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Original Research Article

Echocardiographic assessment of left ventricular function in patients of acute myocardial infarction

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ABSTRACT

Background: 2D Echo can evaluate LV anatomy, function and diagnose post AMI complications in early stages, thus help in management and determining the prognosis. The present study was undertaken to evaluate LV function in patient following AMI and also to find out the incidence of various echocardiographically detectable complications of following AMI.
Methods: The present study was conducted on patients visiting our tertiary health centre during study duration. 50 patients were included in the study. Patients with prior history of acute myocardial infarction, pericarditis and early repolarisation syndrome, and primary myocardial disease diagnosed by serum enzyme levels were not included in the study. Patients were classified as per Killip classification and 2D echo study was performed in all patients.
Results: Maximum incidence of AMI was found in 51-60 years of age, with male predominance (64%). Anterior wall AMI (58%) was more common. 94% of patients had wall motion abnormalities. Incidence of LV thrombus was found to be 24%. In present study, as the extent and severity of wall motion abnormalities increased, the incidence of LV thrombus also increased. Thus, 2DE study of LV regional wall motion can predict the incidence of LV thrombus.
Conclusions: The echocardiographic assessment of LV function in patients of AMI is important as, it detects the regional wall motion abnormality, LVEF and also the complications like LV thrombus, pericardial effusion and LV aneurysm. These observations are of great value in the management of AMI.

Keywords: AMI, Echocardiography, LV function, Wall motion abnormality

INTRODUCTION

Acute myocardial infarction is one of the leading causes of death in developing countries like India. The mortality rate with AMI is approximately 30%. Although mortality rate after hospital admission for AMI has declined by about 30% over the last two decades, approximately 1 of every 25 patients who survive the initial hospitalization die in first year after AMI.[1] Survival after AMI is markedly reduced in elderly patients (age over 75 years) cardiogenic shock, LV failure and Arrythmias are the leading cause of death early post AMI period. While LV dysfunction and thromboembolism contribute to late mortality and morbidity.

After AMI, LV undergoes a series of changes in shape, size and thickness in both the infarcted and non-infarcted segments. This process is called ventricular remodeling.

This leads to progressive dilatation of ventricles with ventricular dysfunction. This dysfunction gives rise to late complications after AMI.

To diagnose LV dysfunction a noninvasive, inexpensive and effective investigation named echocardiography came in use.

Echo sounding, a technique first used by man in 1920's for the purpose of oceanographic studies and submarine detection.

Later echo sounding found its application in human medicine and then the technique of echocardiography gradually developed.

In echocardiography, electrical energy is converted into sound energy, which is propagated as a beam. The reflected echoes are perceived and images of heart are constructed.

Ebina et al developed the technique of 2-D echo under the name of 'cardiotomography'.[2]

2D Echo has become an ideal, noninvasive, informative technique with following advantages.

- It is a noninvasive, safe procedure with no known side effects or complications
- It is painless and can be employed in any setting without patient preparation, discomfort or inconvenience
- It is not time consuming
- It can be done at the bedside
- It can be used repeatedly to follow up serial changes over a period of time.

Thus, in patients with myocardial infarction in the early stages, when the patients are hemodynamically unstable and cannot be taken out of ICCU but at the same time need thorough evaluation of cardiac function for adequate management, quick, bedside, noninvasive, painless and useful investigation like 2D echo is ideal.

The prognosis in survivors of sufferers with AMI relies upon on multiple elements, which relate both to the extreme event, consisting of infarct size, region, transmurality and so forth; as well as age, sex, cardiovascular risk factors which include diabetes mellitus, high blood pressure, dyslipidemia etc and records of earlier infarction.[3]

However, the single most significant determinant of survival is post-infarction left ventricular systolic function.[4]

Even in the era of primary PCI, post-infarction LV systolic function remains the important prognostic factor which influence both immediate and long-term mortality. In patients with AMI, determination of LV systolic function is very important for risk-stratification which in turn help to make suitable therapeutic strategy and measures to avoid further progression of LV systolic impairment and overt heart failure.[5]

2D Echo can evaluate LV anatomy, function and diagnose post AMI complications in early stages, thus help in management and determining the prognosis.

The present study was undertaken to evaluate left ventricular function in patients following AMI and to find out the incidence of various echocardiographically detectable complications following AMI.

METHODS

A total number of 50 patients over period of study duration were included in the study. Written informed consent was obtained from all patients and the study protocol was approved by the ethics committee of the institute. All the patients having first episode of AMI were included in the present study. The following patients were excluded from the study because it was decided that they may interfere with the inference.

- Patients with prior history and treatment records suggestive of acute myocardial infarction
- Patients whose echo could not be done due to technical reasons
- Patients with pericarditis and early repolarisation syndrome diagnosed by
    a) Typical clinical presentation
    b) Electrocardiogram
- Patients with primary myocardial disease diagnosed by serum enzyme levels.

Diagnosis of AMI

The diagnosis of AMI is considered only if the patient has fulfilled any two of the following WHO criteria for acute myocardial infarction.

The characteristic clinical presentation

- History of typical chest pain
- Associated symptoms and sings.

The electrocardiographic changes

All the patients were subjected to 12 lead electrocardiograms with right sided leads. According to Braunwald, Heart Disease, a textbook of cardiovascular medicine, electrocardiographic changes in AMI are as follows;[6]

- Increased ventricular activation time
- Increased amplitude of 'R' wave
- Slope elevation of ST segment
- Tall and widened T waves.

The associated elevated levels of serum enzymes of cardiac damage

(like CPK-MB, Troponin T, troponin I, myoglobin, lactate dehydrogenase)

Criteria for site of myocardial infarction

Acute myocardial infarction is divided into

- Q wave AMI
- Non-Q wave AMI (subendocardial infarction)

a) Electrocardiographic criteria for Q wave AMI -

- Increased amplitude of 'R' wave
- Slope elevation of 'ST' segment
- Significant Q waves (duration more than 0.04 sec)
- Tall T waves
- Reciprocal 'ST' segment depression.

b) Electrocardiographic criteria for non-Q wave AMI (Subendocardial Intarction)

- ST segment depression in more than two leads
- Symmetrical, deeply inverted T waves
- No evidence of Q waves.

Site of Acute myocardial infarction

a) Anterior wall AMI

- ST-T changes of AMI in lead I, aVL, V1-V6
- Reciprocal changes in lead II,III, aVF.

b) Inferior wall AMI

- ST-T changes in lead II,III,aVF
- Reciprocal changes in I, aVL, VI-V6.

c) True posterior wall AMI

- Abnormal tall R waves in V1 (R/S>1.0)
- ST segment depression with concavity upward in lead V1-V2 Tall, symmetrical T wave in lead V1-V2.

d) Right ventricular infarction

- ST segment elevation of 1 mm or more in lead V1, V2 or right precordial leads mainly V4 R.

e) Any combination of the above

- All patients were subjected to detailed history and physical examination with special reference to arterial pulse, jugular venous pulse, blood pressure and systemic examination.

Every patient was classified according to the signs of cardiac failure by Killip and Kimball classification as follows -

- Class I - rales and S3absent
- Class II - rales over < 50% of lung fields
- Class III - rales over > 50% of lung fields (pulmonary edema)
- Class IV - shock.

A 2D echo study was performed in all patients. 2D echoes were performed by the same cardiologist in all patients; hence observer's bias was reduced to a very large extent.

Following views were used in studying the LV

- Parasternal long axis view
- Parasternal short axis view at the level of mitral valve
- Apical 4 chambers view / apical 2 chamber views.
- Subcostal view.

The following 2D echo parameters were used in examination of the patient

a) LV internal dimensions

- At the end of systole (LVESD)
- At the end of Diastole (LVEDD)

b) LV ejection fraction

$$LVEF\ (\%) = \frac{\text{LV diastolic volume} - \text{LV systolic volume}}{\text{LV diastolic volume}}$$

c) Interventricular septum thickness

d) EPSS - mitral E point septal separation

- Distance between E point of mitral valve and the interventricular septum.

e) Detection of wall motion abnormalities,

- Hypokinesia
- Akinesia
- Dyskinesia.

Following abnormal conditions were screened in all these patients

- Mural thrombus
- Ventricular aneurysm
- Papillary muscle dysfunction
- Rupture of interventricular septum
- Pericardial effusion.

Statistical analysis

Descriptive statistics such as frequency and percentage was used to present the data. Data analysis was done by using Microsoft Excel and Epinfo.

RESULTS

Thus, the incidence of AMI is more common in age group 51-60 years with male dominance. The male dominance is more marked in age group less than 40 years (Table 1).

Table 1: Age and sex distribution.

Age (years)	Male	Female	Total
<40	3	1	4 (8%)
41-50	5	2	7 (14%)
51-60	19	7	26 (52%)
61-70	4	6	10 (20%)
>70	1	2	3 (6%)

Table 2: Incidence of AMI according to myocardial wall involvement.

Site of MI	Total no. of cases	Percentage
Anterior	29	58%
Inferior	14	28%
Global	7	14%

The Table shows that anterior wall myocardial infarction is more common than any other type of AMI (Table 2).

Table 3: Incidence of wall motion abnormality.

Wall motion	Total no. of cases	Percentage
Normokinetic	3	6%
Hypokinetic	7	14%
Akinetic	24	48%
Dyskinetic	16	32%

In the present study, 47 patients (94%) had abnormal wall motion (Table 3).

Table 4: Wall motion abnormality in anterior, inferior and global wall AMI.

Wall motion	Anterior		Inferior		Global	
	No. of cases	%	No. of cases	%	No. of cases	%
Normokinetic	0	-	3	21.4	0	-
Hypokinetic	1	3.4	6	42.9	0	-
Akinetic	16	55.2	4	28.6	4	57.1
Dyskinetic	12	41.4	1	7.1	3	42.9

In the present study, all the patients of anterior wall AMI showed abnormal wall motion ranging from hypolinesia to dyskinesia. Out of 14 patients of inferior wall AMI, 11 (78.6%) patients showed wall motion abnormality. In global AMI, the incidence of wall motion abnormality was 100% with more severe forms of abnormalities detected (Table 4).

Table 5: Incidence of LV thrombus in AMI.

Site of AMI	LV thrombus		Total
	Present (%)	Absent (%)	
Anterior wall AMI	10 (34.4)	19 (65.5)	29
Inferior wall AMI	1 (7.1)	13 (92.9)	14
Global AMI	1 (14.3)	6 (85.7)	7

It was observed that, incidence of LV thrombus was highest in anterior wall AMI (Table 5).

This table shows that LV thrombus was detected in patients of wall motion abnormality and as the wall motion became worse the incidence also went on increasing (Table 6).

Table 6: Incidence of LV thrombus in relation to wall motion abnormality.

Wall motion abnormality	LV thrombus		Total
	Present (%)	Absent (%)	
Normal	0	3 (100)	3
Hypokinetic	1 (14.2)	6 (85.7)	7
Akinetic	5 (20.8)	19 (79.2)	24
Dyskinetic	6 (37.5)	10 (62.5)	16

This table shows that LVEF was mainly affected in global and anterior wall AMI (Table 7).

Table 7: Ejection fraction in AMI.

Site of AMI	Ejection fraction		Total
	<40	> 40	
Anterior wall infarction	23 (79.3%)	6 (20.6%)	29
Inferior wall infarction	3 (21.4%)	11 (78.5%)	14
Global infarction	7 (100%)	-	7

The Table shows that the mortality was highest in global AMI while no deaths occurred in patients of inferior wall AMI (Table 8).

Table 8: Mortality in acute myocardial infarction.

Site of AMI	No. of patients	No. of deaths
Anterior wall infarction	29	4 (13.8%)
Inferior wall infarction	14	0
Global infarction	7	4 (57%)
Total	50	8 (16%)

DISCUSSION

Age distribution

In the present study, maximum number of patients were found in the age group 51-60 years (52%). Next common group being 61-70 years (20%)

Incidence of AMI in age group less than 40 years was 8%. The study by Jullian and Valentine also showed that the incidence of AMI is common in age group 51-60 years and average age of incidence was 58.8 years.[7] The findings of present study correlate with those of the other study also.

Sex distribution

The incidence of AMI in males was 64% and that in females was 36%. In the age group less than 40 years, the incidence of AMI in males was 75%. Lerner et al found that 60% of all coronary events are seen in men whereas, Kodilkar found that 83.33% of patients were male.[8,9] Various explanations have been given to account for the discrepancy in the incidence of AMI in the two sexes. According to Friedberg, males have more chances of being heavy cigarette smokers, are more exposed to competitive stress and have a higher incidence of coronary risk factors like hypertension.

Site of AMI

The observed incidence of AMI according to myocardial wall involvement such as 29 (58%) out of 50 patients had anterior wall AMI, 14 (28%) out of 50 patients had inferior wall AMI and 7 (14%) out of 50 patients had Global MI.

Shah JR et al found that 55% of his patients had anterior, 27% had inferior and 12% had global AMI.[10] Jewitt et al observed 222 patients of AMI, out of which 124 cases (55.8%) had anterior wall AMI and 75 cases (33.8%) had inferior wall AMI.[11] In 10 patients, the infarction site was combined. Patients with extensive anterior AMI had a more severe clinical presentation (Killip III / IV) as compared to those with anterolateral, anteroseptal or inferior wall AMI.[9]

Wall motion abnormally

In present study, 47 patients (94%) had abnormal wall motion. Weiss et al proved from their study that the incidence of wall motion abnormality is 90% following AMI.[12] Normal wall motion usually excludes transmural infarct. Hypokinesis is nonspecific and is less significant in distinguishing between injured and uninjured myocardium. Transmural AMI is always associated with akinesia or dyskinesia. It was observed that, wall motion abnormality was present in all patients of anterior wall AMI and global AMI, whereas incidence of wall motion abnormality was 78.5% in patients of inferior wall AMI.

LV thrombus

In the present study, the incidence of LV thrombus in AMI was observed in 12 (24%) patients. Out of 29 patients of anterior wall AMI 10 (34.4%) patients had LV thrombus. Out of 14 patients of inferior wall AMI 1 (7.1%) patient had LV thrombus. Out of 7 patients of global AMI 1 (14.2%) patient had LV thrombus.

According to Visser et al, out of 96 patients, 22 patients (22.9%) had thrombus.[13] The incidence of LV thrombus is more in anterior wall AMI (32.3%) than inferior wall AMI (3.2%).

Incidence of LV thrombus in relation to wall motion abnormality

In present study, as wall motion abnormality increased, the LV thrombus incidence also increased i.e. 14.2% incidence in hypokinetic segment to 37.5% incidence in dyskinetic segment.

Lamas et al found that the frequency of LV thrombus increased with groups of increasing wall motion abnormalities as determined by the extent of akinesia and dyskinesia.[14]

Visser et al found that in anterior wall AMI, LV thrombus was present in no less than 86% of patients with segmental dyskinesia.[13]

In another study, LV thrombus was found in 3.3% of patients with hypokinesis, 26.3% with akinesis and 66.7% patient with dyskinesis.[9]

In present study, in anterior wall AMI patients who demonstrated LV thrombus, all had wall motion abnormality.

Thus, 2DE study of LV regional wall motion can predict the incidence of LV thrombus and subsequent complications of systemic embolisation can be prevented by appropriate therapy.

LVEF in AMI

It was shown that out of 50 patients of AMI, 33 patients (66%) had LVEF less than 40%. It was stated by Gourdon et al that progressive structural LV dilatation resulted in severe global LV dysfunction characterized by depressed LVEF.[15]

LVEF was affected mainly in global AMI (100%)and anterior wall AMI (79.3%). While in patients with inferior wall AMI 21.4% of patients had LVEF less than 40%.

LVEF can be correlated with wall motion abnormality and incidence of LV thrombus. But according to Weckers et al16, a single assessment of LVEF during early hours of transmural AMI may not properly characterizes cardiac performance in an individual patient.

Incidence of mortality in AMI

In this study, out of 50 patients, 8 patients expired, that is mortality rate was 16%. Out of which 4 patients had anterior wall AMI and 4 patients had global AMI.

Out of 7 patients of global AMI, 4 patients expired i.e. mortality rate was 57.1%.

Out of 29 patients of anterior wall AMI, 4 patients expired i.e. mortality rate was 13.8%.

No mortality was observed in patients with inferior wall AMI.

This indicates that, in global and anterior wall AMI, as LV function deteriorates, as manifested by reduced LVEF, wall motion abnormalities and increased incidence of LV thrombus, mortality also increases.

CONCLUSION

In conclusion, the echocardiographic assessment of LV function in patients of AMI is important as, it detects the regional wall motion abnormality, LVEF and also the complications like LV thrombus, pericardial effusion and LV aneurysm. These observations are of great value in the management of AMI.

Therefore, all the patients of AMI should undergo echocardiographic assessment earlier in the course of their management.

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