Clinical Outcome and Echocardiographic Evaluation of Inferior Myocardial Infarction with Right Ventricular Involvement

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Key Words :
Electrocardiography, Echocardiography, Right ventricular infarction, Acute myocardial infarction .

Abstract

Background : *Acute right ventricular myocardial infarction complicates inferior wall myocardial infarction with an incidence of 14-84%. ECG is the cornerstone in initial diagnosis as it is cost effective and done easily. Echocardiographic analysis of the right ventricular involvement can shed light on the severity of the disease. Hence we aimed to study right ventricular infarction in acute inferior wall myocardial infarction using right precordial lead as well as echocardiography.*

Methods: *Present study is based on the analysis of 100 patients admitted to Coronary care unit of the National Institute of Cardiovascular Diseases & Hospital during July 2010 to June 2011, with acute inferior wall myocardial infarction. 12 lead ECG with thorough physical examination was done along with right precordial mapping. ST ³ 1mm in V4R was initial diagnostic of right ventricular involvement followed by echocardiographic assessment of RV and LV within 24 hours.*

Results: *A total of 50 patients showed right ventricular involvement with V4R being the sensitive lead. Echocardiography showed mean RVEF of patients with 29.5 % ± 9.5 in comparison of 44.9%±12.2 without right ventricular involvement. Right ventricular involvement presented with bradycardia (40%) and hypotension, 80% Kussmaul's sign, 14% with complete heart block. Mortality in right ventricular involvement was 6 times higher than without right ventricular involvement (12 %).*

Conclusion: *Clinical signs and symptomatology are not fully diagnostic of RVI in inferior wall acute MI. ECG can diagnose (using right precordial mapping) this condition very early. Echocardiography help to assess the right ventricular function high-risk groups for aggressive management like primary PCI. Early diagnosis will help in careful monitoring and management of such cases.*

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Introduction:

Coronary heart disease (CHD) is a major cause of mortality, and is a global health problem reaching epidemic proportions in both developed as well as developing countries.[1] The South Asian countries of India, Pakistan, Bangladesh, Srilanka, and Nepal contribute the highest proportion of the burden of cardiovascular diseases (CVDs) compared to any other region globally.[2, 3, 4] Estimates from the Global burden of Disease Study suggests that by the year 2020 this part of the world will have more individuals with atherosclerotic cardiovascular disease than any other region.[4]

CHD will be the major health and number one killer disease in developed countries like USA, increased prevalence and excess mortality in CHD was documented by several studies .The prevalence of CHD was estimated as 3.3/1000 in 1976 and 17.2/1000 in 1986 indicating 5 folds increase of the disease in 10 years. AMI is a major component of acute coronary syndrome which usually due to anterior or inferior wall involvement. The presentation of acute myocardial infarction is different depending on the coronary artery involved. Right ventricular infarction (RVI) accompany extensive inferior-posterior infarctions. Inferior wall MI results from either right coronary artery (RCA) or left circumflex coronary artery (LCX) occlusion. RCA predominantly supply the part of conducting system, right atrium, right ventricle, part of left ventricle and the posteromedial papillary muscle. Occlusion of RCA may cause RV infarction with hypotension, cardiogenic shock, and different types of conduction disturbance, mitral regurgitation and sudden death.

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Clinical detection of RV infarction was done by searching raised jugular pressure, clear lung field, low cardiac output which resembles many clinical situations like chronic obstructive pulmonary disease, pulmonary stenosis, pulmonary hypertension, acute pulmonary embolism.[5]

The occurrence of an inferior left ventricular infarction involving the right ventricle ranges from 14% to 84%, but is typically thought to be about 50%.[6] Echocardiography has been very useful in detecting right ventricular dilatation and segmental wall motion abnormalities characteristic of right ventricular infarction RV dilatation may be defined as a ratio of RV end-diastolic area to LV end-diastolic area of -0.6 RV dilatation is severe when the ratio is-1.0.[7]

The mortality of patient with only inferior wall acute myocardial infarction (AMI) is 5-6%, which increases to 25-30% along with the involvement of right ventricle. The patients with RVI had a higher in hospital mortality rate (31% vs 6%,p<0.001) and a higher incidence of major

in-hospital complications (64% vs .28%,p<0.001) than did those without RVI. So the patient with inferior wall AMI, site of culprit lesions is an important determinant of outcome.[8] The patient with anterior myocardial infarction had a substantially worse in hospital and follow up clinical course compared with those with inferior MI . Right ventricular infarction (RVI) occurs in 20 to 50 % of patients with inferior MI. Inferior MI with RVI has a high mortality rate of 25 -30 % as compared with only 6 % for inferior MI without RVI . There is a wide range of hemodynamic disturbance associated with RVI starting with asymptomatic course to severe hypotension , shock , fatal arrhythmias with sudden death.

Materials and methods:

A cross sectional study was carried out conducted in the department of cardiology, National Institute of Cardiovascular Diseases (NICVD), Dhaka, Bangladesh from January 2011 to June 2011.Patients of acute inferior myocardial infarction with or without right ventricular involvement at NICVD during the study period was the study population.

Enrollment of subjects :

Methodology

Patients who presented with acute inferior myocardial infarction within 12 hours and were admitted in NICVD were included in the study. Patients with previous myocardial infarction, concomitant acute anterior myocardial infarction, valvular heart diseases, pacemaker, bundle branch block, cardiomyopathies, congenital heart disease and corpulmonale were excluded from the study. Informed written consent was taken from each subject before enrollment. Evaluation of the patients by taking meticulous history & detailed clinical examination and data was recorded in a pre-designed form. Demographic profile (Age , sex , height , weight), Clinical profile (Pulse ,BP ,NYHA functional class, cardiogenic shock, arrhythmia , heart block), Risk factor profile(Smoking, hypertension, diabetes mellitus (DM), dyslipidemia & family history of coronary artery disease), Medications (Present and recent use of drugs), ECG, with right sided ECG on admission and within 12hrs of the onset of symptoms was recorded. Admission ECG along with right sided ECG was evaluated in all patients with inferior MI. If patients was received thrombolytic, then post thrombolytic ECG was evaluated one and half hour after thrombolysis.

Patients was divided into two groups based on presence or absence of ST segment elevation in lead V4R or V3R.

Group -I: patients with ST segment elevation in V4R or V3R (with RV infarction).

Group-II: patients with isoelectric ST segment in V4R or V3R (without RV infarction)

Patients were evaluated by 2D, M-mode and Doppler echocardiography. Standard echocardiographic measurement was done and averaged in 4 cardiac cycles. Echocardiography was done in all patients within 72 hours of onset of chest pain to look for left ventricular ejection fraction, any mechanical complications. Variables specially included LVID(d), LVID (s), regional wall motion abnormality (RWMA), left ventricular ejection fraction (LVEF). Echocardiography of right ventricular function was done biplane Simpson's method in apical four chamber view and other views.

Statistical analysis

All data were recorded systematically in preformed data collection form and data were expressed as mean and standard deviation and qualitative data as frequency distribution and percentage. Statistical analysis was performed by using SPSS version 16. 95% confidence limit was taken. Probability value <0.05 was considered as level of significance.

Observations and Results

This cross sectional study was conducted in the department of cardiology, NICVD, Dhaka from January 2011 to June 2011 . Total 100 subjects were included in this study. The findings of the study are presented here.

Table I showed that about d" 40 years old patients were 16% in Group I and 18% in Group II. Group I had 26% and group II had 40% of patients between (41-50) years. Next (51-60) years were 34% and 26% in Group I and Group II respectively. Patients of > 60 years were 24% and 16% in Group I and Group II respectively. The age distribution was almost identical between patients with and without right ventricular involvement (54.5±11.2 vs50.2±13.4 years. P=0.08).

Table I

Age distribution of the study population (n=100)

Age group (year)	Group I (n=50)		Group II (n=50)		*P value**
	Number	%	Number	%	
≤40	8	16.0	9	18.0	*0.79*
41- 50	13	26.0	20	40.0	*0.13*
51- 60	17	34.0	13	26.0	*038*
> 60	12	24.0	8	16.0	*0.31*
Mean±SD	54.5±11.2		50.2±13.4		*0.08*

Group I: With RVI , Group II : Without RVI
*p value reached from unpaired t-test

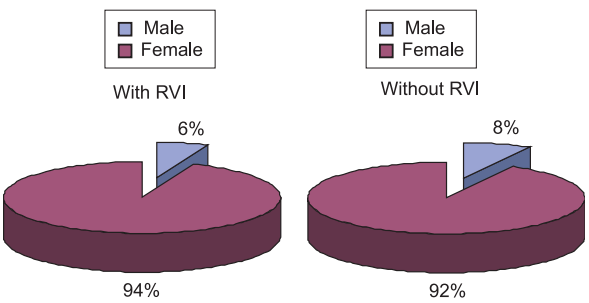

Fig.-1: *Pie diagram showed sex distribution of study populations between two groups.*

Majority of patients were male in Group I and Group II (94% and 92% respectively). Statistically not significant mean sex difference was found between patients of study groups (p>0.05)

Table II

Distribution of risk factors between two groups (n=100)

Risk factors	Group I (n=50)		Group II (n=50)		*P value**
	Number	%	Number	%	
Smoking	44	88.0	34	68.0	*0.01*
Diabetes Mellitus	24	48.0	10	20.0	*0.003*
Hypertension	16	32.0	23	46.0	*0.15*
Dyslipidemia	7	14.0	8	16.0	*0.77*
Family history of CAD	25	50.0	15	30.0	*0.04*

Group I: With RVI
Group II : Without RVI
*p value were analyzed using Pearson Chi-Square Test.

Among the Group I smoking (88%) was the most common risk factor followed by family history of CAD (50%), diabetes mellitus (48%), hypertension (32%) and dyslipidemia (14%). On the other hand among Group II patient highest percentage had smoking (68%), followed by

hypertension (46%), family history of CAD (30%), diabetes mellitus (20%) and dyslipidemia (16%). There were statistically significant risk factors difference between smoking, diabetes mellitus and family history of CAD in between study groups (p<0.05).

Table III

Base- line clinical parameters of the study population (n=100)

Parameters	Group I (n=50)		Group II (n=50)		*P value*
	Mean ± SD		Mean ± SD		
Pulse	68.0±14.7		74.8±14.6		*0.04**
Systolic BP	94.6±30.4		115.4±17.8		*0.001**
Diastolic BP	66.7±14.8		73.1±13.5		*0.05**
	No	%	No	%	
JVP Raised	37	74.0	13	26	*0.001***
Lungs bases clear	35	70.0	13	26	*0.001***

Group I: With RVI , Group II : Without RVI
* p value reached from independent sample t-test.
**p value were analyzed using Pearson Chi-Square Test.

Table III showed that mean pulse rate was 68.0±14.7 vs. 74.8±14.6 /min between Group I and Group II respectively. Mean difference of systolic blood pressure 94.6±30.4mmof Hg vs 115.4±17.8mm of Hg were found between Group I and Group II. Mean difference of diastolic blood pressure was found 66.7±14.8 vs 73.1±13.5 mm of Hg between groups. Raised JVP had 74% in Group I and 26% in Group II. Lungs bases were clear 70% cases in Group I and 26 % in Group II respectively. All these differences were statistically significant (p<0.05).

Table IV

Comparison of echocardiography of the left ventricle between the groups (n=100)

Parameters	Group I (n=50)	Group II (n=50)	*p value**
	Mean ± SD	Mean ± SD	
LVEF	50.6±6.6	53.0±8.5	*0.12*
LVIDd	46.7±5.5	47.3±6.1	*0.65*
LVIDs	34.7±4.9	35.2±7.8	*0.70*

Group I: With RVI, Group II : Without RVI
*p value reached from sample t-test

Above table showed that mean of left ventricular ejection fraction(LVEF) was 50.6±6.6 to 53.0±8.5 in between Group I and Group II respectively (p=0.12). Left ventricular internal dimension in diastole (LVIDd) was 46.7±5.5 to47.3±6.1 respectively between group (p=0.65). Left ventricular internal dimension in systole (LVIDs) was 34.7±4.9 to 35.2±7.8 respectively between group (p=0.70).

Table V

Comparison of echocardiography of Right ventricle between two groups (n=100)

Parameters	Group I (n=50)		Group II (n=50)		*P value*
	Mean ± SD		Mean ± SD		
Right ventricular diameter (in diastole)	29.3±5.6		24.3±5.4		*0.001**
Right ventricular EF	29.5±9.5		44.9±12.2		*0.001**
	No	%	No	%	
TR	20	40.0	4	8.0	*0.001***
MR	6	12.0	1	2.0	*0.05***

Group I: With RVI, Group II : Without RVI
* p value reached from independent sample t-test.
**p value were analyzed using Pearson Chi-Square Test.

Above table shows that mean of right ventricular diameter (in diastole) had 29.3±5.6 vs. 24.3±5.4 between groups. Mean of right ventricular ejection fraction is 29.5±9.5 vs. 44.9±12.2 between groups. Statistically significant differences were between both the groups (p< 0.001). TR had 40% vs. 8% between Group I and Group II respectively and statistically significant (p<0.001). In MR had 12% vs. 2% in between groups respectively and statistically significant differences between groups (p<0.05).

Table VI

Distribution of right Ventricular ejection fraction between two groups (n=100)

Symptoms	Group I (n=50)		Group II (n=50)		*p value**
	Number	%	Number	%	
< 30	32	64.0	4	8.0	*0.001*
30 – 50	16	32.0	33	66.0	*0.001*
> 50	2	4.0	13	26.0	*0.002*

Group I: With RVI , Group II : Without RVI
*p value were analyzed using Pearson Chi-Square Test.

Table VI showed that 4% had ejection fraction (>50) followed by 32% of the patients had (30-50) and 64% had (< 30) in Group I. On the other hand Group II was found that 26% had ejection

fraction (>50) followed by 66% of the patients had (30-50) and 8% had (<40). All these were statistically significant between both the groups.

Table VII

Distribution of in hospital outcome study population (n=100)

Complaints	No.	%
Uneventful recovery	40	40.0
Hypotension	53	53.0
Cardiogenic shock	27	27.0
Acute LVF	12	12.0
Tachyarrhythmia	12	12.0
Complete heart block	12	12.0
1st degree heart block	2	2.0
Junctional bradycardia	2	2.0
Sinus bradycardia	29	29.0
Sinus tachycardia	7	7.0
Mechanical complication		
Mitral Regurgitation	7	7.0
Post MI angina	8	8.0
Reinfarction	5	5.0
Cardiac arrest	10	10.0
Death	7	7.0

Table VII showed that complication of patients in hospital were 40% uneventful recovery, 53% Hypotension, 27% Cardiogenic shock, 12% Acute LVF and 12% Tachyarrhythmia. Brady arrhythmia were 45%, mechanical complications (mitral regurgitation 7%) but no VSR, post MI angina 8%, reinfarction 5%, cardiac arrest 10% and death 7%. In Brady arrhythmia were 12% Complete heart lock, 2% 1st degree heart block, 2% Junctional heart block, 29% sinus bradycardia and 7% sinus tachycardia.

Table VIII

In hospital outcome between two groups (n= 100)

Outcome	Group I (n=50)		Group II (n=50)		p value*
	Number	%	Number	%	
Uneventful recovery	15	30	25	50	0.04
Bradyarrhythmia	30	60	15	30	0.05
Tachyarrhythmia	13	26	6	12	0.001
Heart failure	8	16	4	8	0.21
Mechanical complications	6	12	1	2	0.05
Cardiogenic shock	21	42	6	12	0.001
Cardiac arrest	8	16	1	2	0.04
Death	6	12	1	2	0.05

Group I: With RVI ,Group II : Without RVI
*p value were analyzed using Pearson Chi-Square Test.

Table VIII showed that o in-hospital outcome of patients had 30% vs.50% between groups respectively and ($p<0.05$). Hypotension and cardiogenic shock had 80% vs.46% and 42% vs.12% respectively. These are statistically significant both the groups ($p <0.001$). Tachyarrhythmia had 26% and 12% respectively and ($p<0.01$). Bradyarrhythmia had 60% vs 30% respectively ($p<o.oo5$). Statistically significant differences were between the groups ($p<0.01$). Cardiac arrest had 16% vs. 4% between the groups and ($p<0.05$). Death had 12% vs. 2% in Group I and Group II respectively. Statistically significant differences were present ($p<0.05$). There had mechanical complication 12% vs 2% in group I and group II was Statistically significant ($p < 0.05$) .

Discussion:

Identification of right ventricular infarction in acute inferior myocardial infarction in this study was based on clinical findings and electro-cardiographic and echocardiographic changes. Clinically patients had the features of hypotension, raised JVP and clear lung bases. Right sided chest leads were used for diagnosis. It is now established that ST elevation of ≥1 mm in lead V4R.

Assessment and quantification of right ventricular function is difficult and challenging[9]. Nevertheless, an understanding of right ventricular function may be useful in the management of patients with an inferior acute MI that involves the right ventricle.[10] The extent of involvement of the right ventricle varies in different series and echocardiographic analysis of the right ventricle can shed light on the severity of the disease.[11] The aim of the present study was to assess the clinical and echocardiographic evaluation of inferior myocardial infarction with or without right ventricular involvement

On admission ECG findings in lead V4R among the patients of 50 were with RV myocardial involvement (Group I= ST elevation >1mm) and 50 were without RV myocardial involvement (Group II= ST isoelectric or depression). The ECG remains a crucial tool in the identification and management of acute MI. The analysis of patterns of ST-T segment in right precordial lead V4R may influence decisions regarding treatment strategy. The early and accurate identification of the infarct related artery on the ECG can help to predict the amount of myocardium at risk and guide decisions regarding the urgency of revascularization.

The mean age of Group Group II patients and I were (54.5±11.2 vs 50.2±13.4 years. P=0.08). The highest number of patients was in the age group (50-59) years. One study in Bangladesh found that mean age of their CAD patients to be 53.6±10.3 years,[12] Majority of patients of Group I and Group II (94% and 92% respectively) were male. Statistically not significant mean sex difference was found between patients of study group ($p>0.05$). The numbers of female patients were less in almost all study.[13]

Among the study patient chest pain was the most common presenting compliant both the Groups (100% vs 98%). Followed by breathlessness (60% vs 24%), nausea (54% vs. 58%), vomiting (90% vs 86%), sweating (90% vs 98%), syncope (60% vs20%) dizziness (70% vs 28%) between Group I andGroup II respectively. There were statistically significant

difference were in breathlessness, syncope and dizziness between two groups (p>0.001). The data are similar to the study done [12].The mean duration of symptoms was 6.9±3.6 hours in Group I and 8.9±4.9 hours in Group II. The difference was statistically significant in two groups (p<0.05). Duration of symptoms was longer in Group I (3-24) hours than Group II (1-18) hours.

Regarding hemodynamic status, the mean pulse rate was 68.0±14.7 vs. 74.8±14.6 per minute, systolic blood pressure 94.6±30.4 mm of Hg vs 115.4±17.8 mm of Hg and diastolic blood pressure was found 66.7±14.8 vs 73.1±13.5 mm of Hg between groups. Raised JVP had 74% in Group I and 26% in Group II. Lungs bases were clear 70% cases in Group I and 26 % in Group II respectively. All these differences were statistically significant (p<0.05). Echocardiography had been very useful in detecting right ventricular dilatation and segmental wall motion abnormalities characteristic of right ventricular infraction.[7]

In hospital outcomes of inferior myocardial infarction of both groups were 53% hypotension, 27% cardiogenic shock, 12% Acute LVF and 12% tachyarrhythmia in both groups. In conductive disturbance 45% that were (12% Complete heart lock, 2% 1st degree heart block, 2% Junctional heart block, 29% sinus bradycardia) and 7% were sinus tachycardia. Mechanical complications were (mitral regurgitation)7% , post MI angina 8%, reinfarction 5%, cardiac arrest 10% and death 7%. Among the studied patients, the most important frequent complications were hypotension followed by sinus bradycardia, cardiogenic shock, arrhythmias, acute LVF and cardiac arrest and death.

Comparison of echocardiography of the left ventricular mean ejection fraction (LVEF) was 50.6±6.6 to 53.0±8.5 in between Groups respectively (p=0.12). Left ventricular internal dimension in diastole (LVIDd) was 46.7±5.5 to 47.3±6.1 respectively between group (p=0.65).). Left ventricular internal dimension in systole (LVIDs) was 34.7±4.9 to 35.2±7.8 respectively between group (p=0.70).

Comparison of echocardiography of right ventricular diameter (in diastole) had 29.3±5.6 vs. 24.3±5.4 between groups. Mean of right ventricular ejection fraction 29.5%±9.5vs. 44.9%±12.2 between groups. Statistically significant differences were between both the groups (p< 0.001). Tricuspid regurgitation had 40% vs. 8% and mitral regurgitation had 12% vs. 2% in between groups respectively and statistically significant differences between groups (p<0.05). That means when *right ventricular* diameter in diastole increases right ventricular ejection fraction decreases. Anna et al showed left ventricular ejection fraction % (50±7 vs. 58±8), Right Ventricular end diastolic diameter cm (3.2±1.3 vs. 2.6±2.40) and TR(3/70 vs. 21/50) respectively.[9]

Conclusion:

It may be concluded the study that right ventricular involvement is frequent in acute inferior myocardial infarction and patients who exhibits ST elevation in right sided precordial lead V4R have higher hospital mortality and morbidity. Sequelae of right ventricular involvement are from minimal hemodynamic impairment to frank cardiogenic shock. Clinical suspicion of right ventricular involvement should arise from the presence of hypotension, clear lung field, and engorged neck vein in patients with acute inferior myocardial infarction. Echocardiography is a valuable tool to assess right ventricular function and to diagnose right ventricular involvement but ECG may not be diagnostic after 12 hours of onset of chest pain. It has special role in excluding disease entities which may clinically mimic right ventricular involvement. Use of 12-lead ECG including right precordial leads followed by echocardiography can be the optimum strategy in assessment of right ventricular involvement.

Limitations of the study:

Although the results of the study support the hypothesis, yet this has got some limitation.

This was a nonrandomized trail. Number of study population was limited. These data should be interpreted with caution, because potentially confounding variables influencing mortality are not equally distributed between groups in a registry setting.

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