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ORIGINAL ARTICLE

ECHOCARDIOGRAPHIC EVALUATION OF SYSTOLIC LEFT VENTRICULAR FUNCTION IN ACUTE MYOCARDIAL INFARCTION IN 1ST WEEK OF HOSPITALIZATION

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Abstract:

Objectives: *To assess systolic left ventricular function determined by left ventricular ejection fraction (LVEF) with the help of Echocardiography and correlate with ECG findings in patients of AMI.* ***Methods:*** *One hundred (100) cases of acute myocardial infarction were studied in the Department of Cardiology, DMCH from July 2015 to December 2015. It was an observational study. All selected patients were interviewed with a preformed questionnaire and were observed up to 7 days in hospital. Echocardiography was done to assess left ventricular ejection fraction (LVEF) by applying Teichholz (cube) formula.* ***Results:*** *83% of them were males and 17% of them were females. Mean age (±SD) was 52.24±11.59 years (range 34-82 years). The important risk factors among the study subjects, was hypertension (45%) (Male 40.96%; Female 64.7%) followed by Diabetes mellitus (33%) (Male 31.32%; Female 41.17%). Most of the admitted patients could reach in hospital within 4-12 hours of onset of symptoms and most of the patients of acute myocardial infarction had anterior wall involvement (37%). Mild systolic LV dysfunction (52.87%) was revealed in echocardiography among the survivors.* ***Conclusion:*** *The incidence of AMI was seen common among farmers who were mostly hypertensive. Systolic LV dysfunction was common in most patients where anterior wall involvement was present.*

Keywords: *Echocardiography, Systolic Left Ventricular function, Acute Myocardial Infarction*

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Introduction:

Coronary artery disease (CAD) is an important medical and public health issue because it is common and leading cause of death throughout the world. Bangladesh has been experiencing epidemiological transition from communicable disease to non-communicable disease (NCD). The overall mortality rate has decreased significantly over the last couple of decades. But deaths due to chronic diseases, specially the fatal four i.e. cardiovascular disease, cancer, chronic respiratory disease and diabetes are increasing in an alarming rate. CAD is an important contributor. Of all South Asian countries, Bangladesh probably has the highest rates of cardiovascular diseases.

Myocardial Infarction (MI) is almost always due to the formation of occlusive thrombus at the site of rupture or erosion of an atherosclerotic plaque in a coronary artery. The thrombus often undergoes spontaneous lysis over the course of the next few days, although by this time irreversible myocardial damage has occurred.[4,5] Approximately 40% myocardial infarction are associated with left ventricular (LV) dysfunction in early phase.[6-8] Left ventricular dysfunction is worse where wall motion abnormality is present in anterior wall rather than lateral and inferior wall.[9-10]

An immediate haemodynamic consequence of myocardial infarction is left ventricular systolic dysfunction (LVSD). Left ventricular systolic dysfunction may be defined as the condition where the left ventricle can only manage to eject <40% (occasionally <35%) of the blood with each contraction.[11] It is secondary to a loss of contractile function of the infarct and ischaemic myocardium.[12]

Over a period of 1 to 3 minutes, the regional disturbances of contraction progresses from dyssynchrony through hypokinesis (diminished motion) and akinesis (total lack of motion) to dyskinesia (paradoxical systolic expansion).[13]

This loss of contractile function result in a decreased systolic ejection, increased end systolic volume, increased end diastolic volume and a secondary increase in diastolic filling pressure caused by the increase in ventricular volume.[14] left ventricular systolic dysfunction with clinical signs of failure is said to occur in 30-40% of patients and usually develops when the abnormally contractile segment exceeds 30% of the left ventricular circumference. [15,16]

Measurement of left ventricular systolic function have been shown to be the strongest prognostic indicator after AMI.[17,18]

Systolic dysfunction (determined by left ventricular ejection fraction) can be assessed with the help of two dimensional echocardiography (2D-echo). Left ventricular ejection fraction identified with echocardiography have been well validated[15] and gives important information on the relationship between the location and size of RWMA present, ECG location and size, the status of the patient, complication and survival[10,11].

Proper management of acute MI requires careful monitoring, anti-platelet agents, coronary vasodilators, selective beta-1 blockers and ACE inhibitors etc. Early reperfusion with fibrinolytic therapy or primary angioplasty is also necessary.[19]

The aim of the study is to assess systolic left ventricular function determined by left ventricular ejection fraction (LVEF) with the help of Echocardiography and correlate with ECG findings in patients of AMI.

Methods: This cross sectional observational study was performed in the department of Cardiology, Dhaka Medical College Hospital, Dhaka from July'2015 to December' 2015. 100 patients diagnosed as acute MI were included in this study. Sample size was calculated by the formula

$$n = \frac{Z^2 pq}{e^2}$$

Where,

n = sample size

z = standardized normal value usually set at 1.96 which correspond to 95% confidence level at 5% level of significance

p = prevalence

q = 1- q

e = Precision rate (acceptance error, usually set at 5%) = 0.05

As we have found the prevalence of MI in urban population of Bangladesh is 19%, so

Here –

p = 0.19

So, q = 1- 0.19 = 0.81

Using the above formula sample size is –

$n = (1.96)^2 \times (0.19) \times (0.81) / (0.05)^2 = 236$

As the study will was carried out in a very short period of six months, 100 patients diagnosed as acute MI were included in this study.

Criteria for entry into the study were follows: I) All patients who were diagnosed as acute MI (both ST elevation MI and non-ST elevation MI) in the

department of cardiology. II) Irrespective of age, sex and risk factors. Patients having following conditions were excluded: a) Old MI, b)Valvular heart disease, c) Cardiomyopathy d) Malignancy e) Chronic liver disease, f) Chronic kidney disease.

All selected patients (100) who were diagonosed as AMI, were interviewed with a preformed questionnaire and were observed up to 7 days in hospital. Echocardiography was done to assess left ventricular ejection fraction (LVEF) by applying Teichholz (cube) formula. Left ventricular internal diameter in diastole (LVIDd) and left ventricular internal diameter in systole (LVIDs) were determined.

Calculation was done by echocardiogram itself which is predetermined.

The formula [20, 21]:

$$LVEF = \frac{(LVIDd)^3 - (LVIDs)^3}{OLVIDd^3} \times 100\%$$

Participants were encouraged to take part in the study voluntarily. Informed written consent was obtained after a brief of the study in Bengali described to all respondents. It was made clear to them that they are free to take part or refuse the study. Every attempt was taken to conduct the interview privately.

Statistical analyses related with this study were performed by use of SPSS 19.0 package program. In the course of the evaluation of the data gathered, descriptive statistical methods were used.Data cleaning, validation and analysis were performed. Descriptive & analytical statistics was applied where needed.

Operational definition:

Myocardial Infarction (MI) applied to myocardial necrosis as a result of an acute interruption of the coronary blood supply.

In this study acute Myocardial Infarction was diagonosed by detection of typical rise and gradual fall of Troponin-I in a patient with the following criteria [21, 22] :

- Ischemic symptoms.
- ECG changes indicative of ischemia (ST segment elevation or depression, pathological Q wave, new onset LBBB).
- Echocardiographic evidence of regional wall motion abnormality.

Left ventricular systolic dysfunction can be defined as impaired emptying of the LV, apparent as a decreased (< 50%) effective ejection fraction (LVEF).[19, 20, 21]

LV systolic dysfunction can be graded as:

	LV ejection fraction (%)
Mild	40–50
Moderate	30–40
Severe	<30

Hypertension is a condition in which arterial blood pressure is chronically elevated. [22, 23] In this study, the patient who had Systolic blood pressure > 140 mmHg or Diastolic Blood Pressure > 90 mmHg, was labeled as Hypertensive patient.

Diabetes mellitus is a clinical syndrome characterized by hyperglycaemia caused by absolute or relative deficiency of insulin.

In this study Diabetes mellitus was diagonosed by the following criteria: Fasting plasma glucose e⁴ 7.0 mmol/L (126 mg/dL) Random plasma glucose or 2 hours after a 75g glucose load e⁴ 11.1 mmol/L (200 mg/dL) [22, 23]

Dyslipidemia defined as elevated total or low-density lipoprotein (LDL) cholesterol levels, or low levels of high-density lipoprotein (HDL) cholesterol, is an important risk factor for coronary heart disease (CHD) and stroke. [22,23]

Results:

A total of 100 cases were included in this study. Mean age (±SD) was 52.24±11.59 years (range 34-82 years). 83 of them were male and, 17 were female. Male patients were mostly hypertensive and involved in agriculture. All were analyzed and presented in tabulated form:

Table-I

Age distribution of study patients (n = 100)

Age in years	Number of cases	Percentage
30-39 years	04	04%
40-49 years	29	29%
50 - 59 years	35	35%
60-69 years	20	20%
>70 years	12	12%

Table-I shows that the incidence of maximum numbers of acute myocardial infarction is in the age group of 50 - 59 years (35%). Another thing is also important that majority of acute myocardial infarction happened in the age group of 40 - 59 years (64%) and young onset (age < 40 years) acute myocardial infarction is 04%.

Table-II

Risk factors distribution among study subjects (n = 100)

Risk factors		Number of cases Male -83, Female- 17
Hypertension		45(45%)
	Male-34 (40.96%)	Female- 11 (64.7%)
Diabetes mellitus		33(33%)
	Male-26 (31.32%)	Female- 07 (41.17%)
Smoking		29(29%)
	Male- 28 (33.73%)	Female- 01 (5.88%)
Dyslipidemia		17(17%)
	Male- 12 (14.45%)	Female- 05 (29.41%)
Family history of IHD		14(14%)
	Male- 11 (13.25%)	Female- 03 (17.65%)
Obesity		11(11%)
	Male- 09 (10.84%)	Female- 04 (23.53%)

Table-II shows the risk factors among the study subjects, the most important was hypertension (45%) followed by Diabetes mellitus (33%).

TabIe-III

Distribution of time of onset of symptoms to arrival in hospital (n = 100)

Time of onset	Number of patients	Percentage
< 4 hours	08	08%
4 - 12 hours	56	56%
13 - 24 hours	15	15%
25 - 48 hours	09	09%
> 48 hours	12	12%

Table-III shows that most of the patients of acute myocardial infarction came to the hospital within 4-12 hours of developing symptoms (56%)

Table-IV

Electrocardiographic diagnosis of different wall myocardial infarction with mean LV functions (n—100)

Walls of heart	Number of patients	Mean LV funtion
Anterior	37 (37%)	45.97%
Antero-septal	22 (22%)	46.90%
Extensive anterior	14 (14%)	36.15%
Inferior	20 (20%)	50.37%
Others	07 (7%)	52.25%

Table-IV shows that most of the patients of acute myocardial infarction have anterior wall involvement (37%), followed by anteroseptal (22%) and inferior (20%) wall.

Table- V

Distribution of LV dysfunction of study patients (n = 100)

Walls of heart	LV dysfunction			
	Mild (n=49)	Moderate(n=18)	Severe(n=9)	Normal(n=24)
Anterior	22 (59.46%)	08 (21.62%)	02 (5.41%)	05 (13.51%)
Anteroseptal	11 (50%)	04 (18.18%)	02 (9.09%)	05 (22.72%)
Extensive anterior	05 (35.71%)	04 (28.57%)	05(35.71%)	0
Inferior	09 (45%)	02 (10%)	0	09(45%)

Table-V shows that LV function of the patients of acute myocardial infarction has been deteriorated in extentive anterior wall myocardial infarction (35.71%) and relatively normal in inferior wall myocardial infarction (45%).

Discussion:

This study was conducted in the Department of Cardiology, DMCH. It was a cross-sectional observational study. In this study, Echocardiography was done to assess left ventricular ejection fraction (LVEF). LVEF is one of the important parameters to assess the left ventricular systolic function. A significant reduction in ejection fraction was noted in the AMI patients.

The highest incidence (35%) of acute myocardial infarction was between 50- 59 years in this study. Khan M et al [24] has reported in the study that maximum age incidence was 50-59 years. The next common age group in my study was 40-49 years (29%). This is consistent with the findings of the study done by Chowdhury MZI et al[25] who found it 31%. So it is evident from these studies that peak age incidence is 5th and 6th decade. About 04% of the patients below 40 years of age developed MI in the study. Seetharama N et al [26] have reported that the incidence below 40 years was 11%. In this study male and female ratio was 4.88: 1. This is nearly similar to the finding (6.1: 1) of the study by Kiani F et al.[27]

Most of the cases of acute myocardial infarction (48%) were found amongst farmers who are usually engaged in hard physical activities. Chowdhury MZI et al[25] have reported findings that is similar with this study.

45% of patients in this study were found hypertensive. Observations from the study Kiani F et al[27] and Adhikari G et al[28] shows that incidence of hypertension was 34% and 39% respectively. Jafar TH et al[29] reported 28.7%. Those are more or less consistent with this study. In this study 33% patients were found diabetic. Kiani F et al[27] demonstrated that the incidence of diabetes was 27%. Seetharama N et al[26] and Adhikari G et al[28] found the incidence of diabetes about 24%, and 27.78%. 29% of patients in this study were smoker. Stallones RA[30] found definite relationship between cigarette smoking and coronary heart disease.

Anterior myocardial infarction was found in 37% of patients in this study. Acharya D[31] and Arnold SV et al[32] have reported that anterior myocardial infarction was found in 45.55% and 42.00% patients respectively which are consistent with this study. Incidence of anterior myocardial infarction (37%) was significantly higher than anteroseptal (22%) and inferior (20%) MI.

Measurement of left ventricular ejection fraction shows that among the 100 study patients, 24% patients had normal left ventricular systolic function. Mild systolic left ventricular dysfunction was found in 49% patients and 18% patients had moderate LV dysfunction. About 9% patients had severe left ventricular systolic dysfunction.

Among the patients (n=37) who were diagonosed as acute anterior MI, 59.46% patients had mild LV systolic dysfunction. About 21.62% patients had moderate and 5.41% patients had severe LV systolic dysfunction respectively. 13.51% patients had normal LV systolic function. The mean ejection fraction of acute anterior MI patients was 45.97%. Arnold SV et al[32] and Bajaj A et al[33] have found in their study that the mean EF is 40.49% in anterior myocardial infarction.

The study shows that among the 14 patients who were diagonosed as acute extensive anterior MI, 35.71% patients had mild LV systolic dysfunction. About 28.57% patients had moderate and 35.71% patients had severe LV systolic dysfunction respectively. The mean ejection fraction of acute extensive anterior MI patients was 36.15%.

Among the patients (n=22) who were diagonosed as acute antero-septal MI, 50% patients had mild LV systolic dysfunction. About 18.18% patients had moderate and 9.09% patients had severe LV systolic dysfunction respectively. 22.72% patients had normal LV systolic function. The mean ejection fraction of acute antero-septal MI patients was 46.90%.

The number of patients (n=20) who were diagonosed as acute Inferior MI, were found to have mild LV systolic dysfunction in about 45% patients. About 10% patients had moderate LV systolic dysfunction. 45% patients had normal LV systolic function. The mean ejection fraction of acute Inferior MI patients was 50.37%.

In this study main complication after acute myocardial infarction was left ventricular failure (26%). Other complications were cardiogenic shock (05%), arrhythmias (05%) and conduction defects (04%). Acharya D[31] and Bajaj A et al[33] have found in their study that left ventricular failure was developed after AMI in 27% and 23% patients respectively.

In this study, the peak age of onset of AMI was between 50-59 years and predominant sex was male. Incidence of anterior myocardial infarction (37%) was significantly higher than inferior MI (20%). Left ventricular systolic dysfunction was more marked in anterior MI (mean LVEF=40.49%) than inferior MI (mean LVEF=50.37%). The findings of this study are almost consistent with the observations from previous studies. So it is justified to study the role of echocardiography to assess the left ventricular systolic function (LVEF) in AMI patient.

Conclusion:

Anterior wall MI causes significant reduction of left ventricular ejection fraction (LVEF). Left ventricular failure is more commonly associated with anterior wall MI than inferior wall MI. After acute myocardial infarction (AMI), echocardiography plays a vital role in the diagnosis and management of the patients. It also provides substantial information regarding assessment of complications related to acute MI.

Limitation:

This study is a hospital based study and sample size was not large. So, it may not represent the exact picture of the whole country.

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Declaration of interest:

The authors report no conflict of interest.

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Ethical consideration:

The study was conducted after approval from the ethical review committee. The confidentiality and anonymity of the study participants were maintained.

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