Mohammad Mujtaba Ghaffari* , Abdul Samad Ahmadi

Balkh University, Balkh, Afghanistan
*e-mail: mohammadghaffari123@gmail.com

FLUCTUATIONS OF LEFT VENTRICULAR LVEF IN IHD PATIENTS

Ischemic heart disease (IHD) is the world's major cause of death. It presents clinically as myocardial infarction and ischemic cardiomyopathy and is also known as coronary artery disease. To define LVEF percentage in CAD patients. This cross-sectional study was done retrospectively by collecting data from the database of "Scientific Research Institute of Cardiology and Internal Diseases" Almaty, Kazakhstan during 2020. IHD was confirmed in clinical, angiographic and other lab findings with TTE used for detection of LVEF. A sequential non-random sampling technique used SPSS for statistical analysis. Conventional echocardiography showed that there were significant differences in LVEF percentage in patients based on age and gender. The number of female and male patients who have preserved LVEF was 66.4% and 54.7% accordingly, 21.6% of females and 22.1% of males had Mid-range LVEF and 12.1% of females and 23.3% of males had decreased LVEF (P-value = 0.001). The mean of LVEF was (55.8% ±11.79). Maximum and minimum of EF were 84%, 12% respectively. We discovered that EF was moderately lower in male patients than in females in the sample. When compared to patients without a history of IHD, those with IHD history showed more significant EF deterioration. IHD patients with low EF appeared to be at high risk of Hypertension and infarction with decreased HDLc.

Key words: LVEF, Comorbidities, IHD, Myocardial.

Introduction

Ischemic heart disease is a medical condition that occurs when blood flow to the heart muscle is reduced or when oxygen demand increases (mismatch between demand and supply of oxygen). The most prevalent predisposing factors include coronary artery atherosclerosis (CAD), epicardial artery spasm, or pathological changes in the microvascular system. CHD is caused by a chronic condition that worsens over time or by sudden changes in atherosclerotic plaque (erosion, rupture, hemorrhage, and fissure). CCS was first established in ECS rules in previous American recommendations in 2019 [1].

ACS encompasses unstable angina pectoris and acute myocardial infarction, which is further split into ST-segment elevation myocardial infarction (STEMI) and non-ST segment elevation myocardial infarction (non-ST segment elevation myocardial infarction) (NSTEMI). Cardiovascular diseases are still the top cause of death [1]. In the United States, 30 percent of all deaths occur in people over the age of 35 [2]. CAD is responsible for more than 1.7 million fatalities in European countries [3]. The highest mortality rate due to CAD is observed in non-European nations, while the lowest rate is found in 15 European countries [3]. When anterior and nonanterior infarcts are compared, anterior infarcts are linked to higher enzymatic infarct size and poorer LVEF [4]. Left ventricular (LV) dysfunction in the days to months following an acute myocardial infarction (MI) is used to identify patients at higher risk of sudden cardiac arrest (SCA) and mortality [5]. Baseline left ventricular EF (EF) is also an independent predictor of MI survival at the time of initial percutaneous coronary intervention [6].

In the treatment of patients with cardiovascular disease, an accurate measurement of LVEF is crucial. LVEF has a predictive value in predicting adverse outcomes in patients with congestive heart failure, following a myocardial infarction, and after revascularization [7,8]. Up to an LVEF of 45 percent higher LVEFs were associated with a linear decrease in mortality in heart failure patients. Increases above 45 percent, on the other hand, were not associated with further reductions in mortality. Although LVEF is a strong independent predictor of death in individuals with heart failure, its prognostic relevance must be weighed against other known risk factors. Current American College of Cardiology/American Heart Association guidelines recommend regularly testing LVEF in heart failure patients to guide therapy, but they do not specify a relationship between LVEF and prognosis [9,10].

*Justification of the choice of articles and goals and objective*s

Aim: To assess LVEF percentage in IHD patients.
Objectives:

• To study the decline in LVEF based on the sex of patients.

- To find the correlation of LVEF decline with other comorbidity diseases.
- To find differences in LVEF based on age.

Materials and Methods

This is a descriptive retrospective cross-sectional study of 649 IHD registered patients in "Scientific Research Institute of Cardiology and Internal Diseases" Almaty, Kazakhstan during 2020. A consecutive non-random sampling was used to include all patients with IHD. LVEF was compared in patients of different age, sex, with different history of HTN, BMI, DM, and previous IHD. Patients were excluded if they had been discharged from the emergency room, leaving the hospital early and without making an echocardiography report. Statistical analysis is made based on IBM SPSS statistics 22 and Excel. Chi squire test is used to compare categorical variables and P-value <0.05 was considered significant. Independent T-test performed with 95% CI to compare scale variable with categorical variable. One sample T-test with 95% CI was used to compare the mean of LVEF in our study with the average of LVEF in other publications. Data are presented showing the number of patients or mean± SD.

Results and Discussion

The study includes 649 valid patients. According to risk factors, arterial hypertension was detected in more than 90% of patients, almost a third of patients had diabetes mellitus (31.5%) and high cholesterol (31.3%), more than 85% were overweight, and 93.5% of patients do not drink alcohol, family anamnesis of CVD was confirmed in 13.4% only, which in average of IHD patients was (64.2 ± 9.24). Average age in males (63±9) and females (66±6), and statistical analysis with independent T-test shows relation between age and gender group P < 0,001 (95% CI, –4.441: -1.29) (Table 1).

Table 1 – General characteristics of the study sample

Variables	Female		Male		Test of differences		
Number / Percent	N	%	N	%	χ2	DF	P value
Age Category (Year)							
<40	3	1.30%	4	1.00%	19.919	5	0.001
>80	15	6.50%	15	3.60%			
40 – 49	6	2.60%	27	6.50%			
50 – 59	44	19.00%	98	23.50%			
60 – 69	87	37.50%	187	44.80%			
70 – 79	77	33.20%	86	20.60%			
Family History							
No	201	86.60%	372	89.20%	0.953	1	0.329
Yes	31	13.40%	45	10.80%			
Previous IHD							
No	161	69.40%	210	50.40%	22.062	1	0.000
Yes	71	30.60%	207	49.60%			
Hypertension							
No	22	9.50%	60	14.40%	3.25	1	0.071
Yes	210	90.50%	357	85.60%			
Diabetes Mellitus							
No	159	68.50%	308	73.90%	2.096	1	0.148
Yes	73	31.50%	109	26.10%			
Alcohol							

Table continuation

Variables	Female		Male		Test of differences		
Number / Percent	N	%	N	%	χ2	DF	P value
No	217	93.50%	388	93.00%	0.056	1	0.812
BMI Category							
Underweight	0	0.00%	1	0.20%	4.486	5	0.486
Normal	50	21.60%	96	23.00%			
Over weight	93	40.10%	190	45.60%			
Obese -1	59	25.40%	89	21.30%			
Obese -2	23	9.90%	29	7.00%			
Obese -3	7	3.00%	12	2.90%			
Total Cholesterol							
Optimal	161	69.70%	303	73.00%	1.657	2	0.437
Intermediate	39	16.90%	70	16.90%			
High	31	13.40%	42	10.10%			
LVEF Category							
Preserved EF	154	66.4%	228	54.7%	13.18	2	0.001
Mid-Range EF	50	21.6%	92	22.1%			
Decreased	28	12.1%	97	23.3%			

Preserved LVEF was observed in 71.40% of patients under 40 years old, 28.6% of patients in the same category had a decreased LVEF.

Data in patients over 80 y. o. show that 50% of them had a preserved LVEF, 10% had mid-range LVEF and 40 % had a decreased LVEF.

Among patients between 40 – 49 years old 54.5% had a preserved LVEF, 18.2% had mid-range LVEF, 27.3% had a decreased LVEF.

In the category 50 – 59 years ago 59.9% of patients had a preserved LVEF, 22.5% had mid-range and 17.6% had a decreased LVEF.

In patients between 60 and 69 years old 55.5% of them showed preserved LVEF, 25.2% – mid-range LVEF, and 19.3% decreased- decreased LVEF (P = 0.055) (Table 2).

When we assess data, we found some differences of EF category with gender category. In female; 66.4% of female had preserved LVEF ,21.6% had mid-range LVEF,12.1% had a decreased LVEF. In male; 54.7% of patients had preserved LVEF, 22.1% had mid-range LVEF, 23.3% had a decreased LVEF (Table 3, Figure 1).

Some differences were seen in LVEF in patients with history of IHD; 43.5% of them with preserved LVEF, 28.4% with mid-range LVEF, and 28.1% with decreased LVEF. (P= 0,000). (Table 4, Figure 2).

Table 2 – Correlation of EF category with the category of age

| LVEF	<40		>80		40 – 49		50 – 59		60 – 69		70 – 79		Test of Differences	
	N	%	N	%	N	%	N	%	N	%	N	%	Chi square	PV
Preserved EF	5	71.4	15	50.0	18	54.5	85	59.9	152	55.5	107	65.6	18	0.055
Mid-Range EF	0	0.0	3	10.0	6	18.2	32	22.5	69	25.2	32	19.6		
Decreased EF	2	28.6	12	40.0	9	27.3	25	17.6	53	19.3	24	14.7		

Table 3 – Effect of gender on LVEF

		Female		Male		Test Differences	
		N	%	N	%	Chi – square	PV
LVEF	Preserved	154	66.4%	228	54.7%		
	Mid-Range	50	21.6%	92	22.1%	13.18	0.001
	Reduced	28	12.1%	97	23.3%		
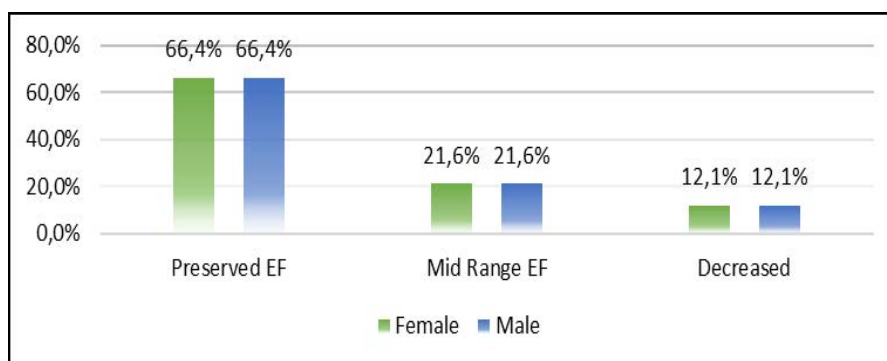
Figure 1 – Correlation of EF category with the category of age

Table 4 – LVEF fluctuations in patients with history of IHD

	Previous IHD					
	No		Yes		Test of Differences	
	N	%	N	%	X^2	PV
Preserved EF	261	70.4%	121	43.5%		
Mid-Range EF	63	17.0%	79	28.4%	48.46	0.000
Decreased EF	47	12.7%	78	28.1%		
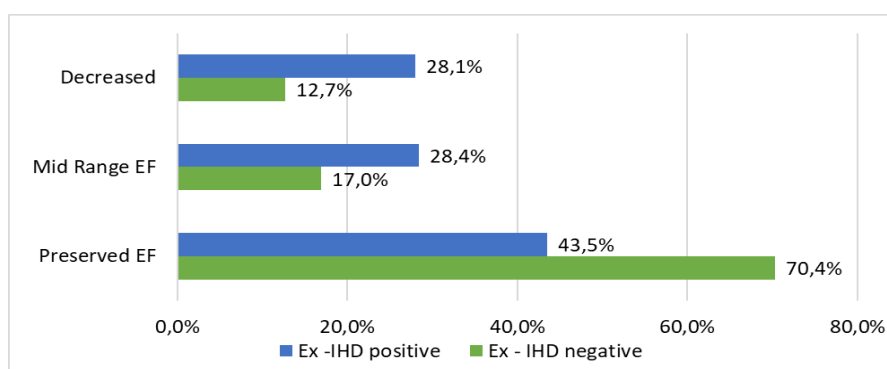
Figure 2 – LVEF fluctuations in patients with IHD history

Note: EF classification in two systems:

Decreased EF < 40%; Midrange EF = 40 – 49%; Preserved EF = 40 -49%, Normal≥50%

Normal = 55 -75%; Mild decrease =45 -54%; Mild decrease = 30 -44%; Severe LVEF decrease <30%; High EF>75%

Ischemic heart disease (IHD) is a main contributing pathogenic factor in HF, with an 8-fold increased risk of HF and a population-attributable risk of 65 % in men and 48 % in women [11]. The influence of IHD on HF and its subtypes is changing due to an aging population and increasingly successful treatment of acute coronary syndrome, which results in less severe myocardial damage and chronic remodeling. Recent evidence pointing to a temporal change in the mix of types of HF post-IHD cases, favoring HFmrEF and HFpEF over HFrEF, further emphasized this argument[12]. In our study average age of patients with decreased EF was 63.35±10 and average LVEF constituted 32.96±5.6. Average age of patients with mid-range EF was 63.9±9 and average LVEF – 44.67±2.78. Average age of patients with preserved EF was 64.4±9.17 with average LVEF being 61.74±6.82. A study performed by Vedin et al in 2017 including 14,277 IHD patients with decreased EF showed that of the average age was 76 years (P <0.001). In second group they observed 5,600 IHD patients with mid range EF,and found that the the average age was 77 years old (P <0.001). In third group they evaluated 5,222 IHD patients with preserved EF , and the average age in this group was 80 years old (P <0.001) [13].

The age of patients in a study performed by Elsman et al in 2006 showed that the age ranged between (60±12) years old in non-LAD and 59±11 years old in LAD patients. Overall average age made up 59.5 years old. In 9% of patients with non- LAD and 7% of patients with LAD DM influence the level of LVEF, in addition HTN was present in 22% of patients with non-LAD and 21% of patients with LAD suffered myocardial infarction[14].

In comparison with Vedin et al there were differences in ages, the reasons could be due to lack of knowledge about heart diseases, life style variations (heavy meal, sedentary life, impact of comorbidities, but there was no any difference between mean age in our study and the study of Elsman et al.

In our study mean LVEF was 55.8±11.8 with normal distribution, while in another study performed by Elsman et al in 2006 they compare mean LVEF in IHD (MI) patients with LAD (432) and non- LAD (456). LVEF one week after infarct in LAD group was 39% (28 -50), and in infarct with non-LAD was 49 % (41 – 57), and average LVEF in this study was 44 % (P<0.001), [14].

In a prospective study done by Chew et al in 2018 MI patients were assessed in three categories (no recovery, moderate increase in LVEF, significant increase in LVEF). [5]. In the first group they assessed 77 patients with baseline LVEF being 40 (36, 44) at the time of attack, in eight weeks again they evaluated LVEF and observed a decline in percentage of LVEF -2(-7,0), (P =0.3). In the second group a researcher evaluated 83 MI patients, in eight weeks they showed moderate increase in LVEF (Baseline LVEF 40 (38 ,45)), (P =0.3), and in eight weeks they found some significant positive signs of better outcome (7(4, 9)). In the third group they evaluated 88 MI patients with baseline LVEF 40 (35 , 43) (P =0.3), and assessment in eight weeks showed increase in LVEF (19 (15 ,24)) [5].

LVEF measurements in our study include all patients with ACS, chronic stable angina, variant angina, however we exclude number patients who had serious and fatal health status and died in hospital. There were no cases strenuous comorbidity diseases that significantly declined LVEF. One important risk factor for IHD and its complication is male gender which in our study is 64.3%, less than in a compared study (LAD group 83%, non – LAD 73%).

In a study done by Xing et al in 2020 they evaluated LVEF in patients with obstructive CAD, Coronary microvascular dysfunction (CMD) and in a control group; in obstructive CAD the LVEF was 70±4.2 , in CMD patients it was 70.6±4.7 and in the control group it was 71.1±4.7 (P =0.509) [15]. Professional cardiologist, equipped medical center, giving preventive information for citizens, following physicians' recommendations, and life style modifications were the reasons for good LVEF in this study.

Conclusion

In the performed study we found that EF moderately decreased in male patients than females. EF declined more moderately in patients with previous history of IHD in comparison to patients with no history of IHD. Hypertension and decreased HDLc were considered as significant risk factors in IHD patents with decreased EF.

Public awareness about cardiovascular diseases is the key for better results: Comorbidities such as HTN, DM, obesity, hyperlipidemia, and other risk factors should be early diagnosed and treated. Screening test should be performed in IHD patients' families for early detection of possible IHD.

1-There were significant differences in LVEF decline in both genders (p = 0.009).

2-Significant differences were seen in LVEF decline in patients with history of IHD. (p <0.001), but very weak or no association was present between decline of LVEF and other comorbidities.

3-There were not seen any significant differences in declined LVEF in category of age.

References

1.   Montalescot G, Sechtem U, Achenbach S, Andreotti F, Arden C, Budaj A, et al. 2013 ESC guidelines on the management of stable coronary artery disease. Eur Heart J. 2013;34(38):2949–3003.

2.   Ibanez B, James S, Agewall S, Antunes MJ, Bucciarelli-Ducci C, Bueno H, et al. 2017 ESC Guidelines for the management of acute myocardial infarction in patients presenting with ST-segment elevation. Eur Heart J. 2018;39(2):119–77.

3.   Piepoli MF, Hoes AW, Agewall S, Albus C, Brotons C, Catapano AL, et al. 2016 European Guidelines on cardiovascular disease prevention in clinical practice. Eur Heart J. 2016;37(29):2315–81.

4.   Thanavaro S, Kleiger RE, Province MA, Hubert JW, Miller JP, Krone RJ, et al. Effect of infarct location on the in-hospital prognosis of patients with first transmural myocardial infarction. Circulation. 1982;66(4 I):742–7.

5.   Chew DS, Heikki H, Schmidt G, Kavanagh KM, Dommasch M, Bloch Thomsen PE, et al. Change in Left Ventricular Ejection Fraction Following First Myocardial Infarction and Outcome. JACC Clin Electrophysiol. 2018;4(5):672–82.

6.   Halkin A, Stone GW, Dixon SR, Grines CL, Tcheng JE, Cox DA, et al. Impact and determinants of left ventricular function in patients undergoing primary percutaneous coronary intervention in acute myocardial infarction. Am J Cardiol. 2005;96(3):325–31.

7.   Song L, Brezden-Masley C, Ramanan V, Ghugre N, Barfett JJ, Chan KKW, et al. Serial Measurements of Left Ventricular Systolic and Diastolic Function by Cardiac Magnetic Resonance Imaging in Patients with Early Stage Breast Cancer on Trastuzumab. Am J Cardiol [Internet]. 2019;123(7):1173–9. Available from: https://doi.org/10.1016/j.amjcard.2018.12.046

8.   Moon YJ, Kim JW, Bang YS, Lim YS, Ki Y, Sang BH. Prediction of all-cause mortality after liver transplantation using left ventricular systolic and diastolic function assessment. PLoS One. 2019;14(1):1–16.

9.   Alushi B, Douedari A, Froehlig G, Knie W, Wurster TH, Leistner DM, et al. Impella versus IABP in acute myocardial infarction complicated by cardiogenic shock. Open Hear. 2019;6(1):1–10.

10. Yoshihisa A, Ichijo Y, Sato Y, Kanno Y, Takiguchi M, Yokokawa T, et al. Comprehensive clinical characteristics of hospitalized patients with mid-range left ventricular ejection fraction. Eur J Prev Cardiol. 2020;27(19):2084–8.

11. Lund LH, Mancini D. Heart failure in women. Med Clin North Am. 2004;88(5):1321–45.

12. Gerber Y, Weston SA, Berardi C, McNallan SM, Jiang R, Redfield MM, et al. Contemporary trends in heart failure with reduced and preserved ejection fraction after myocardial infarction: A community study. Am J Epidemiol. 2013;178(8):1272–80.

13. Vedin O, Lam CSP, Koh AS, Benson L, Teng THK, Tay WT, et al. Significance of Ischemic Heart Disease in Patients with Heart Failure and Preserved, Midrange, and Reduced Ejection Fraction: A Nationwide Cohort Study. Circ Hear Fail. 2017;10(6):1–4.

14. Elsman P, van't Hof AWJ, de Boer MJ, Suryapranata H, Borm GF, Hoorntje JCA, et al. Impact of infarct location on left ventricular ejection fraction after correction for enzymatic infarct size in acute myocardial infarction treated with primary coronary intervention. Am Heart J. 2006;151(6):1239.e9-1239.e14.

15. Xing X, Li D, Chen S, Wang L, Li Z, He L. Evaluation of left ventricular systolic function in patients with different types of ischemic heart disease by two-dimensional speckle tracking imaging. J Cardiothorac Surg. 2020;15(1):1–11.