Pre-ejection mitral annular motion velocity responses to dobutamine infusion: A quantitative approach for assessment of myocardial viability

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Background: **Dobutamine stress echocardiography (DSE) is widely used for detection of myocardial viability. The main limitation of DSE is its subjective interpretation. Assessment of mitral annular motion velocities with tissue Doppler imaging is a simple and quantitative measurement.**

Objective: **To determine the relationship between myocardial viability and regional systolic mitral annular motion tissue Doppler velocities responses to dobutamine stress.**

Methods: **Our study group included 42 patients with previous myocardial infarction referred for coronary angiography and revascularization. We did dobutamine stress tissue Doppler echocardiography (DSTDE) measuring velocities of pre-ejection wave (pre-Ej) and peak ejection wave (Ej) at rest and during low-dose dobutamine infusion. We did follow up echocardiography after 1 month.**

Results: **After exclusion of the normokinetic walls, we analyzed 196 walls. Using receiver operator characteristic ROC curves, the optimal cut-off value for viability assessment was an increase of 1.75 cm/s in pre-ejection velocity during DSTDE (area under the curve 0.70, $p < 0.001$). On the other hand, the optimal cut-off value for viability assessment was an increase of 1.75 cm/s in ejection velocity during DSTDE (area under the curve 0.613, $p = 0.01$). The sensitivity, specificity, and total accuracy of the DSTSE (pre-Ej) versus the gold standard for detection of myocardial viability were 66.15%, 67.94%, and 67.35%, respectively. The sensitivity, specificity, and total accuracy of the DTSE (Ej) were 56.92%, 64.12%, and 61.43%, respectively. There was a good correlation between the pre-Ej at 5 ug/kg/min dobutamine infusion and the pre-Ej after revascularization ($r = 0.64$, $p = 0.01$) while the correlation with the Ej was moderate ($r = 0.50$, $p = 0.01$).**

Conclusion: **Viable left ventricular myocardium could be identified easily and quantitatively with pre-ejection mitral annular velocity during dobutamine infusion. The pre-ejection wave during DSTDE showed greater sensitivity and specificity for the prediction of myocardial viability than the ejection wave.**

Keywords: Dobutamine stress echocardiography, Tissue Doppler imaging, Myocardial viability

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Introduction

Assessment of myocardial viability in patients with myocardial infarction is important. Myocardial scintigraphy [1], dobutamine stress echocardiography, [2] and contrast echocardiography [3] are used in the determination of viability. Among these procedures, dobutamine stress echocardiography is widely used in the clinical setting because it is a safe and accurate method for detection of myocardial viability. The main limitation of dobutamine echocardiography is its subjective interpretation [4].

Because the mitral annulus shifts towards the cardiac apex during systole [5], the mitral annular motion recorded with M-mode echocardiography correlates with the left ventricular ejection fraction [6,7] and myocardial viability [8]. One study showed that changes in the amplitude of the AV plane displacement during low-dose dobutamine stress echocardiography can easily be used to detect myocardial viability at an early stage with late potential for spontaneous recovery [9].

Tissue Doppler imaging facilitates the direct measurement of the left ventricular wall and mitral annular motion velocities [10,11]. This method can therefore be used for quantitation of regional left ventricular wall motion [12]. Thus, the parameters obtained from mitral annular systolic motion velocities with pulsed tissue Doppler imaging reflect left ventricular (LV) asynergy corresponding to the infarct regions in patients with myocardial infarction, and global LV systolic function may be evaluated with these parameters [13]. Assessment of mitral annular motion velocities along the long axis with tissue Doppler imaging has several advantages over other methods, such as the simplicity of measurement, superior time resolution, and preload independence [13–15].

However, there have been no many studies correlating myocardial viability and regional systolic mitral annular motion velocity response to dobutamine stress, particularly during early systole. It has been found that the pre-systolic annular motion towards the cardiac apex accurately predicts regional left ventricular myocardial viability [12].

Objective

The objective of this study is to determine the accuracy of regional systolic mitral annular motion tissue Doppler velocities responses to dobutamine stress in the detection of myocardial viability in patients with previous myocardial infarction.

Abbreviations

+Vic	myocardial positive pre-ejection velocity
CABG	Gcoronary artery bypass grafting
CI	95% confidence interval
DSE	Dobutamine stress echocardiography
DSTDE	dobutamine stress tissue Doppler echocardiography
EF	ejection fraction
Ej	ejection wave
IVS	interventricular septal thickening
LA	left atrial diameter
LAD	left anterior descending
LCX	left circumflex
LDDSE	low dose dobutamine stress echocardiography
LV	left ventricular
LVEDD	left ventricular end diastolic diameter
LVEF	left ventricular ejection fraction
LVESD	left ventricular end systolic diameter
MI	myocardial infarction
MRI	magnetic resonance imaging
PCI	percutaneous coronary intervention
PET	positron emission tomography
pre-Ej	pre-ejection wave
PW	posterior wall thickening
RCA	right coronary artery
ROC	receiver operator characteristic
TDI	tissue Doppler imaging

Methodology

We enrolled consecutive patients with previous myocardial infarction who were referred to Ain Shams University Hospitals for coronary angiography and revascularization.

Inclusion criteria were: (1) Significant (>50%) reduction in the luminal diameter of a major coronary artery corresponding to the infarcted area on the basis of recent coronary angiographic results; (2) previous Q-wave myocardial infarction of more than one-week duration; and (3) regional left ventricular wall motion abnormality corresponding to the infracted region on the basis of two-dimensional echocardiography. The infract-related coronary artery stenosis was revascularized by either coronary artery bypass grafting (CABG) or percutaneous coronary intervention (PCI).

Exclusion criteria were: (1) Postinfarction unstable angina or infarction complicated by severe hemodynamic instability; (2) decompensated congestive heart failure; (3) protruding thrombus in the left ventricular cavity with fresh mobile edges; (4) significant valvular or congenital heart disease; (5) any myocardial disease apart from ischemia; (6) coexistent relevant liver or renal disease; (7) a contraindication to dobutamine administration particularly; (8) moderate or severe mitral regurgi-