Echocardiographic Correlation of Clips Classification to Asses Left Ventricular Function in Patients with Acute Myocardial Infarction

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Abstract: Objective: To correlate killip class with left ventricular dysfunction on echocardiography in patients with acute myocardial infarction. **Study Design:** Descriptive case series study. **Sample technique:** Non-probability consecutive. **Materials and methods:** 150 consecutive patients were included in this study. The present study was conducted on the newly diagnosed cases of acute myocardial infarction visiting emergency of cardiology department Liaquat University of Medical health science Hyderabad/Jamshoro, over a period of one year. Patients with prior history of acute myocardial infarction, valvular heart disease, cardiomyopathy, cardiac surgery, congenital heart disease, and patients with co-morbidities like renal failure, chronic liver disease, anemia, gastroenteritis, dehydration and chest diseases were not included in this study. Patients were classified as per killip's classification and 2D echo was performed on patients within 24hours of admission. Findings of clinical examination (presenting killip class) were correlated with two-dimensional and Doppler echocardiographic findings. **Results:** Patients included in this study were grouped into four Killip classes separately in ST and Non ST elevation myocardial infarction. 107 (71.5%) cases were found with ST elevation MI, while NST elevation MI patients were found 43 (28.5%). In ST Elevation MI killip classes were found as: Class 1 (74.7%), Class II (14%), Class III (9%), and Class IV (8%). In Non ST elevation MI kilip classes were found as: Class I (79%), Class II (9.3%), Class III (6.9%) and Class IV (4.6%). Early mortality rate was greater in patients with both reduced ejection fraction EF 30% or < 30% and a higher Killip class. Patients with lower ejection fraction when they were in class1/11 compared with those in killip class 111/1V had increased morbidity and mortality. Mortality was more in STEMI 4.6% as compared with NSTEMI 1.1%, and in the STEMI cases mortality mostly found in class IV. **Conclusion:** Echocardiographic left ventricular ejection fraction obtained after an acute myocardial infarction is an affordable and readily available technique, which provides important prognostic information regarding patient's clinical outcome along with prognosis. From our study, we conclude that Echocardiographic findings are correlated with Killip Class. Patients with higher Killip Class have lower ejection fraction, increased left ventricular size and complications.

1.   Introduction

Cardiovascular disease has a major impact on global health. Among the cardiovascular diseases acute myocardial infarction is the leading cause of mortality and morbidity in the world. Early detection of patients with acute myocardial infarction (AMI) at risk of development of in-hospital congestive heart failure (CHF) is necessary to limit myocardial injury and left ventricular (LV) dysfunction. Early non-invasive evaluation of LV function assessed by echocardiography reduces morbidity and mortality in acute myocardial infarction. Heart failure significantly worsens the prognosis of patients with acute myocardial infarction[1]. Myocardial infarction (MI) commonly triggers left ventricular (LV) remodeling, progressive deterioration of cardiac function, and ultimately, the clinical syndrome of heart failure (HF).[2] Several factors, such as recurrent myocardial ischemia, infarct size, ventricular remodeling, stunned myocardium, mechanical complications, and hibernating myocardium determine the appearance of left ventricular systolic dysfunction with or without clinical HF after MI.[3–4] Heart failure is a common complication of MI[5] with the estimated incidence varying from 10% to 40%[6].

Post-MI HF is associated with a markedly elevated risk of death, with an estimated median survival of 4 years[7.] Considering the kind of cardiac dysfunction following MI, most patients present with systolic dysfunction. Consequences of cardiac dysfunction after MI are well established, and its presence increases the risk of death by at least 3–4 fold[8]. Compared with patients without heart failure and left ventricular systolic dysfunction after myocardial infarction, patients who have heart failure and left ventricular systolic dysfunction are at higher risk for adverse outcomes including cardiac rupture, cardiac arrest, stroke, longer hospitalizations, ventricular arrhythmias, recurrent myocardial infarction, and death, including sudden death[9-10]. In-hospital mortality in patients with acute myocardial infarction is predominantly related to heart failure,

shock and mechanical complications (acute mitral regurgitation, ventricular septal rupture, and free wall rupture). Heart failure and shock are primarily the consequences of contractile dysfunction of the left ventricle[11]. Cardiogenic shock is the most common cause of death in patients hospitalized with acute myocardial infarction and is associated with a poor prognosis. Cardiogenic shock was the commonest complication with frequency of 25.8% followed by acute left ventricular failure (LVF) in 17.8% and atrioventricular blocks[12]. Coronary artery disease is the leading cause of mortality and morbidity globally and acute myocardial infarction is the commonest mode of presentation[13]. In patients with acute myocardial infarction heart failure is characterized either by systolic dysfunction alone or by both systolic and diastolic dysfunction[14].

The echocardiogram is a standard tool in the management of patients with acute myocardial infarction (MI). The role of echocardiography in establishing the diagnosis, location, ejection fraction, and extent of myocardial infarction (MI), in diagnosing mechanical complications of infarction, and in providing prognostic information that is important for risk stratification will be reviewed[15]. The value of echocardiography as a tool for evaluating the prognosis of patients after myocardial infarction lies in its ability to define the region, extent of ischemic damage and left ventricular function. Complications of myocardial infarction such as right ventricular infarction, the location of interventricular septal rupture, and papillary muscle rupture, and papillary muscle dysfunction, formation of mural thrombi or left ventricular thrombi, severity of mitral regurgitation, ventricular aneurysms and pseudo aneurysms, and pericardial effusion can be diagnosed echocardiographically at the bedside. This diagnostic tool can provide vital information regarding the appropriate clinical management of patients after myocardial infarction[16]. Ventricular septal rupture (VSR), which can complicate an acute myocardial infarction (MI), carries a high mortality rate. Echocardiography can identify the type of rupture and assess right ventricular (RV) function at the patient's bedside[17.] Mitral regurgitation (MR) has been associated with adverse outcomes after myocardial infarction (MI). Echocardiography plays an essential role in the early diagnosis of MR, estimating its severity, the mechanisms and also the prognosis[18]. The echocardiography performed in the early stages of disease should be integral part of the treatment of the acute myocardial infarction and by this modality we can reduce morbidity and mortality of acute myocardial infarction.

2. Material & Methods

Setting: Department of cardiology, LUMHS, Hyderabad.

Sample size: The sample size calculation was done using the raosoft software for "Sample size calculation" by using the proportion (prevalence of coronary artery disease (CAD) has been reported as being 11%)[122], with 95% confidential interval and 5% of margin error, the sample size stands to be n=150.

Sample technique: Non-probability consecutive.

Study Design: Descriptive case series study.

Sample Selection:

Inclusion criteria: Newly diagnosed cases of acute myocardial infarction, of all age and either sex.

Exclusion criteria: The patients with: Previous history of acute myocardial infarction. Congenital Heart diseases. Patients having chest diseases. Patients having comorbids like chronic renal failure, chronic liver disease, gastroenteritis and anemia. Valvular heart diseases.

Data Collection Procedure:

Newly diagnosed cases of acute myocardial infarction requiring Hospitalization & meeting inclusion criteria were enrolled in this study. History was recorded and a detailed clinical examination was done in all patients for heart failure according to Killip classification system, & all routine / baseline investigations were performed. Depending on severity every patient was put on a cardiac monitor & vital signs were recorded every 4 hours for the first three days then thrice daily. An informed consent was taken from every patient or attendant of patient after explaining the purpose of the study.

Following investigations were done in every relevant patient.

3. Results

In this study total 150 patients with acute MI were included; patient's age was found as, mean+SD of 42.5+5.43, and majority of the cases were found 46- 55 years with percentage of 64(42.6%). Results are shown in **Table: 1.**

Table No. 1. Demographic Variable N = 150

Gender	Frequency (%)
Mean+SD	42.4+5.43
Age groups	
25 – 35	09 (6.0%)
36 – 45	39 (26.0%)
46 – 55	64 (42.6%)
56 – 65	30 (20.0%)
> 65	08 (5.3%)

Male were found in majority 96(64%) and females were found 54(36%) (**Table: 2).**

Table No. 2. Gender Distribution N = 150

Gender	Frequency	%
Male	96	64%
Female	54	36%

According to the risk factors hypertension was most common 70%, while second most common risk factor was smoking 59%, and 3rd most common was family history and diabetes, results shown in Figures.
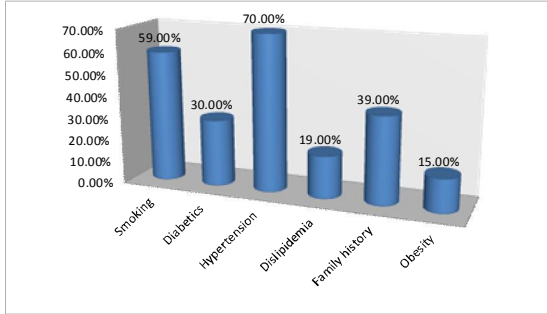

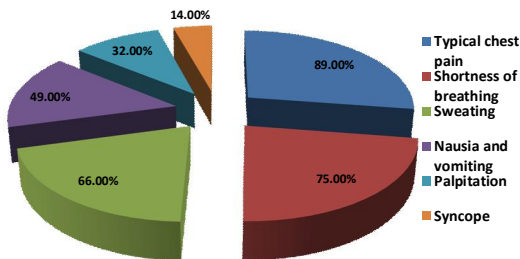**FIG: 1. Risk factors presentation (n=150)**

FIG: 2. Presenting symptoms in the patients (n=150)

Among the total cases 107(71.5%) cases were found with ST elevation MI, while NST elevation MI patients were found 43(28.5%).

Table: 3. Distribution of Stemi and Nstemi (N=150)

MI	N. of pt. (%)
STEMI	107(71.5%)
NSTEMI	43(28.5%)

In the patients with STEMI, Killip's classification was found as; Class I 80(74.7%) Class II 15 (14.0%), Class III 09(8.4%) and Class IV 03 (2.8%). While in the cases of NSTEMI Killip's classification was found as Class I 34 (79.0%) Class II 04(9.3%), Class III 03(6.9%) and Class IV 02(4.6%).

Table: 4. Killip's Classification of Mi (N=150)

STEMI n= 107		NSTEMI n= 43	
Classification	N. of pt (%)	Classification	N. of pt (%)
Class I Class II Class III Class IV	80 (74.7%) 15 (14.0%) 09 (8.4%) 03 (2.8%)	Class I Class II Class III Class IV	34 (79.0%) 04 (9.3%) 03 (6.9%) 02 (4.6%)

Types of STEMI were found in the different killips classification with significant difference p value 0.01, like as; Inferior wall MI was the most common and totally cases were noted in class I, Anterior wall MI was the 2nd most common and mostly found in class I.

TABLE: 5. Types of STEMI and Killips classes (n=107)

Types of STEMI	KILLIPS		CLASSES		
	Class I	Class II	Class III	Class IV	
Anterior wall MI	20(18.6%)	14(13.0%)	10(18.6%)	03(2.8%)	P-Value
EXT, AWMI	08(7.4%)	05(4.6%)	04(3.7%)	01(0.9%)	
Inferior wall MI	21(19.5%)	00	00	00	
Inferior + RV MI	14(13.0%)	03(2.8%)	00	00	0.01
Lateral wall MI	02(1.8%)	00	0	00	
AVR STEMI	00	00	01(0.9%)	01(0.9%)	

Blood urea was normal in **116(**77.4%), raised in **27(**18%) and not done in 7(4.6%) of cases. Serum Creatinine was found normal in 122(82%), raised in 20(13%) and not done in 8(5%) of cases.

Echocardiographic findings in STEMI patients and its correlation with Killip's classication shows, that ejection fraction decreases and left ventricular dimensions increase with higher killip class. Also percentage of left ventricle thrombus, mitral regurgitation and ventricular septal rupture increases with increase in killip class.

Echocardiographic findings in NSTEMI patients and its correlation with Killip's classication shows, that ejection fraction decreases and left ventricular dimensions increase with higher Killip class. Also percentage of left ventricle thrombus, mitral regurgitation increases with increase in Killip class.

TABLE: 6. Distribution of Urea and creatinine in the cases n=I50

UREA					
NORMAL		RAISED		NOT DONE	
FREQ	%	FREQ	%	FREQ	%
116	77.4	27	18	7	4.6
CREATININE					
NORMAL		RAISED		NOT DONE	
FREQ	%	FREQ	%	FREQ	%
122	82	20	13.4	8	5

Table No: 7left Ventricular Ejection Fraction Correlation with Killip Class in Stemi N=107

ECHO-FINDINGS	CLASS I N. of pts (%)	CLASS II N. of pts (%)	CLASS III N. of pts (%)	CLASS IV N. of pts (%)
*LVEF 30% OR <30%	3 (2.8%)	5 (4.6%)	6 (5.6%)	8 (7.4%)
*LVEF 31-49%	43 (40%)	17(15%)	7 (6.5%)	2 (1.86%)
*LVEF 50% OR >50%	13(12.14%)	2(1.86%)	1(.9%)	0
**LVESD (mm)	22-39	30-48	31-50	32-52
***LVEDD (mm)	40-50	41-55	43-64	43-69
LV THROMBUS	1 (.9%)	1 (0.9%)	3 (2.8%)	2(1.86%)
****VSR	0	0	0	1 (apical VSR)(.9%)
*****MR	3 (2.8%)	5 (4.6%)	3 (2.8%)	2 (1.86%)

*left ventricle ejection fraction, **left ventricle end Systolic, dimension,*** left ventricle end diastolic dimension, **** ventricular septal rupture, *****mitral regurgitation

Table No: 8. Left Ventricular Ejection Fraction Correlation with Killip Class in Nstemi N=43

ECHO-FINDINGS	CLASS I frequency	CLASS II frequency	CLASS III frequency	CLASS IV frequency
*LVEF 30% OR <30%	1 (2.3%)	1 (2.3%)	2 (4.6%)	2 (4.6%)
*LVEF 31-49%	11 (25.5%)	7(16.2%)	4 (3.7%)	1 (2.3%)
*LVEF 50% OR >50%	12(27.9%)	1(2.3%)	1 (2.3%)	0
**LVESD (mm)	20-38	26-39	29-43	30-47
***LVEDD (mm)	25-48	40-5	42-54	43-62
LV THROMBUS	0	0	0	1 (2.3%)
****VSR	0	0	0	0
*****MR	1 (2.3%)	1 (2.3%)	2 (4.6%)	1 (2.3%)

*left ventricle ejection fraction, **left ventricle end Systolic, dimension, *** left ventricle end diastolic dimension,**** ventricular septal rupture, *****mitral regurgitation

In this study complications of acute myocardial infarction were noted with the significant difference in different killips classifications P value 0.01.

TABLE: 9 Correlation of complications with MI (n=150)

Types of STEMI	KILLIPS		CLASSES		
	Class I	Class II	Class III	Class IV	P Value
Arrhythmias	08(5.3%)	03(2.0%)	01(0.6%)		
Stroke	00	00	03(2.0%)	01(0.6%)	
Shock	00	00	00	07(4.6%)	
Pericarditis	00	00	01(0.6%)	01(0.6%)	
Mechanical (acute MR)	04(2.6%)	06(4.0%)	05(3.3%)	03(2.0%)	0.01
Mechanical VSR	00	00	00	01(0.6%)	

Mortality was more in STEMI 4.6% as compared with NSTEMI 1.1%, and in the STEMI cases mortality mostly found in class IV.

TABLE: 10 Mortality of the patients (n=150)

STEMI n= 107				
Class I 00	Class II 01	Class III 01	Class IV 03	Total 05(4.6%)
NSTEMI n= 43				
Class I 00	Class II 01	Class III 00	Class IV 01	Total 02(1.1%)

Mean ejection fraction of patients with STEMI was as follows: Killip's class 1 was 40.61% $\pm$ 9.4, Class 2 was 35.62% $\pm$ 9.3, and class 3 was 27.78% $\pm$ 1.16% and in class 4 were 19.90% $\pm$ 9.2%.
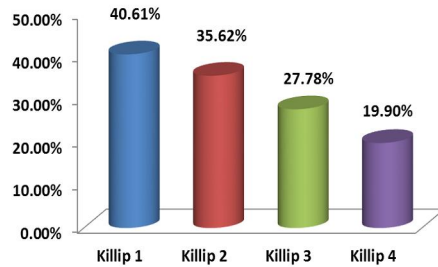

Fig: 3. STEMI mean EF in different types of Killip's classes

There was a statistically highly significant correlation between ejection fraction and Killip's class: the greater the Killip class the less the ejection fraction (P<0.001) after applying ANOVA test.

Mean ejection fraction in patients with NSTEMI was as follows: Killip's class 1 was 45.33% $\pm$ 9.2, Class 2 was 36.44% $\pm$ 7.9, and class 3 was 32.28% $\pm$ 4.6 and in class 4 was 24.33% $\pm$ 5.2.
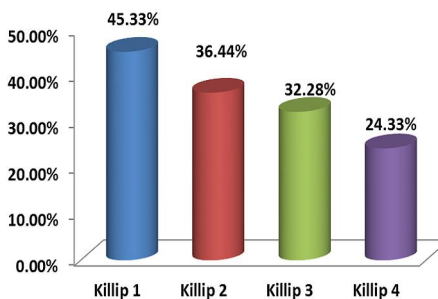

Fig: 4. NSTEMI mean EF in different types of Killip's classes

There was a statistically significant correlation between ejection fraction and Killip's class: the greater the Killip class the less the ejection fraction (P = 0.001) after applying ANOVA test.

4. Discussions

The key findings of this study were the following[19], Killip Class II, III, and IV patients had higher risk profiles and rates of major adverse clinical events across AMI.[20] Classes II, III, and IV were associated with higher rate of death in patients presenting with STEMI as well as NSTEMI. In this series male were found in majority 64% and females were found 36%. Masood A et al,[21] had also found male in the majority 75% as compared to female 25%. A study on coronary artery disease, it reported that the total 42% patients were hypertensive.[22] Study of Arvind kumar et al, was found high smoking rate as risk factor and also majority of males were involved.[23] In the study of masood A et al,[24] Eighty-six (53.8%) patients were hypertensive, 66 (41.3%) were smokers, 58 (36.3%) had diabetes mellitus, 38 (23.8%) patients had family history of ischemic heart disease and 40 (25%) patients had dyslipidemia. While in the present study hypertension was most common 70%, while second most common risk factor was smoking 59%, and 3rd most common was family history and diabetes. In this study among the total cases 71.5% cases were found with ST elevation MI, while NST elevation MI patients were found 28.5%. Similarly Bruno Henrique et al,[25] identified 64% of the patients with STEMI and 36% with NSTEMI. Khan SH et al,[26] reported (52%) patients had STEMI while (48%) were non-STEMI (NSTEMI). Ninety-eight (37%) patients had heart failure while 166 (63%) didn't develop heart failure. Forty-four (44.9%) patients were in Killip Class II, 35 (35.71%) were in Killip Class III, and 19 (19.39%) were in Class IV, as well as in the present study STEMI Killip's classification was found as; Class I (74.7%) Class II (14.0%), Class III (8.4%) and Class IV (8.4%), and in all the cases of NSTEMI Killip's classification was found as Class I (79.0%) Class II (9.3%), Class III (6.9%) and Class IV (4.6%). Masood A et al,[115] stated one hundred and two (63.8%) patients had anterior wall, 50 (31.3%) had inferior wall, 6 (3.8%) had posterior wall and 2 (1.3%) had lateral wall myocardial infarction. In this study cases

of ST elevation as; Anterioseptal wall MI, Inferior wall MI, Anteriolateral wall MI, Inferior + RVMI, Lateral wall MI, Posterior wall MI and AVR STEMI, 29%, 26%, 22%, 14%, 3.7%, 2.8%, and 1.8% respectively. According to the Echocardiographic findings in both STEMI and NSTEMI patient's ejection fraction have been decreased with the elevation of killip class. These findings can be compared with results of Ayman El-Menyar MBChB et al,[27.] Mean ejection fraction of patients with STEMI was found with significant difference (P<0.001) as follows: Killip's class 1 was 40.61% + 9.4, Class 2 was 35.62% + 9.3, and class 3 was 27.78% + 1.16% and in class 4 was 19.90% + 9.2%. N. Salehi MD, et al.[26] mentioned that mean ejection fraction in patients was as follows: Killip's class 1 was 37.84+ 7.84, Class 2 was 33.49+ 9.38, class 3 was 17.69%+8.98 and in class 4 was 17.14+8.9, significant correlation between ejection fraction and Killip's class: the greater the Killip's class the less the ejection fraction (P<0.0001). Similarly Jitendra Kodilkar et al,[28] reported that, severity of the infarction increased with the increase in the Killip class. Mean ejection fraction was also observed to be decreasing in patients with increase in severity of the infarction. In this study complications associated with acute myocardial infarction were noted as arrhythmias, stroke, shock, pericarditis, mechanical (acute MR) and mechanical VSR with the percentage of 7.9%, 2.6%, 4.6%, 1.2%, 11.9% and 0.6%respectively. Similarly Masood A et al,[29] reported post MI arrhythmias were in 2 (2.2%) patients, cardiogenic shock was noted in 6 (6.7%) patients, pulmonary oedema occurred in 6 (6.7%) patients and death occurred in 4 (4.4%) patients. While in this study death was more in STEMI 4.6% as compared with NSTEMI 1.1% and in the STEMI cases mortality mostly found in class IV. While N. Salehi MD, et al.[30, 31] reported mortality in n Killip's class 4, all patients died (100%). In class 3, four patients died (31%); while in class 2, five patients (9%) and in class 1, 2 patients (3%) died.

Conclusion

Echocardiography is a reliable, accurate and easily available modality for the evaluation of patients with coronary artery disease. Echocardiographic left ventricular ejection (EF) and wall motion score index (WMSI) obtained shortly after an acute myocardial infarction is a non-invasive and readily available technique, which provides important prognostic information regarding patient's clinical outcome. From our study, we conclude that Echocardiographic findings are correlated with Killip Class. Patients with higher Killip class have Lower ejection fraction, increased left ventricular size and complications. Left ventricular ejection fraction measured at the bedside

in patients with acute myocardial infarction, is a risk stratification tool of great value to the clinician treating patients with acute MI. Assessment of left ventricular function at the time of admission is an effective predictor of in- hospital mortality and long-term outcome and maintains its place as one of the most useful tool in the management of patients with acute Ml and by using this modality we can reduce morbidity and mortality in patients of acute myocardial infarction.

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