MEDICO RESEARCH CHRONICLES
ISSN NO. 2394-3971
DOI No. 10.26838/MEDRECH.2022.9.6.656
Contents available at www.medrech.com

PROGRESSION OF LEFT VENTRICULAR EJECTION FRACTION AFTER ACUTE MYOCARDIAL INFARCTION

Amir Hossain[1], Md. Abdur Rashid[1], Md. Durul Hoda[1], Faruk Ahmed[1], Md. Badiuzzaman[1], Mohammad Refatul Islam[1], Mohammad Abdullah Al Mamun[2], Muhammad Anwar Saadat[3]

1. Assistant Professor (Cardiology), Shaheed Tajuddin Ahmad Medical College, Gazipur, Bangladesh

2. Junior Consultant (Cardiology), Shaheed Tajuddin Ahmad Medical College, Gazipur, Bangladesh

3. Assistant Professor (Surgery), Shaheed Ziaur Rahman Medical College, Bogura, Bangladesh

ARTICLE INFO **ABSTRACT** **ORIGINAL RESEARCH ARTICLE**

Article History
Received: September 2022
Accepted: November 2022
Key Words: Acute Myocardial Infarction, Left Ventricular Failure, Left Ventricular Ejection Fraction, Echocardiography.

Introduction: A significant proportion of deaths in patients with chronic ischemic cardiomyopathy are due to heart failure or sudden cardiac death (SCD) [1]. Numerous clinical trials have confirmed the benefit of implantable cardioverter-defibrillator (ICD) treatment in patients with reduced left ventricular (LV) function after an acute myocardial infarction (AMI). Objective: To measure and compare Left Ventricular Ejection Fraction (LVEF) after acute anterior wall and inferior wall myocardial Infarction and correlate LVEF with clinical findings in the patients. **Methods**: It was a prospective observational echocardiography based study which was carried out in the Dept. of Cardiology, Shaheed Tajuddin Ahmad Medical College Hospital, Gazipur, Bangladesh from March to October 2022. A total of 60 (sixty) patients of (anterior or inferior) Acute Myocardial infarction (AMI) were included in the study. Patients were divided in two groups on the basis of anterior myocardial wall MI (AWMI) or inferior myocardial wall MI (IWMI). Echocardiography was done on all cases and ejection fraction was calculated by applying Simpson's Rule and patients were examined at the same time to see the presence of signs of left ventricular failure (LVF). (LVEF) was correlated with the findings of LVF in these patients. **Results:** Out of 30 patients of anterior wall MI, 18 (60%) were male and 12 (40%) were female. In inferior wall MI, 28 (93.3%) were male and 2 (6.7%) were female. In all 60 patients (76.7%) patients were male and (23.3%) were females. In anterior wall MI, (6.7%) were in 30 to 40 years of age, (33.3%) were in 41 to 50 years of age, (33.3) were in 51 to 60 years of age, (20.0%) were in 61 to 70 years of age, and (6.7%) were in 71 to 80 years of age. Minimum age was 39 years; maximum was 72 years, with mean of 54.57 and SD of 9.22. In

patients with LVF mean ejection fraction (EF) was 37.13 with standard deviation (SD) of 8.4 %. In patients without failure the mean EF was 56.29% with SD of 3.75. In 30 patients of IWMI, mean EF was 54.93% with SD of 6.86. In 30 patients of AWMI it was 46.07% with SD of 11.72. In all 60 patients minimum EF was 30% and maximum was 60% with a mean of 50.50 with SD of 10.52. In AWMI, 53% patients had signs of left ventricular failure. In patients of IWMI, 13.3% had signs of LVF. **Conclusions:** AWMI causes more decrease in LVEF. LVF is more commonly associated with AWMI than IWMI. There is statistically significant difference in LVEF of patients with and without LVF.

Corresponding author
Dr. A. Hossain*

2022, www.medrech.com

INTRODUCTION

A significant proportion of deaths in patients with chronic ischemic cardiomyopathy are due to heart failure or sudden cardiac death (SCD) [1]. Numerous clinical trials have confirmed the benefit of implantable cardioverter-defibrillator (ICD) treatment in patients with reduced left ventricular (LV) function after an acute myocardial infarction (AMI) [2,3]. Despite the risk of SCD being highest during the first month after AMI, [4,5] there is no benefit of ICD treatment early after myocardial infarction [6,7]. At the beginning of 20 centuries, ischemic heart disease the (IHD) accounted for less than 10% of all deaths worldwide [8]. At its end, it accounted for nearly half of all deaths in the developed world and 25% in developing world. IHD will claim 25 million deaths annually and it will surpass infectious diseases as world's number one cause of death and disability in future. It will be accounting for 36.3% of all deaths by year 2020. When 1 myocardium undergoes ischemic injury, left ventricular pump function becomes depressed, cardiac output, stroke volume, and BP is decreased. AMI frequently causes heart failure, characterized by either systolic dysfunction alone or by both systolic and diastolic dysfunctions. Heart failure has increased risk of mortality. LV dysfunction and increased systolic volume are important predictors of mortality after AMI [8]. LV diastolic 1 dysfunction leads to pulmonary congestion and pulmonary venous hypertension whereas systolic dysfunction is principally responsible for the depression of cardiac output and of ejection fraction. Clinical manifestations of LV failure become more common as the extent of the injury to LV increases [9]. Echocardiography is a standard tool in the management of patients with AMI. With color flow Doppler it can assess left and right ventricular function, and other important cardiac parameters. It is usually the preferred test to measure the LVEF, since it can detect other abnormalities that are associated with a worse prognosis including diastolic dysfunction, concurrent right ventricular involvement, increased left atrial volume, mitral regurgitation, and a high wall motion score index. (LVEF) is a major predictor of long-term prognosis after both ST elevation and non-ST elevation infarctions. For those with an LVEF <28 percent, survival at one year is 24 percent (versus 56 percent for those with a higher LVEF). Another explanation could be that the impaired LV function seen immediately after AMI is due to some extent to myocardial stunning. In previous studies, improvement of the LV ejection fraction (LVEF) has been observed in 30% to 50% of post-AMI patients [8,9,10,11,12].

MATERIALS AND METHODS

It was a prospective observational echocardiography based study which was

carried out in the Dept. of Cardiology, Shaheed Tajuddin Ahmad Medical College Hospital, Gazipur, Bangladesh from March to October 2022. All the patients with isolated acute anterior or inferior wall myocardial infarction that present within five days of onset of symptoms were included in the study. There was no discrimination for age and sex. The diagnostic criteria for myocardial infarction were presence of any two (2) of the followings:

- History suggesting AMI,
- ECG changes in anterior or inferior leads suggesting acute MI of that area.
- Raised cardiac enzymes.

Following patients were excluded from the study:

1. Patients having evidence of previous myocardial infarction by history or ECG.
2. Patients who were having all other MI or presented later than five days of onset of severe symptoms.
3. Patients having combined anterior and inferior wall MI or with non-Q wave MI.
4. Patients having isolated pericardial disease, gross valvular heart disease, inflammatory heart disease because these conditions independently decrease EF, however presence or absence of signs of LVF was not an inclusion or exclusion criteria.

A total of 60 patients, 30 consecutive patients of each type (anterior or inferior) of AMI were under study. Patients were divided in two groups. One group included patients of AWMI (group I), and other included patients of IWMI (group II). Echocardiography was done on all cases on the fifth post MI day. Left ventricular internal diameter during diastole as well as during systole were measured by applying Simpson's Rule and ejection fraction was calculated in apical two chamber and four chamber views separately. Mean ejection fraction was calculated. Patients were examined at the same time to see the presence of signs of LVF. Patients in each group were further subdivided into two groups each based on the clinical signs of LVF. Group Ia and IIa were having signs of left ventricular failure and groups Ib and IIb having no findings of LVF. Mean LVEF and standard deviation for each group was calculated and compared by applying independent sample t-test. Group comparison of mean LVEF was done. Proportion of the patients with left ventricular failure was calculated in each group and compared by using chi-square test.

LVEF of patients with failure was compared with LVEF of patients without failure by using independent sample t-test. Similarly, age of all patients was compared collectively and separately in anterior and inferior wall MI. Sex proportion of patients of both groups of anterior wall and inferior wall MI was noted separately and collectively.

Instrument (Echo Machine): The echocardiography machine of department of cardiology was used for calculation of LVEF. This is high technology stuff with built-in computer and advanced software. The SPSS statistical package (SPSS Inc., Chicago, IL, USA) was used to perform all statistical evaluations. A p value<0.05 was considered statistically significant.

RESULTS

In 30 patients of anterior wall MI, 18 (60%) were male and 12 (40%) were female. In inferior wall MI, 28 (93.3%) were male and 2 (6.7%) were female. In all 60 patients (76.7%) patients were male and (23.3%) were females. In anterior wall MI, (6.7%) were in 30 to 40 years of age, (33.3%) were in 41 to 50 years of age, (33.3) were in 51 to 60 years of age, (20.0%) were in 61 to 70 years of age, and (6.7%) were in 71 to 80 years of age. Minimum age was 39 years; maximum was 72 years, with mean of 54.57 and SD of 9.22. In inferior wall MI, (13.1%) were between 30 to 40 years, (23.3%) were between 41 to 50 years, (40.0%) were between 51 to 60 years, and (3.3%) were between 71 to 80 years. Minimum age was 38 years; maximum was 71 years with mean of 52.50 and SD of 9.69. In all 60 patients, (10%)

patients were in age group of 30 to 40 years, (28.3 %) patients were in 41 to 50 years, 22 (36.7%) were in 51 to 60 years. (20%) were in 61 to 70 years. (5%) were in 71 to 80 years (Table-I).

In anterior wall MI, (6.7%) had 30% EF, (6.7%) had 31%, (20%) had 32%, (6.7%) had 32% EF, (6.7%) had EF of 45%, (6.7%) had 52 %, (6.7%) had 53%, (6.7%) had EF of 54%, and another (6.7 %) had 56% EF, (13.3%) had EF of 57% and lastly 2 patients having EF of 64%. The mean EF was 46.07% with standard deviation of 11.72. In 30 patients of inferior wall MI, (6.7%) had EF of 39%, (13.3%) had 49%, (20%) had 52%, and (13.3%) had 55%, (13.3%) had 56%, (13.3%) had 57%, (6.7%) had 62%, (6.7%) had 65% and (6.7%) had 68% EF. Mean EF was 54.93% with standard deviation of 6.86. In all 60 patients minimum EF was 30% and maximum EF was 60% with a mean of 50.50 with standard deviation of 10.52(Table-II & III).

In 4 (13.3%) patients of IWMI who were having cardiac failure clinically, minimum EF was 39% and maximum was 49%, mean of 44% with SD of 5.77. In 26 (86.7%) patients without failure, minimum EF was 49% and maximum EF was 68 %mean of 56.62% and SD of 5.34. In 16 patients (53.0%) of AWMI who were having failure clinically, minimum EF was 30 % and maximum was 54%, mean of 37.13 % with SD of 8.4. In 26 (86.7%) patients without failure, minimum EF was 49% and maximum EF was 68 %mean of 56.62% and SD of 5.34(Table-IV & V).

In all patients with failure, mean EF was 37.13 with SD of 8.4 and min. was 30 % and max was 54%. In patients without failure the mean EF was 56.29% with SD of 3.75, and min. of 52% and max was 64 % (Table-VI).

Table-1: Comparison of age.

	Minimum	**Maximum**	**Mean**	**SD**	**P value**
Anterior wall MI	39	72	54.47	9.22	0.62
Inferior wall MI	38	71	52.50	9.69	

Table-II: Comparison of LVEF in anterior and interior wall MI.

Type of MI	**Left ventricular ejection fraction**				
	Min	**Max**	**Mean**	**SD**	**P value**
Anterior wall MI	30	64	46.07	11.72	<0.001
Inferior wall MI	39	68	54.93	6.68	

Table-III: Proportion of patients with LVE.

	LVF Present		
	Yes	**No**	**P value**
Anterior wall MI	16	14	0.001
Inferior wall MI	04	26	
Total	20	40	

Table-IV: Left ventricular ejection fraction in patients with and without LVF in anterior wall MI.

	Min	**Max**	**Mean**	**SD**	**P value**
Patients with failure	30	54	37.13	8.4	0.001
Patients without failure	52	64	56.29	3.75	

Table-V: Left ventricular ejection fraction in patients with and without LVF in inferior wall MI.

	LVEF				
	Min	**Max**	**Mean**	**SD**	**P value**
Patients with failure	39	49	44	5.77	0.001
Patients without failure	49	68	57	5.34	

Table-VI: LVEF in patients with and without failure.

LVE	**No. of patients**	**Mean LVEF**	**SD**	**P value**
Yes	20	38.50	8.30	0.001
No	40	56.50	4.80	

DISCUSSION

It was noted that patients of AWMI had more decrease in LVEF as compared to patients with IWMI. More over larger proportion of patients of AWMI had clinically and statistically significant LVF. In the study of Awan ZA et al. [4], among 210 patients 76% were males and 24% were females. In studies conducted such as Haq et al [5], mean 3 age was 54 years. In our study mean age was 53 years. In our study males were 76% and females were 23%. In anterior wall MI, 18 patients (30%) were males and 12 patients (40%) were female. In inferior wall MI, 28 (93%) were male and 2 patients (7%) were females. There were 79% males and 21% were females in the study [5]. Males and females were in the proportion of 3:1 in 3 the study of Karim MA et al. [13], and co-workers. In our study, 4 about 53 % of patients had LVF clinically in anterior wall MI and about 13% of patients in inferior wall MI with overall proportion of 33 % in all patients. Whereas the percentage of patients having failure was 43 % without mentioning the type of MI in the study [14]. The mean LVEF was 47% in study of Sola M et al. [15], without mentioning the type of MI from which the patients were suffering. In our study mean LVEF was 46 % in anterior wall MI and 54 % in inferior wall MI and mean of all patients was 50 %. LVEF decreased to 45% in the study of Senior R and Coworkers [16]. Ali AS et al. [17], workers made pulmonary rales, S3 gallop, and interstitial edema on the chest radiograph the criteria for the presence or absence of left ventricular failure and labeling a patient in LVF. In my study vital signs especially pulse, blood pressure, and respiratory rate were also included in the criteria. In the study of Ali AS et al. [17], 43% patients had LVF, whereas in our study 54% 8 and 13% patients had LVF in AWMI and IWMI respectively. In the study of Awan ZA, 29% patients had 2 sign and symptoms of left ventricular failure [4]. VAUR L9 noticed mean LVEF of 50% in patients of AMI, and 17% patients had clinical failure with 35% LVEF. My findings of increased incidence of LVF in patients with AWMI are consistent with the findings of Vaur L [18]. Darbar D noticed 10 that anterior infarction causes more decrease in LVEF and our findings are consistent with it [19]. He also had the findings that the patients in which signs and symptoms of LVF are present have mean LVEF of 40%, in my studies these patients have mean LVEF of 37.13% in patients of anterior MI, and 44% in patients of inferior MI with SD of 8.4 and 5.77 respectively. The clinical presence of LVF (killip class >1) was noted in about 50% of cases in study of Poulsen SH, whereas 11 in my study it is present in 53 % of AWMI and 13% of patients with IWMI and 33% of all cases [20]. But the clear cut difference in the clinical and echocardiographical findings between the patients of anterior wall MI and that of inferior wall MI are not noted in the recent data.

Councelo J, found that Simpson's rule is the method of 12 choices for calculating LV volumes and he has recommended this method for calculating left ventricular volumes and LVEF, this method is used in our study for calculating left ventricular volume and left ventricular ejection fraction [21]. Moreover, it is more commonly employed method as stated in the study of Yvorchuck KJ [22]. In my study inferior wall MI were more frequent than 13 anterior wall MI. When 30 patients of inferior wall MI were completed and enrolled about 20 patients of anterior wall MI were enrolled at that time. But in the study of Awan ZA 56 % were of anterior wall MI and 12% patients were 2 of inferior wall MI. We used the criteria of prolonged chest pain for more than 45 minutes, typical ECG changes of AMI, and raised cardiac enzymes for the diagnosis of acute myocardial infarction. These all criteria were also used in the study of Awan ZA [4]. One limitation is that LVEF estimation can sometimes be difficult because of a lack of proper visualization of the endocardium. In that case, we used contrast agents and harmonics to increase the accuracy of the method. Another issue is the intraobserver and interobserver variability among observers. The intraobserver and interobserver variations for calculating LVEF can be high because of the inappropriate quality of echocardiography recordings. In our study, we had relatively low intraobserver and interobserver variabilities for calculating LVEF.

CONCLUSION

Anterior wall MI causes more decrease in LVEF. Left ventricular failure is more commonly associated with anterior wall MI than inferior wall MI. There is statistically significant difference in LVEF of patients with LVF and without LVF. Male genderis more common among patients of acute myocardial infarction and MI is more common in 6 decade of life.

CONFLICT OF INTEREST: None.

REFERENCES:

1. Moss AJ, Hall WJ, Cannom DS, Daubert JP, Higgins SL, Klein H, Levine JH, Saksena S, Waldo AL, Wilber D, Brown MW, Heo M. Improved survival with an implanted defibrillator in patients with coronary disease at high risk for ventricular arrhythmia: Multicenter Automatic Defibrillator Implantation Trial Investigators.N Engl J Med. 1996; 335:1933–1940.
2. Buxton AE, Lee KL, Fisher JD, Josephson ME, Prystowsky EN, Hafley G. A randomized study of the prevention of sudden death in patients with coronary artery disease: Multicenter Unsustained Tachycardia Trial Investigators.N Engl J Med. 1999; 341:1882–1890.
3. Antman EM, Braunwald E. Acute myocardial infarction. In: Braunwald E, Fauci AS, Isselbacher KJ, Wilson JD, Martin JB, Kasper DL et al eds. Harrison's Principles of internal medicine .New York:McGraw-Hill, 1998: 1352-65.
4. Awan ZA, Mufti W. First year mortality and morbidity after AMI in Peshawar. J Ayub Med Coll 1996; 8: 3-5.
5. Haq I. In-hospital mortality after acute myocardial infarction. Specialist, 1993; 9: 249-51
6. Greenberg H, Case RB, Moss AJ, Brown MW, Carroll ER, Andrews ML; MADIT-II Investigators. Analysis of mortality events in the Multicenter Automatic Defibrillator Implantation Trial (MADIT-II).J Am Coll Cardiol. 2004; 43:1459–1465.
7. Steinbeck G, Andresen D, Seidl K, Brachmann J, Hoffmann E, Wojciechowski D, Kornacewicz-Jach Z, Sredniawa B, Lupkovics G, Hofgärtner F, Lubinski A, Rosenqvist M, Habets A, Wegscheider K, Senges J; IRIS Investigators. Defibrillator implantation early after myocardial infarction.N Engl J Med. 2009; 361:1427–1436.

8. Adabag AS, Therneau TM, Gersh BJ, Weston SA, Roger VL. Sudden death after myocardial infarction. JAMA. 2008; 300:2022–2029.
9. Solomon SD, Zelenkofske S, McMurray JJ, Finn PV, Velazquez E, Ertl G, Harsanyi A, Rouleau JL, Maggioni A, Kober L, White H, Van de Werf F, Pieper K, Califf RM, Pfeffer MA; Valsartan in Acute Myocardial Infarction Trial (VALIANT) Investigators. Sudden death in patients with myocardial infarction and left ventricular dysfunction, heart failure, or both.N Engl J Med. 2005; 352:2581–2588.
10. Hohnloser SH, Kuck KH, Dorian P, Roberts RS, Hampton JR, Hatala R, Fain E, Gent M, Connolly SJ; DINAMIT Investigators. Prophylactic use of an implantable cardioverter-defibrillator after acute myocardial infarction.N Engl J Med. 2004; 351:2481–2488.
11. Dorian P, Hohnloser SH, Thorpe KE, Roberts RS, Kuck KH, Gent M, Connolly SJ. Mechanisms underlying the lack of effect of implantable cardioverter-defibrillator therapy on mortality in high-risk patients with recent myocardial infarction: insights from the Defibrillation in Acute Myocardial Infarction Trial (DINAMIT).Circulation. 2010; 122:2645–2652.
12. Braunwald E, Rutherford JD. Reversible ischemic left ventricular dysfunction: evidence for the "hibernating myocardium."J Am Coll Cardiol. 1986; 8:1467–1470.
13. Karim MA, Mehmood SF, Akhtar J, Qureshi J. Thrombolytic therapy in AMI in Pakistan. J Pak Med Assoc. 1995; 45: 54-8.
14. Kyne L, Hausdorff JM, Knight E, Dukas L, Azhar G, Wei JY. Neutrophilia and congestive heart failure after acute myocardial infarction. Am Heart J. 2000; 139: 94- 100.
15. Sola M, Margrina J, Pavia J, Vidal-Sicart S, Huguet M, Pare C, et al. Predictive value of 99 Tcm-Sestamibi gated SPECT for long-term myocardial perfusion and recovery after acute myocardial infarction. Nucl Med Commun 1998; 19: 823-30.
16. Senior R, Basu S, Kinsey C, Schaeffer S, Lahiri A. Carvedilol prevents remodeling in patients with left ventricular dysfunction after acute myocardial infarction. Am Heart J 1999; 137 (4 pt.1): 646–52.
17. Ali AS, Rybicki BA, Alam M, Wulbercht N, Kicher-CornishK, Khaja F, et- al. Clinical predictors of heart failure in patients with first acute myocardial infarction. Am Heart J 1999; 138: 1133-9.
18. Vaur L, Danchin N, Genes N, Renault M,etienne S, Ferriers, et al. Characteristics of patients hospitalized for myocardial infarction in France with respect to left ventricular dysfunction. Arch Mal Coer–Vaiss. 1997. 11: 1485-92.
19. Darbar D, Gillepsie N, Choy AM, Lang CC, Pringle SD, and Pringle TH et al. Diagnosing left ventricular dysfunction after myocardial infarction: the Dundee algorithm. QJM 1997; 90: 677-83.
20. Poulsen SH, Jensen SE, Egstrup K. Longitudinal changes and prognostic implications of left ventricular diastolic function in first acute myocardial infarction. Am Heart J. 1999; 137: 910-8.
21. Coucelo J, Joaquim N. Calculation of volumes and systolic indices of heart ventricle from Halobatrachus didactylus. J Exp Zool. 2000; 286: 585 –95.
22. Yorchuk KJ, Davies RA, Chang KL. Measurement of left ventricular ejection fraction by acoustic quantification and comparison with radionuclide angiography. Am J Cardiol. 1994; 74: 1052-56.