

**EARLY DIAGNOSIS OF LEFT VENTRICULAR RELAXATION AND FILLING  
ABNORMALITIES IN ACUTE MYOCARDIAL INFARCTION: A DOPPLER  
ECHOCARDIOGRAPHY STUDY**

<sup>1</sup>\*Dr. Syed Fasih Ahmed Hashmi, <sup>2</sup>Dr. Mashooq Ali Dasti, <sup>3</sup>Dr. Akber Yousfani, <sup>4</sup>Dr. Sumera Bukhari, <sup>5</sup>Dr. Javeria Samejo, <sup>6</sup>Dr. Zaheer Ahmed and <sup>7</sup>Dr. Zulfiqar Ali Qutrio Baloch

<sup>1</sup>FCPS, Associate Professor, Department of Cardiology, LUMHS Jamshoro.

<sup>2</sup>Dip. Card, MD (Cardiology), Consultant Cardiologist, Department of Cardiology, Liaquat University Hospital Hyderabad / Jamshoro.

<sup>3</sup>MD, MCPS, Assistant Professor, Department of Medicine Unit-III, Liaquat University Hospital Hyderabad / LUMHS, Jamshoro, Sindh Pakistan.

<sup>4</sup>St. Francis Medical Center, Trenton, New Jersey.

<sup>5</sup>Postgraduate, Department of Cardiology, Liaquat University of Medical and Health Sciences (LUMHS), Jamshoro, Pakistan.

<sup>6</sup>General Practitioner, Medeor 24 X7 Hospital, Abu Dhabi.

<sup>7</sup>Brandon Regional Hospital, Brandon, Florida.

\*Corresponding Author: Dr. Syed Fasih Ahmed Hashmi

FCPS, Associate Professor, Department of Cardiology, LUMHS Jamshoro.

Article Received on 16/09/2016

Article Revised on 07/10/2016

Article Accepted on 27/10/2016

**ABSTRACT**

**OBJECTIVE:** To assess left ventricular diastolic function in patients treated with thrombolytic therapy for ST elevation myocardial infarction and their outcomes within 2 weeks. **PATIENTS AND METHODS:** This study was conducted at department of cardiology Liaquat University Hospital Hyderabad From august 2015 To October 2015. Total of 65 Patients with first episode of ST elevation of myocardial infarction received thrombolytic therapy, had risk factors for ischemic heart disease were recruited. Myocardial infarction was considered according to the WHO criteria while echocardiography was done to measure various parameters whereas the data was entered and analyzed in SPSS version 16. **RESULTS:** Out of 70 patients studied 14 had normal, 34 patients had impaired relaxation, 5 patients had pseudo-normalization, 4 patients reversible and 3 patients irreversible restrictive filling on the day of admission. In those patients with prolonged IVRT, reversal of E/A, increased E-DT were indicating impaired relaxation pattern. Decreased E-DT and tissue Doppler imaging detected restrictive filling pattern of diastolic dysfunction. During the 14 days of follow up period patients had developed complications in the form of longer period of stay in hospital, arrhythmias, heart failure and death. 2 patients who were admitted with STEMI in restrictive filling pattern died on the 2nd and 4th day of admission. **CONCLUSION:** This study helps in early diagnosis of left ventricular filling and relaxation abnormalities and their severity. It also helps in monitoring of patients, early detection of complications, management and prognosis.

**KEYWORDS:** Left ventricular, acute myocardial infarction and Doppler echocardiography.

**INTRODUCTION**

Acute myocardial infarction (AMI) is one of the risk factor for systemic and local neuro-hormonal activation, and vascular malfunction.<sup>[1]</sup> The wall motion abnormalities occur after obstruction of coronary vessel leads to drop in ejection fraction and further leads to ischemic events. This presentation can vary, and is dependent on collateral flow, collateral perfusion and ischemic preconditioning.<sup>[2]</sup> Post MI patients with systolic and diastolic dysfunction are at highest risk of developing major non-fatal cardiovascular events.<sup>[3]</sup>

Doppler imaging is a echocardiographic technique that can measure the regional myocardial velocities and atrioventricular annular, and may be more sensitive than conventional echocardiography in detecting abnormalities of left ventricular systolic and diastolic functions.<sup>[4,5]</sup> Acute myocardial infarction (AMI) will influence the rate of active relaxation while interstitial edema, scar formation and fibrocellular infiltration will also affect left ventricular chamber stiffness.<sup>[6]</sup>

The aim of this study is to determine the left ventricular diastolic function in patients with ST elevation

myocardial infarction treated with thrombolytic therapy for and to evaluate their outcomes within 2 weeks.

### PATIENTS AND METHODS

This study was undertaken in Cardiology department of Liaquat University Hospital Hyderabad From August 2015 to October 2015. A total of 65 Patients with diagnosis of a first myocardial infarction with ST-elevation, receiving thrombolytic therapy having risk factors for ischemic heart disease and age between 30 and 70 years, were included by purposive sampling. Myocardial infarction was defined according to the WHO definition. Hemodynamic parameters were recorded at the time of admission. The investigations included serial electrocardiography for diagnosis of acute myocardial infarction, cardiac enzymes (i.e. CK-MB). All patients underwent conventional TTE examination as well as Doppler imaging after 1 to 2 day of thrombolytic therapy, using an Arida Toshiba echocardiographic machine with TDI software incorporated in the device using a 2.5 MHz transducer.

#### The various parameters were used as follows<sup>(7-9)</sup>

1. Systolic function was determined by 2D Echo, M-mode and colour doppler study
  2. Mitral valve inflow patterns by pulsed wave Doppler assessment was done in apical 4 chamber view to see
    - Peak early inflow velocity (E) i.e. the rapid filling phase.
    - Peak late (A) inflow velocity, occurs during atrial contraction
    - E/ A ratio (normal= 1.2-1.5): Ratio of peak E and A velocity.
    - Deceleration time of early mitral flow velocity (DT) (normal 160- 240 ms) represents the time interval between the peak E and the point on the baseline intercepted by the deceleration waveform.
    - Isovolumetric relaxation time (IVRT) (normal=70-90 ms)
- LV filling pattern or diastolic dysfunction was assessed according to the Mayo echocardiography laboratory grading system.
- Normal (E>A)
  - IRP- impaired relaxation - E/A<1, prolonged DT, prolonged IVRT
  - PNP - pseudo-normalization pattern - E>A
  - RRF - reversible restrictive filling pattern - E>>A
  - IRFP - Irreversible restrictive filling pattern E>>A

Analysis of tissue medial and lateral E/E' ratio was performed in order to differentiate normal filling from pseudonormal pattern. Valsalva maneuvers were performed to differentiate between reversible and irreversible restrictive filling pattern.

The data analysis was done by using SPSS version 16. Mean and standard deviation were used for numerical variables and qualitative variables as frequency distribution and percentage. The comparison by 2 tailed Student's t test while chi-square test on categorical variables and probability value  $\leq 0.05$  was considered as significance.

### RESULTS

The mean age of coronary artery disease was in the 52 yrs age and males (83.3%) were affected more commonly than females (16.7%). In the symptom analysis of 70 patients it was found that diabetes was the predominant risk factor (61.7%) followed by smoking (41.7%). Of 70 patients studied 14 had normal, 34 patients had impaired relaxation, 5 patients had had pseudo-normalization, four patients reversible and three patients irreversible restrictive filling on the day of admission. In those patients with prolonged IVRT, reversal of E/A, increased E-DT were indicating impaired relaxation pattern. Decreased E-DT and tissue Doppler imaging detected restrictive filling pattern of diastolic dysfunction. During the 14 days of follow up period patients had developed complications in the form of longer period of stay in hospital, arrhythmias, heart failure and death. Two patients who were admitted with STEMI in restrictive filling pattern died on the 2nd and 4th day of admission. The results are presented in Table I-V.

**Table I: Statistics of Age.**

N=70

<b>Mean</b>	<b>52.31</b>
<b>Median</b>	51.50
<b>Std. Deviation</b>	10.410
<b>Minimum</b>	27
<b>Maximum</b>	80

**Table II: Distribution Of Gender**

N=70

<b>Gender</b>	<b>No (%)</b>
<b>Male</b>	62 (88.6%)
<b>Female</b>	8 (11.4%)

**Table # Iii: Comparison of Demographic Data and Risk Factors (Hemo And Biochemical) In Both Groups.**

<b>Variable</b>		<b>All Patients N=70</b>	<b>Group I (E/e &lt; 15) N= 52</b>	<b>Group II (E/e &gt; 15) N=18</b>	<b>P -value</b>
<b>Demographic variables</b>					
<b>Mean Age ( years)</b>		52.31 ± 10.410	50.63 ± 9.2	57.17 ± 12.3	.021
<b>Sex</b>	<b>Male</b>	61 (87.1%)	45 (64.2%)	16 (22.8%)	.582
	<b>Female</b>	9 (12.8%)	6 (8.5%)	3 (4.2%)	.017
<b>Risk factor variables</b>					

<b>Smoking</b>	31 (44.2%)	22 (31.4%)	9 (12.8%)	.098
<b>Dyslipidemia</b>	4 (5.7%)	3 (4.2%)	1 (1.4%)	.974
<b>Diabetes</b>	15 (21.4%)	11 (15.7%)	4 (5.7%)	.926
<b>Hypertention</b>	30 (42.8%)	20 (28.5%)	10 (14.2%)	.163
<b>Family history</b>	7 (10%)	4 (5.7%)	3 (4.2%)	.661
<b>Hemodynamic Parameter</b>				
<b>Mean Pulse ( min)</b>	80.32 ± 17.89	81.19 ± 17.95	77.83 ± 17.99	.496
<b>Mean Systolic blood pressure (mmHg)</b>	121.92 ± 14.69	115.68 ± 25.20	137.14 ± 30.01	.957
<b>Mean diastolic blood pressure (mmHg)</b>	75.31 ± 14.69	76.00 ± 14.01	73.33 ± 16.80	.511
<b>Biochemical Parameters</b>				
<b>Mean CKMB (u/l)</b>	132.31 ± 102.49	130.00 ± 155.55	138.95 ± 50.7	.752
<b>Mean serum creatinine (mg/dl)</b>	1.07 ± .47	1.04 ± .50	1.16 ± .39	.349
<b>Mean random blood sugar ( mg/dl)</b>	125.40 ± 54.57	123.52 ± 56.53	111.12 ± 49.90	.826

Table # Iv: Comparison Of Outcomes In Both Groups.

Outcomes	Total patients N=70 (Mean ± Std. Deviation)	Group I (E/e < 15 mm) N= 52 (Mean ± Std. Deviation)	Group II (E/e > 15 mm) N=18 (Mean ± Std. Deviation)	P - value
<b>Hospital stay (in days)</b>	4.1 ± 1.3	3.7 ± 1.01	5.1 ± 1.6	.000
<b>Arrhythmia</b>	1.90.30	1.83 ± 0.38	1.9 ± 0.26	.281
<b>Heart failure (Killip class)</b>	1.80 ± .40	1.88 ± 0.32	1.55 ± 0.51	.002
<b>Death</b>	2.07± 1.32	1.50 ± 1.22	2.50 ± 1.30	.172
	1.98± 0.11	2.00 ± 0.00	1.94 ± 0.23	.089

Table # V: Incidence Of Heart Failure Between Groups (N=70)

KILLIP CLASS	GROUP I E/E' < 15	GROUP II E/E' >15	P VALUE
<b>No any class</b>	46	11	.012
<b>class-I</b>	4	2	.144
<b>class-II</b>	1	3	.000
<b>class-III</b>	0	0	000
<b>class-IV</b>	1	2	.001

## DISCUSSION

Doppler echocardiography has been used to evaluate left ventricular relaxation and filling. Left ventricular relaxation is an energy dependent process. However, prolonged relaxation is the earliest abnormality in left ventricular dysfunction and is preceded by filling abnormality.<sup>[10]</sup> Due to impairment of active relaxation there is decrease in early mitral inflow velocity; atrial contribution increases to fill, leads to E/A ratio reversal and a prolonged DT. With diastolic dysfunction worsening, LA pressure increases and the LA and LV gradient increases at mitral valve opening; increases the early inflow velocity even relaxation also impaired. With further deterioration, early filling ends abruptly due to increase in stiffness of LV.<sup>[11]</sup> The DT will be short abnormally and the ratio of E/A will be raised, a pattern called as restrictive (diastolic dysfunction grade 3). The restrictive filling pattern subdivides as reversible, if preload reduction either by the valsalva maneuver or treatment causes filling pattern reversal to the nonrestrictive pattern, or irreversible, if preload reduction leads to non reversal filling pattern.<sup>[11-13]</sup> In our

study many patients in the impaired relaxation state 56.7%, Pseudo normalization pattern (PNP) - E > A5 8.3%, Reversible Restrictive filling pattern (RRFP) - E >>A4 6.7%, irreversible restrictive filling pattern (IRFP) - E >> A3 5%. Bonow, et al observed abnormal LV diastolic filling in a high percentage of patients with CAD at rest independent of previous myocardial infarction.<sup>[8]</sup> The outcomes after diastolic dysfunction were mean Hospital stay (in days) 4.11 ± 1.4, arrhythmia 7 (11.7%), heart failure 13 (21.7%), death 2 (3.3%). Moller JE et al, studied echocardiography within 24 h, five days and one and three months after MI and observed that restrictive filling patterns or pseudonormal are association with progressive dilation of LV and predict cardiac death after a first MI.<sup>[14]</sup>

## CONCLUSION

This study helps in early diagnosis of left ventricular filling and relaxation abnormalities and their severity. It also helps in monitoring of patients, early detection of complications, management and prognosis.

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