Proceeding S.Z.P.G.M.I. Vol: 28(1): pp. 25-32, 2014.

Compare Wall Motion Score at 6 Weeks in Patients With Short and Normal Deceleration Time On Day 1 After Acute MI

Muhammad Yasir, Qazi Abdul Saboor, Saulat Siddique and Amber Malik
Department of Cardiology, Shaikh Zayed Postgraduate Medical Institute, Lahore

ABSTRACT

Objective: To compare wall motion score at 6weeks in patients with short and normal deceleration time on day 1 after acute MI. **Study Design:** Cohort study. **Setting:** Cardiology Department Sheikh Zayed Hospital Lahore. **Sample Size:** 100 patients. **Sample Technique.** Non probability convenient sampling. **Data Collection Procedure:** In my study I evaluated 100 patients with acute MI on day 1 and at six weeks post MI. All patients were treated with streptokinase and heparin. Echocardiography was performed using Vivid I ultrasound machine (GE medical system). Patients were divided in two equal groups depending on deceleration time, group A (DT <150 ms) and group B (DT >150 ms) on day 1 post MI .Their wall motion score ,left ventricular volumes and ejection fraction were compared at base line and at six weeks. **Results:** Patients with short DT showed higher wall motion score (29±3 vs 20±2.5) higher left ventricular volumes (LVEDV 98±21 vs 77±8 , LVESV 64±13 vs 38±6) and lower ejection fraction (37±5 vs 50±4) at base line. Also, at 6 weeks, patients with short DT showed less improvement in wall motion score (27±2 vs 17±6) and ejection fraction (39±5 vs 53±5) compared to patients with normal deceleration time. **Conclusion:** Patients with short deceleration time have larger infarcts(high WMS) , poorer left ventricular systolic function and are at higher risk of ventricular remodeling compared to patients with normal deceleration time. DT measured post MI is a reliable and noninvasive short term predictor of outcome after MI

Key Words: Deceleration time (DT)Wall motion score (WMS)Myocardial infarction (MI)

INTRODUCTION

Despite revolutionary achievements in diagnosis and management over the last three decades, acute myocardial infarction continues to be a major public health problem in the industrialized world[1-2]. In the United States nearly 1.5 million patients annually suffer from acute myocardial infarction[3]. Although the death rate from acute myocardial infarction has declined by about 30 percent over the last decade, its development is still a fatal event in approximately one third of patients.[3] Acute M.I has multiple complications.

After acute myocardial infarction left ventricle under goes changes in its size, shape and function. These changes are collectively known as remodeling. Measurements of the extent of LV remodeling have prognostic value; the greater the extent of the remodeling, the poorer the prognosis. Among patients with coronary heart disease, a recent myocardial infarction, or HF, relatively small increases in ventricular volume are associated with major increases in the risk of death [4-5] Measures that assess the extent of LV remodeling include LV end-diastolic and end-systolic dimensions and volumes, shape, mass, ejection fraction (LVEF) and myocardial strain.[5]

There is lot of interest in identifying high risk patient relatively early after AMI. Assessment of resting left ventricular function is an important part of risk stratification in patients with acute MI and was recommended by the 2004 ACC/AHA STEMI guidelines [6]. No changes to this recommendation were made in the 2007 ACC/AHA focused update [7]. Patients with left ventricular systolic dysfunction have increased mortality at six months and one year [8-10]. The increase in mortality is most pronounced in the minority of patients with an LVEF ≤ 30 percent.

LV systolic function can be assessed either by invasive methods for example contrast ventriculography or non-invasively by echocardiography. Other non invasive methods include radionuclide ventriculography ,gated SPECT and cardiac MRI .Echocardiography has the advantage of being widely available ,cost effective ,can be performed at the bed side and reproducible.

Measures of systolic function during echocardiography include Ejection fraction, wall motion analysis, fractional shortening and LV volumes. Patients with higher wall motion score and lower ejection fraction have poorer outcome post MI.

Another advantage of echocardiography is it ability to diagnose diastolic function .There is considerable evidence to suggest that diastolic function is a marker of left ventricular dilation and poor outcome post MI [11]

The presence of left atrial enlargement that is otherwise unexplained [12] and left ventricular hypertrophy support the diagnosis of diastolic dysfunction. In the absence of left ventricular hypertrophy, concentric remodeling of the left ventricle may be present.

In addition to the initial assessment, echocardiography can be performed serially to monitor the course of the disease. Doppler evaluations of parameters of left ventricular filling and relaxation have shown good reproducibility when standard procedures for imaging and reading are followed [13].

Doppler demonstration of the velocity profile of left ventricular transmitral inflow is among the most easily acquired and most informative methods of characterizing left ventricular filling [14,15-17.] Transmitral Doppler flow is usually measured with the sample volume at the tips of the mitral leaflets from the apical four-chamber view.

During diastole, there are three phases of left ventricular filling: There is an initial phase of rapid transmitral flow as the mitral valve opens and the left ventricle relaxes; this early filling phase results in a peak in the transmitral flow profile referred to as the E wave. The early filling phase is followed by diastasis, during which the slowing of left ventricular relaxation and the rise in left ventricular diastolic pressure result in a decrease in transmitral flow velocity. A late second phase of rapid filling occurs with atrial contraction, resulting in a second peak in the transmitral flow profile referred to as the A wave. This sequence of patterns — E wave, diastasis, A wave — can easily be discerned from the Doppler velocity profile.

Analysis of the Doppler velocity profile permits calculation of several important diagnostic parameters. These include the ratio of peak early filling velocity to late filling velocity (E/A ratio; normal value ≥ 1.0), the deceleration time of the early filling curve (DT; normal value >150 to ≤ 220 m/sec), and the isovolumic relaxation time (IVRT).[15-17] Measurement of the IVRT requires simultaneous interrogation of left ventricular outflow and mitral inflow. A pulsed Doppler sample volume is positioned between the aortic valve and the mitral valve in the apical five-chamber view.

Impaired left ventricular relaxation is characterized by a reduction in early diastolic mitral flow velocity, manifested by a decrease in E wave amplitude, and an increase in late diastolic filling, manifested by an increase in A wave amplitude. The E/A ratio is decreased and is <1 compared to normal subjects in whom the E/A ratio is ≥ 1.[15-17] In addition, there is prolongation of both the DT (>220 msec) and the IVRT. This pattern indicates grade I diastolic dysfunction. [18]

This form of diastolic dysfunction occurs in ischemic heart disease, hypertension, and with normal aging. The decrease in E/A ratio and prolongation of IVRT associated with normal aging[19] is only partially mitigated by endurance training[20].

In patients with symptomatic heart failure as well as patients post-myocardial infarction, the presence of a restrictive pattern is associated with increased mortality.

The rate of relaxation and the filling characteristics are also dependent upon preload, after load, heart rate, and contractility. DT is largely independent of the factors which affect E/A ratio .In addition , DT is inversely related with pulmonary capillary wedge pressure which is one the strongest predictors of mortality after MI. DT is one of the simplest and most powerful indicator of diastolic function.[21] Patients with short DT show higher wall motion score(32±15vs 23±14), end diastolic volume (81±21 vs 78±19), end systolic volume (46±17 vs 41±14) and low ejection fraction (44±7 vs 48±7).[22] However the relation between DT early after MI and subsequent LV dilation and wall motion score is less well clear.[23]

The aim of my study is to evaluate the relation between DT and wall motion score early after MI .This will provide a noninvasive method of identifying high risk patients at an early stage post MI

Aims and Objectives

To compare left ventricular wall motion score at 6 weeks in patients with normal and short deceleration time on day 1 after acute MI

Operational Definitions

Myocardial Infarction

Chest pain lasting more than 30min, ST elevation in at least two contiguous ECG leads and transient elevation in cardiac enzymes. At least two should be present to make the diagnosis.

Deceleration Time (DT)

DT is time interval after which peak mitral inflow gets reduced to minimum. It is measured with pulse wave Doppler using echocardiography machine. Short DT <150 ms and normal >150ms.

Wall Motion Score

16 segments of the left ventricle will be analyzed in semi quantitative manner during echocardiography and graded as normokinesia=1, hypokinesia=2, akinesia =3, dyskinesia=4. Wall motion score will be calculated by summing the scores for each segment.

Hypothesis

There is difference in wall motion score in patients with normal and short DT in the setting of AMI

MATERIAL AND METHODS

Sample size

The calculated sample size was 100 cases with 95% level of significance ,80% power of study taking magnitude of wall motion score(mean±SD) i.e. (32±15 & 23 ±14)[22] in short deceleration time and normal deceleration time.

Inclusion Criteria

1. Adults above 18 and below 70years of age.
2. Patients of both sexes who present with their first myocardial infarction.

Exclusion Criteria

1. Patients with atrial fibrillation on ECG.
2. Moderate mitral regurgitation on Echocardiogram.
3. Heart rate above 120/min as tachycardia alters mitral inflow pattern.
4. Patients with restrictive cardiomyopathy or constrictive pericarditis on echocardiogram.

Data Collection Procedure

Echocardiograms were performed within 24hours of the onset of symptoms and at 6 weeks post infarction using GE vivid I echocardiography machine.

3 MHz ultrasound probe was used. DT was calculated by transmitral flow recordings obtained in apical four chamber view, with the sample volume placed at the tips of mitral leaflets .Patients were divided in two groups, group A having normal DT (>150ms) and group B with short DT (<150ms)

In both these groups wall motion score and other variables of ventricular performance (e.g. left ventricular end diastolic volume, end systolic volume and ejection fraction) were measured. Ventricular volumes and ejection fraction were measured with modified Simpson method. WMS plus above mentioned variables on day 1 and at 6wks were compared in two groups

Data Analysis Procedure

Data was analyzed by SPSS version 13. Wall motion score and age of the patients were quantitative variables and were expressed as mean±S.D. For quantitative variables t test was used for comparison between the two groups. P value of 0.05 was considered significant. Qualitative variables such as sex were recorded as frequencies.

RESULTS

One hundred patients of acute ST segment elevation MI who were admitted to the hospital were enrolled for the study purpose. Demographic features, deceleration time, wall motion score, left ventricular volumes and ejection fraction were noted.

Study population was divided into the following two groups according to deceleration time on day 1 after acute MI:

Group A: DT >150 ms

Group B: DT <150 ms

66 patients were male while 36 were female (Table 1). Mean age of the patients was 56 ±13.Group A had 30 male and 20 female patients with a mean age of 58 ±13. Group B had 36 male and 14 female patients with a mean age of 55 ±13. There was no significant difference with respect to age or sex between the two groups (Table 2).

Table 1: Group wise sex distribution

Group	Frequency	Percent
Group A(DT >150ms)		
Male	30	60
Female	20	40
Group B (DT <150ms)	36	72
Male	14	28
Female		

Table 2: Age group of studied patient n = 100

Groups	Age	P value
Group A	58.2±13	0.328
Group B	55.6±13	

Two patients were lost to follow up in each group and there were two deaths in the study population during follow up period. Both patients belonged to short DT group.

Patients with short DT showed higher wall motion score (29 ±3 vs. 20± 2.5 p value=.001) higher left ventricular volumes (LVEDV 98 ±21 vs. 77 ±8, LVESV 64± 13 vs. 38± 6 p value=.001) and lower ejection fraction (37± 5 vs. 50 ±4 p value =.001) at base line (Table 3).

Also, at 6 weeks patients with short DT showed less improvement in wall motion score (27 ±2 vs. 17 ±6 p value =.001), ejection fraction (39 ±5 vs. 53± 5 p value =.001) and greater LV dilatation at 6 weeks (LVEDV 105 ±19 vs. 79 ±9 p value=.001, LVESV 64 ±14 vs. 38 ±6 p value=.001) compared to patients with normal deceleration time (Table 4).

Table 3: Comparison of wall motion score (WMS)

	Group	Mean	No.	P value
WMS day1	A (DT>150ms)	20.9 ±2.5	N=50	<.001
	B (DT<150ms)	29.3±2.8	N=50	
WMS 6 week	A (DT>150ms)	17.6±2.1	N =48	<.001
	B (DT<150ms)	26.9±2.4	N=46	

Table 4: Left ventricular volumes and ejection fraction

LVEDV_day1	A (DT>150ms)	77.2±7.9	<0.001
	B (DT<150ms)	98.8±21	
LVEDV_6week	A (DT>150ms)	79.1±9.2	<.001
	B (DT<150ms)	105.8±19	
LVESV_1day	A (DT>150ms)	38.3±5.9	<.001
	B (DT<150ms)	63.9±13.7	
LVESV_6week	A (DT>150ms)	38.6±6.6	<.001
	B (DT<150ms)	64.7±14	
EF_1day	A (DT>150ms)	50.6±4.9	<.001
	B (DT<150ms)	36.8±5.89	
EF_6week	A (DT>150ms)	53.2±5	<.001
	B (DT<150ms)	38.7±5.4	

DISCUSSION

Recently increasing attention has been given to diastolic dysfunction after AMI and there is growing evidence indicating a strong association between diastolic dysfunction and adverse outcomes [24-25]

Several studies have shown that a short DT, irrespective of the ratio of early and late filling velocity (E/A ratio), is strongly related to pulmonary capillary wedge pressure, and is an ideal parameter for the serial assessment of diastolic function post MI.[25-26]

For this reason we used DT as a means to assess LV filling irrespective of filling pattern and classified those with DT <150 as short although in some other studies a cutoff value of 130 ms has been used[22]. In line with previous studies,[25-27] we found that patients with short DT were more likely to have larger infarcts, as expressed by a higher wall motion score and lower ejection fraction(p value .001). During follow up period these patients showed less recovery of WMA and less improvement in ejection fraction(P value .001).

Patency of infarct related artery is a major determinant of improvement in systolic function, diastolic function and preventing LV remodeling. Recently, Cerisano and colleagues[25] have reported, in a selected group of patients with reperfused acute anterior myocardial infarction, that a short deceleration time on day 3 is a strong predictor of left ventricular dilatation in the following six months. In our study, this observation was extended to unselected patients with relatively short follow up period (6weeks) following infarction.

Studies have shown that only deceleration time measured on day 1 could separate patients in whom left ventricular remodeling is likely to occur during the next year, while deceleration time measured after 24 hours failed to do so.[28-29] In addition, the value of the initial variable has the greatest prognostic potential, as the sickest patients may die before the next measure is obtained. Finally, deceleration time values late after MI may be influenced by various therapeutic interventions during the acute and chronic phases of myocardial infarction.

Studies have recently shown that left ventricular chamber stiffness is increased 24-48 hours after infarction, but returned to normal within several days.[28] Interestingly, it appears that changes in deceleration time are more pronounced in patients with an initially short deceleration time.[25] These findings may be attributed, at least in part, to the decrease in left ventricular filling pressures caused by ventricular dilatation, and the subsequent prolongation of deceleration time**.**

As ventricular dilatation is more pronounced in patients with an initially short deceleration time, it may be assumed that changes in filling pressures are greater, leading to pronounced changes in deceleration time later on in these patients. We found that patients with a short deceleration time had larger infarcts, which is consistent with a previous finding that deceleration time is directly related to the size of the infarct.[30]

The only predictor of a short deceleration time in the literature is the initial wall motion score,[25-26] implying that the extent of infarction is the major determinant of early left ventricular chamber stiffness. As left ventricular dilatation is critically dependent on infarct size,[31] it appears that the amount of infarcted myocardium is the link between increased early chamber stiffness and subsequent left ventricular remodeling over the next year following the infarct. These observations have been extended by Poulsen and colleagues,[24] who have shown that a short deceleration time on day 1 predicts the development of congestive heart failure following acute myocardial infarction better than the ejection fraction.

Thus the ability of a short deceleration time to identify patients prone to left ventricular dilatation as early as day 1 may have therapeutic and clinical implications in relation to attempts to prevent further remodeling. These patients might benefit from a more aggressive attempt to reopen the infarct related artery with alteplase[32] or reteplase,[33] or from primary percutaneous transluminal coronary angioplasty.[34-35] Also, acute administration of intravenous β blockers[36] and glyceryl trinitrate[37] to reduce infarct size, as well as the early use of ACE inhibitors[38] to limit left ventricular remodeling, should be strongly recommended in these patients.

There were two deaths in our study population and both occurred in short DT group which shows prognostic value of DT measured early after MI. Studies have shown significantly greater one year and five year cardiac mortality in patients with a short initial deceleration time[22].

Although it has been shown that a restrictive filling pattern is associated with a worse prognosis in patients with dilated cardiomyopathy,[39-40] there are few data on the prognostic value of restrictive filling after myocardial infarction. It has recently been reported that restrictive filling is the single best predictor of cardiac mortality following myocardial infarction, and that it adds significantly to the predictive power of clinical and echocardiographic markers of systolic dysfunction.[39-40]

Exclusion criteria for deceleration time measurement used in our study were the same as those used by other groups, and all these criteria (sinus tachycardia, atrial fibrillation, and significant mitral regurgitation) have been shown to be predictors of adverse outcome following infarction.[41] It appears that by applying these criteria we have excluded patients with the worse prognosis, and that patients in whom deceleration time was obtained represent the group that has a more favorable prognosis.

However, it should be emphasized that although deceleration time measurement cohort had a selection bias, a short initial deceleration time could still identify patients who are at increased risk for cardiac death and in whom short and long term left ventricular remodeling is likely to occur.

CONCLUSION

Patients with short deceleration time have higher wall motion score (larger infarcts), poorer left ventricular systolic function and are at higher risk of ventricular remodeling compared to patients with normal deceleration time. DT measured on day 1post MI is a reliable and noninvasive predictor of short term outcome after MI.

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The Authors:

Muhaamad Yasir,
Trainee Registrar
Department of Cardiology,
Shaikh Zayed Postgraduate Medical Institute,
Lahore

Qazi Abdul Saboor,
Associate Professor
Department of Cardiology,
Shaikh Zayed Postgraduate Medical Institute,
Lahore

Saulat Siddique
Professor
Department of Cardiology,
Shaikh Zayed Postgraduate Medical Institute,
Lahore

Amber Malik
Professor
Department of Cardiology,
Shaikh Zayed Postgraduate Medical Institute,
Lahore

Corresponding Author:

Qazi Abdul Saboor,
Associate Professor
Department of Cardiology,
Shaikh Zayed Postgraduate Medical Institute,
Lahore