ORIGINAL RESEARCH PAPER

Volume-6 | Issue-11 | November-2017 | ISSN No 2277 - 8179 | IF : 4.176 | IC Value : 78.46

INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

ECHOCARDIOGRAPHIC EVALUATION OF LEFT VENTRICULAR DIASTOLIC DYSFUNCTION WITH TISSUE DOPPLER IMAGING IN PATIENTS WITH ACUTE MYOCARDIAL INFARCTION.

Cardiology

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ABSTRACT

Introduction: Acute myocardial infarction (AMI) is one of the most common diagnosis in hospitalized patients in industrialized countries. Left ventricular diastolic function is recognized as an important contributory factor in the pathophysiology of many common cardiovascular diseases. The aim of this study was to assess the left ventricular diastolic dysfunction by tissue Doppler imaging in acute myocardial infarction and to assess the clinical correlation with the tissue Doppler imaging.

Materials and Methods: This was a prospective study done between August 2016 to July 2017 at the department of Cardiology, Government Mohan Kumaramangalam Medical College, Salem. We had enrolled 100 patients who were referred to our department for the management of acute myocardial infarction.

Results: The study group consisted of 100 patients with acute myocardial infarction including 82 males (82%) and 18 females (18%) after informed consent for study. Mean age of the patient was 53.09 ± 6.4 (25 to 74) years. Median delay of thrombolysed patients was 8 ± 1.5 hrs (6.5 hrs to 9.5 hrs). All the selected patients underwent standard Doppler and TD echocardiography. Thrombolysed patient showed average E/Ea Value 14.5 and non thrombolysed patients showed average E/Ea17.4.

Conclusion: In the present study it showed increased morbidity and mortality in patients with E/Ea value more than15. Tissue Doppler imaging is a simple noninvasive investigation to diagnose the diastolic dysfunction and prognosticate the patients with acute myocardial infarction.

KEYWORDS

2D - Two Dimensional, STEMI - ST elevation myocardial infarction, TDI - Tissue Doppler Imaging

Introduction:

STEMI usually occurs when coronary blood flow decreases abruptly after a thrombotic occlusion of a coronary artery previously affected by atherosclerosis[3]. Coronary artery disease remains the leading cause of mortality and morbidity. Earlier thought to be a disease of the modern world, it has been found to be equally or even more prevalence in underdeveloped and developing countries[2,3]. This disease is unfortunately being witnessed in the younger population also. It remains the most common single cause of mortality and morbidity in men below 65 years of age.

Left ventricular diastolic function is recognized as an important contributing factor in the pathophysiology of many common cardiovascular diseases. Diastolic dysfunction is the primary mechanism responsible for dyspnea in patients with heart failure, irrespective of the severity of systolic dysfunction. The clinical manifestations of coronary artery disease are often the result of abnormalities of left ventricular filling. Diastolic dysfunction may be present prior to or concomitant with systolic dysfunction.

Although treatments are often a made at improving left ventricular contractile performance, they may conflict with appropriate therapy for diastolic abnormalities. Recently attention has been increasing directed toward the diagnosis, evaluation and treatment of diastolic dysfunction[2,3]. Although catheterization measurements of diastolic performance remain the standard, these invasive parameters have proved technically challenging and tedious to acquire. In recent years, a large body of literature has accured describing various Doppler echocardiographic techniques for assessing diastolic function. These methods have given new insight into the flow dynamics of the left ventricle, mitral valve and have allowed a more practical noninvasive assessment of diastolic function. Several features of Doppler flow pattern have emerged as having important diagnostic and therapeutic implications.

Materials and Methods:

This was a prospective study done between August 2016 to July 2017 at the department of Cardiology, Government Mohan Kumaramangalam Medical College, Salem. We had enrolled 100 patients who were referred to our department for the management of acute myocardial infarction. The diagnosis of MI was based on 3rd universal definition of MI[1].Exclusion criteria were hemodynamically significant valvular heart disease, previous myocardial infarction and unstable angina.

All patients underwent detailed evaluation including history and physical examination. Mean age of the patients was 53.09 ± 6.4 (25 to 74) years. 82 (82%) were males,18 (18%) were females in this study. Totally 74 patients were thrombolysed including48 patients with anterior wall infarction and 26 patients with inferior wall infarction. Of the 26 nonthrombolysed patients, 18 patients were with anterior wall infarction and 8 patients were with inferior wall infarction. Totally there were 66 anterior wall infarction and 34 inferior wall infarction. Median delay of thrombolysed patients was 8 ± 1.5 hrs (6.5 hrs to 9.5 hrs). The most common cause for non-thrombolysis was median delay more than 12 hours.

All patients were classified into thrombolysed and not thrombolysed. All the selected patient underwent standard Doppler and TD echocardiography. Standard Doppler echocardiograms and Pulsed TD were performed with the subjects in partial left decubitus using the Philips IE 33 model equipped with a variable frequency phased- array transducer and TD Capabilities. Two D-guided M-mode LV analysis and Doppler recording of the LV transmitral diastolic inflow was performed as previously described.

Pulsed TD was performed at transducer frequencies of 3.5-4MHz, adjusting the spectral pulsed Doppler signal filters to obtain Nyquist limits of 15 and 20 cm/s and using the minimal optimal gain. The apical 4-chamber view was used to measure transmitral flow velocity parameters and tissue Doppler mitral annulus velocity parameters. The continuous wave beam is directed from the apical five chamber view across the region between the aortic outflow tract and mitral inflow tract to measure the IVRT. The following TD measurements were determined as indexes of regional myocardial function: myocardial systolic peak velocity (Sa, m/s) and myocardial early (Ea m/s) and atrial (Aa m/s) peak velocities (m/s) and their ratios as diastolic measurements by placing the sample volume in the septal aspect of mitral annulus. Our TDI methods and reproducibility have been previously described.

Results

Patient's clinical data were analyzed in relation to the Doppler data in routine trans mitral flow parameters and mitral annulus tissue Doppler velocity parameters. Variables were present as mean±1SD. Analysis of variance was performed to estimate intergroup differences. Linear regression analysis and partial correlation testing using Pearson's method were used to assess univariable relations. The null hypothesis was rejected for $P<0.05$.

In this study, there were 64% smokers, 28% type 2DM, 37% systolic hypertension, 12% family history of CAD and 28% dyslipidemia. There were no differences in gender, age, body mass index, heart rate and blood pressure. The results of Doppler echocardiographic analysis are reported in Table 1.

Table 1 Doppler echocardiographic analysis of Ejection Fraction.

Parameters	Impaired relaxation pattern (n=19)	Pseudo normal pattern N=(36)	Restrictive pattern (n=45)
E (cm/s)	53±3	86±4	97±6
A (cm/s)	75±4	62±5	48±6
E/A	0.68±0.16	1.39±0.14	1.99±0.15
DT (m sec)	232±14	164±16	135±11
IVRT(m sec)	116±9	84±8	56±7
EF %	48±12	45±15	39±15

Conventional transmitral flow showed impaired relaxation filing pattern in 19 patients, pseudo normal filing pattern in 36 patients and restrictive filling pattern in 45 patients. There was no linear relationship between ejection fraction and severity of pattern abnormality. Even the patients with normal EF had several form of diastolic dysfunction.

The DT value less than 140 m/sec was significantly associated with increased morbidity and mortality with hazard ratio of 2.4 (95% Cl 1.2 to 3.6). Likewise the IVRT value less than 60 msec was also a marker for increased morbidity and mortality with relative risk of 2.1 (95% cl 1.5 to 2.7). Totally there were 25 symptomatic patients due to diastolic dysfunction. Most of symptomatic patients had restrictive pattern of diastolic filling, 15 out of 25 symptomatic patients had restrictive pattern of filling with E/Ea value more than 15(60%) P<0.005.

In patients with pseudonormal pattern in transmitral flow pattern, differentiation from normal pattern was consistently and reproducibly possible with the tissue Doppler imaging. If Ea value was less than that of Aa Value, the absolute Ea value less than 8 and if E/Ea more than 15, then the pseudo normal pattern was confirmed.

Table-2 Tissue Doppler Annular Velocities Parameters

Parameter	Impaired relaxation pattern (n=19)	Pseudonormal filling pattern n=(36)	Restrictive filling pattern (n=45)
Ea (cm/s)	6.9±2.5	6.2±1.8	5.4±1.8
Aa (cm/s)	9.2±3	7.2±2.9	4.4±1.8
Ea/ Aa	0.77±0.3	0.87±0.3	1.25±0.28
E/Ea	7.44±2.4	14.1±2.7	18.4±3.34

The absolute Ea, Aa Values did not correlated with degree of diastolic dysfunction. E/Ea ratio was very much reliable indicator of elevated PCWP/LVEDP. It was well correlated with clinical features, morbidity and mortality of patients with diastolic dysfunction as in other studies. If the E/Ea value was more than 15, then it showed features increased LV filling pressures.

There were totally 12 deaths in this study during the hospital stay of 10 days. Nine deaths were occurred in patients with E/Ea more than 15 (30%). Three deaths were occurred in patients with E/Ea less than 15(12%) P<0.003. Patients with anterior wall myocardial infarction had more patients with E/Ea more than 15 and patients with restrictive pattern of filling. Out of 66 patients with anterior wall infarction 36(53%) had restrictive pattern of filling with E/Ea more than 15 P<0.03. The average E/Ea value in anterior wall infarction was 16.40. The patients with inferior wall infarction 34% (n=14) with restrictive pattern 35% (n=12) with pseudonormal pattern and 20% (n=7) with impaired relaxation. The average E/Ea value in patients with inferior wall infarction was 12.25 when compared with anterior wall infarction, this value significantly lower P<0.04

Thrombolysis definitely improves diastolic function in acute myocardial infarction patients. In this study, there was significant increase E/Ea of value in nonthrombolysed patients. The average E/Ea value in thrombolysed patients was 14.5 and in non-thrombolysed patients was 17.4 P <0.004.

Table-3 Diastolic filling pattern in Thrombolysed patients.

Parameters	Impaired relaxation pattern (n=10) 14%	Pseudonormal filling pattern N=(28) 38%	Restrictive filling pattern (n=36) 48%
E (cm/s)	56±8	82±7	90±6
A (cm/s)	75±7	53±7	45±4
E/ A	0.76±0.3	1.54±0.28	2.0±0.25
DT (msec)	222±12	164±14	130±11
IVRT (msec)	110±9	72±8	54±8
Ea (cm/s)	8.2±3.2	5.8±2.5	5.1±2.6
Aa (cm/s)	9.8±3.1	8.7±2.8	4.6±1.7
E/Ea	7.02±1.3	14.37±1.6	18.4±2.2
EF	48±14	45±12	39±12

Table-4 Diastolic filling pattern in Non-Thrombolysed Patients

Parameters	Impaired relaxation pattern (n=5) 19%	Pseudonormal filling pattern N=(9)35%	Restrictive filling pattern (n=12)46%
E (cm/s)	55±7	86±8	97±5
A (cm/s)	76±6	49±7	45±4
E/ A	0.76±0.4	1.54±0.28	2.02±0.25
DT (msec)	223±14	174±14	131±11
IVRT (msec)	109±8	69±8	50±7
Ea (cm/s)	7.8±3.2	5.5±2.4	4.8±2.6
Aa (cm/s)	9.6±3.2	9.1±2.7	4.4±1.5
E/Ea	7.1±1.2	16.20±1.6	20.4±2.3
EF	44±12	40±12	38±12

Discussion:

Ventricular filling can be assessed by continuously measuring the velocity of flow across the mitral valve using Doppler ultrasound. In the absence of direct measurements of filling pressure, noninvasive estimation of filling pressures with the use of E/Ea could prove useful. An increased (>15) E/Ea ratio was found to be an important predictor of all-cause mortality incremental to LVEF, age and a restrictive filling transmitral filling pattern. Importantly, E/Ea allowed risk stratification among patients with preserve as well as depressed LV systolic function. When LV filling is assessed with the use of transmitral, color M mode and tissue Doppler echocardiography, an instantaneous assessment of filling dynamics will be obtained.

In a recent study of post infarction patients with left ventricular ejection fraction less than 35%, mitral declaration time of less than 120 msec was highly predictive of pulmonary capillary wedge pressure of greater than 20 mm Hg[18]. In a second study of patients with systolic dysfunction after infarction (EF>40%), there was an increased rate adverse events in two years of follow up in patients with higher mitral E/A ratio and shorter declaration times[21]. This finding has been confirmed in subsequent studies.

The progressive importance of a restrictive filling pattern after AMI was initially reported by **Oh JK et al** in 1992[2]. In a cohort of 62 patients, a restrictive filling pattern was associated with a high occurrence of inhospital congestive heart failure. This was confirmed by **Poulsen et al**[19] in an age related population with a first AMI in which Doppler echocardiography was performed within 1 hour of hospital admission.

In 1997, **Nijland et al**[14] reported in a study of 95 patients with first AMI those DT <140 ms was associated with a 22% survival rate at 3 years compared with 10% in the non-restrictive group. Although the study was limited by a small number of deaths (n=8), this finding has subsequently been confirmed in several studies. In these studies, Patients with a restrictive filling pattern have been characterized by higher age, more advanced LV systolic dysfunction and high risk of inhospital heart failure. This study is showed that an abnormality short DT is an independent predictor of adverse outcome after AMI.

E/Ea value more than 15, IVRT less than 60 msec and DT less than 140 msec were the reliable predictors of morbidity and mortality following acute myocardial infarction. In this study also, results were in concurrence with the finding in previous other study. Thrombolysis was associated with improvement in the diastolic function. This study was simple noninvasive assessment of diastolic function in acute myocardial infarction to prognosticate the patients with normal or low left ventricular ejection fraction.

Conclusion:

Tissue Doppler Echocardiography remains the primary method for clinical assessment of diastolic function. In the present study, thrombolysed patients showed average E/Ea 14.5 and nonthrombolysed patients showed average 17.4. This study showed increased morbidity and mortality in patients with E/Ea value more than 15. The proposed methods are technically simple and can be easily performed using any echo machine equipped with conventional pulsed Doppler myocardial imaging. Pulsed TD derived echocardiographic methods are quantifiable, reproducible and non-invasive techniques for assessing the presence of diastolic dysfunction in acute myocardial infarction.

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