7.56	25.7 ± 5.7
Mitral inflow (E/A)	1.1 ± 1.19	1.4 ± 0.5	2.9 ± 0.9
TDI (E/e')	11.3 ± 5.4	18.9 ± 4.9	19.5 ± 6.4
LAVI	30.3 ±10.9	49.2 ± 36.6	45.3 ± 12.6
TAPSE	18 ± 2.9	17.1 ± 3.3	15.3 ± 4.2

rehospitalization in 6 months since treatment last (table 2).

Association between degrees dysfunction diastolic ventricle left moment *pre-discharge* with rehospitalization 30 days and 6 months in patients *heart failure with reduced ejection fraction* (HFrEF)
This research has found significant relationship between degrees dysfunction diastolic ventricle left moment *pre-discharge* with 30 day rehospitalization of the patient *heart failure with reduced ejection fraction* (HFrEF) (*p-value* < 0.001) (table 3).

Table 3. Association between degrees dysfunction diastolic ventricle left moment *pre-discharge* with 30 day rehospitalization of the patient *heart failure with reduced ejection fraction* (HFrEF)

		Rehospitalization 30 days		*p-values*
		Yes	No	
dysfunction diastolic ventricle left *pre-discharge*	Grade I	8	32	< 0.001
	Grade II	6	16	
	Grade III	20	11	

The chi square test

This research has found no significant relationship between degrees dysfunction diastolic ventricle left moment *pre-discharge* with 6 month rehospitalization of the patient *heart failure with reduced ejection fraction* (HFrEF) with *p-value* 1.000 (table 4).

Table 4. Association between degrees dysfunction diastolic ventricle left moment *pre-discharge* with 6 month rehospitalization of the patient *heart failure with reduced ejection fraction* (HFrEF)

		Rehospitalization 6 months		*p-values*
		Yes	No	
dysfunction diastolic ventricle left *pre-discharge*	Grade I	9	31	1,000
	Grade II	5	17	
	Grade III	7	24	

Fisher Exact Test

DISCUSSION

Heart failure is a complex clinical syndrome caused by a decrease in the structural and functional ability of the ventricles to fill or eject blood. The causes of heart failure can be caused by several factors including, ventricular pump disorders, increased afterload and impaired ventricular filling and relaxation. Heart failure was caused by abnormalities of ventricular emptying, due to impaired contractility and increased afterload and a systolic dysfunction. Meanwhile, heart failure caused by impaired diastolic relaxation or ventricular filling is called diastolic dysfunction.

In this study, the average age of the research subjects was 54.26 ± 13.23 years with 86% male and 14% female. According to a study conducted by Framingham, the annual incidence of men with heart failure (per 1000 events) increased at the age of 50-59 years to 80-89 years, while women had a third lower incidence of heart failure than men. This is also in accordance with McDonagh et al who stated that the incidence of heart failure in developed countries, based on overall age, tends to increase with age: from about 1% for those aged <55 years, to >10% in those aged 70 years or more [3,12]. Januzzi and Mann also stated that although the incidence of heart failure in women is lower than men, women have a longer life expectancy than men so that the prevalence of heart failure in women is more in the age group >80 years [13].

In this study found comorbid CAD 89.2% and HHD 34%. This is in accordance with McDonagh et al which stated that in developing countries the majority of comorbidities in heart failure were found, namely CAD and hypertension [3]. The study by Saverese and Lind also stated that the majority of comorbid heart failure in Asia, Australia and the Middle East were CAD, but in Africa comorbid heart failure was found, namely HHD and cardiomyopathy [4].

In this study, the average value of the ratio E/e' was 15.85 ± 6.83 which indicates an increase in left ventricular diastolic pressure. Nagueh et al said that an E/e' ratio >15 indicates an increase in left ventricular filling pressure while an E/e' ratio <8 indicates normal left ventricular filling pressure [5]. An increase in the E/e' ratio is also a predictor of worsening prognosis in patients with heart failure [6,14].

Left ventricular diastolic dysfunction can be assessed using echocardiography. Diastolic dysfunction divided into 3 with grade 3 diastolic dysfunction is severe diastolic dysfunction characterized by mitral inflow E/A > 2 and indicates an increase in left ventricular filling pressure [5,6,14].

In this study, a significant association was found between the degree of left ventricular diastolic dysfunction during pre-discharge and 30-day rehospitalization in heart failure patients with reduced ejection fraction (HFrEF) (p-value <0.001). This is consistent with a study by Mann et al which stated that there was a relationship between worsening left ventricular diastolic dysfunction and 30-day rehospitalization [7]. This is because in patients with grade III diastolic dysfunction, an increase in LV filling pressure is still found which indicates that the patient suffer congested condition. Gheorghiade et al also stated that congestion hemodynamically which is characterized by a persistent increase in LV filling pressure is not immediately recognized and treated before the patient returns to the hospital which will result in rehospitalization events [15,16].

In this study, there was no significant association between the degree of left ventricular diastolic dysfunction during pre-discharge and 6 months of rehospitalization in heart failure patients with reduced ejection fraction (HFrEF) (p-value 1,000). This was also found in a study by Mann et al which stated that patients with worse diastolic dysfunction experienced rehospitalization within 30 days or had never been rehospitalized even at 6 months post-hospitalization. This is because patients who have better disease control in the initial phase of returning from the hospital will usually be able to maintain a lifestyle and also take heart failure medications regularly so that these patients will not experience rehospitalization and do not depend on previous the degree of diastolic dysfunction [7].

CONCLUSION

Grading of pre-discharge LV diastolic dysfunction on HFrEF patient is correlated with readmission at 30 days post discharge.

DECLARATIONS

Ethics approval and consent to participate. Permission for this study was obtained from the Ethics Committee of Universitas Sumatera Utara and H. Adam Malik General Hospital.

CONSENT FOR PUBLICATION

The Authors agree to publication in Journal of Society Medicine.

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COMPETING INTERESTS

None.

AUTHORS' CONTRIBUTIONS

All authors significantly contribute to the work reported, whether in the conception, study design, execution, acquisition of data, analysis, and interpretation, or in all these areas. Contribute to drafting, revising, or critically reviewing the article. Approved the final version to be published, agreed on the journal to be submitted, and agreed to be accountable for all aspects of the work.

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