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The prognostic value of left atrial function assessed by TDI after myocardial infarction (comparison between ST and non ST segment elevation myocardial infarction)

Authors
Mai Salama MD, Sahar Al-Shedody MD, Ayman El-Sheikh MD
Shimaa El-Odamy (M.B.B.CH.,)
Cardiovascular Medicine Department, Faculty of Medicine, Tanta University

ABSTRACT

Aim: *The aim of this study is to assess the predictive value of LA function by TDI for assessment of the prognosis of patients with ST and non ST segment elevation (NSTE) myocardial infarction (MI).*

Methods and Results: *The study included 41 patients with myocardial infarction who admitted to cardiology department at Tanta University Hospital divided as 25 patients with STEMI and 16 patients with NSTEMI, where clinical and echocardiographic parameters were collected within the first 72 hours of admission. Primary end point was assessed during the 3-month follow-up period which included cardiac mortality and/or rehospitalization for recurrent ACS or heart failure. Atrial function was assessed by conventional echocardiographic parameters and by Pulsed wave TDI that measured the mean atrial contraction velocity at the midsegments of interatrial septum, anterior, inferior, and lateral wall of LA (mLA-V). During the 3-month follow-up period, primary end point occurred in 16% (4/25) in STEMI patients and 18.8 % (3/16) in NSTEMI patients. STEMI patients mLA-V< 8 cm/sec emerged as an independent predictor for cardiac events (p. value = 0.001), in comparison to mLA-V< 6.3 cm/sec in NSTEMI patients with cardiac events. Also E/E` ratio showed a significant difference in patients with cardiac events in both groups.*

Conclusion: *Assessment of LA function by TDI is a strong parameter in the prognosis and prediction of cardiac events in patients with ST and non ST segment elevation (NSTE) myocardial infarction (MI).*

Introduction

It is clear that studies of LA function provide new insights into the contribution of LA performance to cardiovascular disease and are promising tools for predicting cardiovascular events in a wide range of patient populations.[(1)]

Myocardial infarction (MI) is an increasing problem, worldwide. An appreciation of its causes and morphology helps provide a basis for development of new interventions, as well as its management, and in the future prevention .MI which causes irreversible damage to heart muscle through deprivation of oxygen to the area at risk, is common and contributes to significant debilitation, morbidity and mortality, as well as substantial medical costs. This damage is potentially preventable both through risk factor modification and use of medical technology such as urgent identification and revascularization. [(2)]

In recent studies, both left ventricle (LV) systolic and diastolic function assessed by echocardiography have been shown to predict cardiovascular events in ACS patients .However, little is known about left atrium (LA) function which is an integral part of overall cardiac function in predicting the prognosis of ACS patients. [3-6]

Echocardiography is now the most commonly used noninvasive tool for the assessment of cardiac anatomy and function. In addition to commonly established roles such as confirming diagnosis, etiologic work-up, complication screening, and disease monitoring, echocardio-graphy plays an important clinical role in prognostic assessment. [7]

Tissue Doppler imaging (TDI) has been validated for the assessment of both global and regional LV function and has recently been applied to the evaluation of regional LA function, using parameters such as the peak myocardial late diastolic velocity of septal mitral annulus (septalA')and LA contraction velocity of different atrial segments.[8-12]

Because tissue Doppler velocity imaging is readily available in most of the current echocardiographic systems, this information is now ready to apply toward optimal clinical management for patients who are vulnerable to the development of cardiovascular events.[7]

Patients and Methods

The study included 41 patients with myocardial infarction who admitted to cardiology department at Tanta University Hospital divided as 25 patients with STEMI and 16 patients with NSTEMI were enrolled into the study. Patients with atrial fibrillation, severe valvular heart disease, left bundle branch block and presence of pacemaker were excluded.

Clinical and echocardiographic parameters were collected within the first 72 hours of admission and formed the baseline data.

The study was conducted using machine vivid 7–dimension (GE Vingmed, Horten, Norway), all acquisitions were performed with a broad band M4s transducer .With the patient in left lateral position using parasternal long axis, short axis and apical four chamber view according to American society of echocardiography recommendations.

LV end-diastolic volume (LVEDV), LV end systolic volume (LVESV), and LV ejection fraction (LVEF) were assessed using the modified biplane Simpson's equation in the apical four- and two chamber views according to the American Society of Echocardiography's Guidelines. [13]

Mitral inflow was assessed with pulsed-wave Doppler echocardiography from the apical four-chamber view .The Doppler beam was aligned parallel to the direction of flow and a 1- to 2-mm sample volume was placed between the tips of mitral leaflets during diastole. [14]

Left Atrial Volume

LA volume was measured by biplane area length method.[13]

Three phasic LA volume was obtained: maximal LA volume at end ventricular systole (LAVmax), the LA volume before atrial systole (LAVmid, i.e., LA volume just prior to the p-wave on the electrocardiogram), and minimal LA volume at end ventricular diastole (LAVmin). [15]

LA active emptying volume was the difference between LAVmid and LAVmin, and the LA active ejection fraction (active LAEF) was given by the ratio of the LA active emptying volume to the LAVmax. [16]

Tissue Doppler

TDI was performed at the apical four-chamber view for the long-axis motion of the heart. [17,18]

Two-dimensional echocardiography with Pulsed wave TDI imaging was performed. The imaging angle was adjusted to ensure a parallel alignment of the sampling window with the-myocardial segment of interest. Pulse Doppler sample volume was placed at the septal MV annulus to get the early diastolic (E`) and late diastolic velocity (A`), the ratio of E/E` was calculated.

Atrial Doppler velocity profile signals were reconstituted offline by placing a 2×6 mm sampling window at the mid levels of the interatrial septum, anterior, inferior, and lateral wall of LA.

The peak regional atrial contraction velocities (LAV) were measured, and the mean value of LA-

V (mLA-V) from the four atrial walls was calculated.

Follow-up

Follow-up was performed for 3 months after the onset of myocardial infarction. All the patients or their relatives were contacted to verify the occurence of cardiac events.

Cardiac events were documented during the follow up as the primary end point which consisted of the composite of cardiac mortality as well as rehospitalization due to recurrent ACS or heart failure.

Cardiac deaths were confirmed either by reviewing the hospital records or contacting patients' relatives for details and reviewing the death certificate for out of hospital mortality.

Statistical Analysis

Data were analyzed with SPSS V.16 .The values of parametric data were expressed as mean ± SD. A P-value <0.05 was considered statistically significant .The difference in mean between the two groups was examined by independent t-test. Categorical variables were compared between two groups by the chi-square test. Multivariate logistic regression analysis was performed to investigate the independent effect of various covariates on cardiac events in a stepwise forward conditional manner with entry and retention in the model set at a significance level of 0.05. The incremental value of LA function was assessed in four modeling steps which included the independent predictors in the multivariate analysis. The first step consisted of clinical data, LV systolic function and diastolic function were then added sequentially. Finally, LA function was included. The change in overall chi-square was used to assess the increment of predictive power at each step.

Results

During the 3-month follow-up period Primary end point occurred in 16% (4/25) in STEMI patients and 18.8 % (3/16) in NSTEMI patients.

Patients were divided into STEMI and NSTEMI patients. Their base line general characteristic data are listed in Table I.

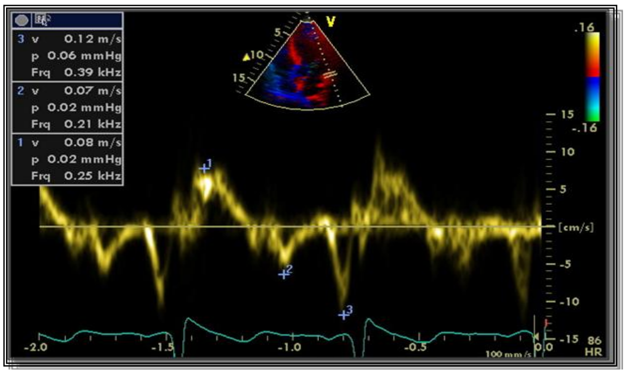

Figure (1): Pulsed wave TDI apical four chamber view showing lateral left atrial wall.

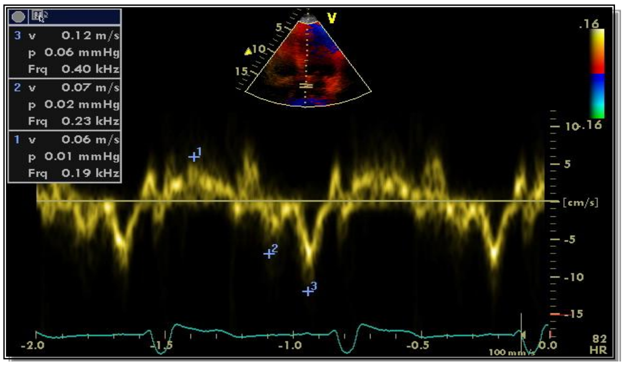

Figure (2): Pulsed wave TDI apical four chamber view showing interatrial septum of the left atrium.

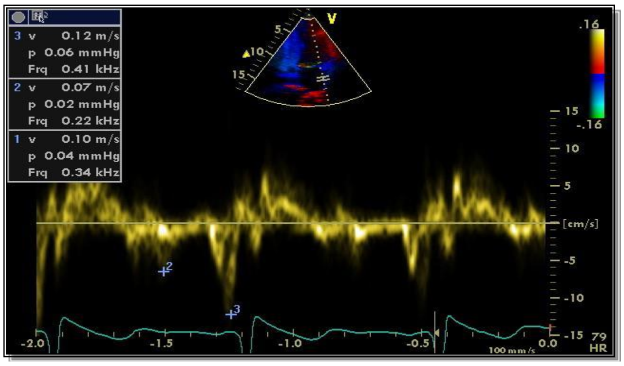

Figure (3): Pulsed wave TDI apical two chamber view showing anterior wall of the left atrium.

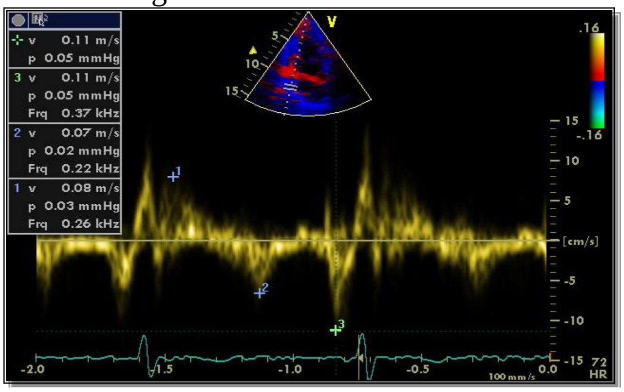

Figure (4): Pulsed wave TDI apical two chamber view showing inferior wall of the left atrium

Table 1: Base line general characteristics

	STEMI	NSTEMI	p. value
Age	54.1±10.1	57.1±8.1	0.447
Gender	Male 22 (88 %)	10 (62.5 %)	0.528
Hypertension	14 (56 %)	9 (56.3 %)	0.965
Diabetes mellitus	6 (24 %)	10 (62.5 %)	0.014*
Smoker	20 (80 %)	9 (56.3 %)	0.103
Weight (Kg)	78.5±11.4	73±7.63	0.635
Height (m)	1.70±0.05	1.68±0.04	0.241
Body surface area	27.1±3.81	25.8±2.62	0.412
Heart Rate(beats/min)	82.2±10.9	81.8±10.7	0.224

There was no difference in the gender, prevalence of hypertension, and number of smokers between the two groups.

There was statistically significant increase in diabetes mellitus in NSTEMI patients 62.5% (10/16) in comparison to STEMI patients 24% (6/25) (p. value = 0.014).

For echocardiographic data, there were significant differences in E/E` ratio, septal A` as well as mLA-V in STEMI patients who had cardiac events in comparison with those who had no cardiac events. (Table 2)

Table 2: Comparison between patients with cardiac events and without cardiac events in STEMI group

	STEMI		p. value
	Yes	No	
mLA-V (cm/sec)	7.77±0.33	11.7±1.7	0.001*
E/E` (cm/sec)	14.4±5.74	10.17±2.27	0.025*
Septal A` (cm/sec)	6±1.41	9.8±2.1	0.002*
LAEF %	22.5±1.76	19.7±4.05	0.096
A Wave(MVA) (cm/s)	65.7±13.6	73.4±18.2	0.427
LVEF %	34.2±4.1	49.9±9.1	0.003*

Clinical and echocardiographic parameters that showed a difference between patients with and without cardiac events (defined as $P < 0.05$)

STEMI patient's mLA-V< 8 cm/sec emerged as an independent predictor for cardiac events (p. value = 0.001). in comparison to mLA-V< 6.3 cm/sec in NSTEMI patients with cardiac events .Also E/E` ratio showed a significant difference in patients with cardiac events in both groups.

Also NSTEMI patients who had cardiac events had a significant differences in E/E` ratio and mLA-V. (Table 3)

Table 3: Comparison between patients with cardiac events and without cardiac events in NSTEMI group

	NONSTEMI		p. value
	Yes	No	
mLA-V (cm/sec)	6.2±0.17	10.9±1.14	0.001*
E/E` (cm/sec)	11.25±2.75	10.02±1.69	0.014*
Septal A` (cm/sec)	8±1.73	9.46±1.39	0.753
LAEF %	25.1±0.72	19.1±3.57	0.951
A Wave(MVA) (cm/s)	69.6±12.1	74.1±10.1	0.258
LVEF %	36.3±5.85	43.5±12.2	0.239

Discussion

Recently, the relationship between cardiovascular disease and LA dimension and function has gained greater recognition. [19,20]

Survivors of a first acute myocardial infarction (MI) face a substantial risk of further cardiovascular events, including death, recurrent myocardial infarction, heart failure, arrhythmias, angina, and stroke. However, the prognosis may vary widely between individuals, according to the presence or absence of risk factors present before the MI.[21]

TDI provides a relatively load independent method of measuring the segmental myocardial movement. septal A `is the septal annulus late diastolic velocity which is caused by atrial contraction but it is not directly measuring the real atrial contractile velocity. The peak regional atrial contraction velocities estimated by TDI present atrial function directly. [22]

In addition to its diagnostic capacity, myocardial velocity measurements obtained with TDI provide improved prognostic information in a wide range of cardiac diseases.[7]

We found that assessment of LA function by TDI is a strong parameter in the prognosis of patients with ST and non ST segment elevation (NSTE) myocardial infarction (MI) in addition to that of LV. However, in contrast to the assessment of LV, there is currently no accepted "gold standard" regarding the evaluation of LA function.

Findings of the present study demonstrated increase in E /E ` and the mean value of the peak regional atrial contraction velocities from the four atrial walls (mLA-V) in STEMI patients with cardiac events in comparison with NSTE-MI patients with cardiac events .

The finding of our study was supported also by Liu, et al who found that the velocity of atrial contraction is a parameter, which can estimate the atrial function and predict the 6-month cardiac events after the onset of NSTE-ACS. However, in contrast to the assessment of LV, there is currently no accepted "gold standard" regarding the evaluation of LA function.[22]

Lonborg *et al* aimed to evaluate the prognostic importance of LA function in patients following ST elevation myocardial infarction (STEMI). This is the first study to evaluate LA function in patients following STEMI by the use of Cardiovascular magnetic resonance (CMR). the main findings of this study are: (i) LA fractional change, LA passive fraction, and LAmin reflect acute and chronic heart disease, whereas LAmax mainly reflects chronic heart disease; and (ii) LA fractional change provides independent prong-ostic information beyond known predictors. [23]

Recently, using computed tomography, Kühl *et al* have demonstrated that impaired LA function is associated with a poorer prognosis in patients with non ST-segment elevation myocardial infarction (NSTEMI). However, patients with NSTEMI often have a more longstanding history of ischaemic heart disease, increased prevalence of comorbidities, smaller acute ischaemic burden, and a different prognosis from those with STEMI. [24,25]

Conclusion

Myocardial infarction (MI) is an increasing problem, worldwide. An appreciation of its causes and prognosis helps provide a basis for development of new interventions, as well as its management, and in the future prevention. In patients with myocardial infarction, early assessment of LA function by TDI appears useful to predict the midterm cardiac events, which adds prognostic information in addition to that of LV function. The peak regional atrial contraction velocities of the left atrial walls estimated by pulsed wave TDI present atrial function directly and a measure of LA function gave additional prognostic power to predicting future cardiac events with clinical and echocardiographic assessment of LV systolic and diastolic function

Limitation

The major limitation of this study is the lack of a gold standard measurement of left atrial function. The sample in this study is relatively small and the follow time was short. However, even with these numbers we were able to demonstrate the value of a direct measurement of LA function. Pulsed-wave TDI has high temporal resolution but does not permit simultaneous analysis of multiple myocardial segments.

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