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ORIGINAL ARTICLE

Tissue Doppler tricuspid annular motion in acute inferior wall myocardial infarction and infarction related artery

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KEYWORDS

Right ventricular function;
Right coronary artery stenosis;
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Abstract *Background:* Patients with inferior wall myocardial infarction (IWMI) associated with right ventricular (RV) infarction have much higher rates of adverse events.

Aim: Tissue Doppler (TDI) systolic annular velocity (S′) and myocardial performance index may be useful predictors of proximal right coronary artery (RCA) stenosis as a culprit lesion in inferior wall myocardial infarction.

Methods: In a prospective study, patients with first episode of acute IWMI underwent early conventional and tissue Doppler echocardiographic assessment (within 24 h) of symptom onset and RV indices; Tricuspid annular systolic plane excursion(TAPSE), myocardial performance index (MPI) and tissue Doppler velocities from RV free wall were measured. Patients underwent coronary angiogram within one month and were divided into two groups (A, B) according to angiographic findings based on the presence or absence of significant proximal RCA stenosis.

Results: There were 35 patients with first episode of IWMI, group A includes (n 14 patients) and group B includes (n 21patients), There was significant difference between groups in TAPSE (1.28 cm vs 1.98 $p < 0.001$), MPI–TDI (0.69 ± 0.12 vs 0.38 ± 0.05 $p < 0.001$), and in S′ velocity from RV free wall (0.09 m/s ± 0.02 vs 0.12 m/s ± 0.02 $p < 0.001$). It was found that S′ < 10 cm/s is a predictor of proximal RCA lesion with a sensitivity of 92.86% and a specificity of 85.71% ppv 81.25, npv 94.74, MPI–TDI > 0.55 with a sensitivity of 92.86% and a specificity of 100%, 100% ppv and 95.45% npv, and TAPSE < 16 mm (sensitivity 93%, specificity 100%).

Conclusion: RV indices (S′ velocity, MPI–TDI and TAPSE) are useful in predicting proximal RCA as infarct related artery in IWMI.

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1. Introduction

RV infarction is one of the major causes of RV contractile dysfunction. RV infarction occurs in 20–50% of inferior infarctions. [1] Patients with right ventricular infarctions associated with inferior infarctions have much higher rates of significant hypotension, bradycardia requiring pacing support, and in-hospital mortality than isolated inferior infarction [2]. Occlusion of proximal dominant right coronary artery is usually responsible for right ventricular infarction in inferior wall myocardial infarction [3]. The classic clinical triad of right ventricular infarction includes distended neck veins, clear lung fields, and hypotension [4].

Electrocardiogram often proves inadequate to predict proximal right coronary artery stenosis as infarct related artery [5]. Electrocardiogram changes are transient and disappear in 48% of cases within 10 h that make it less dependable tool [6].

Echocardiography, being non-invasive, widely available, relatively inexpensive, and having no side effects, is the modality of choice for the assessment of morphology and function of the RV in clinical practice. Recent developments have provided several new methods for analyzing the RV [7].

Conventional measurements of area and volume have limited utility in assessing RV function [8] due to the complex geometry of the right ventricle and difficulty in defining the endocardial borders [9].

Using Doppler myocardial imaging, several global and regional parameters such as timing, direction, and amplitude of the velocity of the ventricular wall can be determined. The technique is less dependent on chamber geometry. Furthermore, no endocardial border delineation is needed, which makes TDI usable even if the echocardiographic image quality is suboptimal [7].

In this study we tried to assess whether Echocardiographic assessment of RV function is useful to predict proximal RCA stenosis and hence identify a subset of inferior wall myocardial infarction patients at a higher risk of adverse clinical events.

2. Patients and methods

Our study was done from Jan 2014 to Nov 2015 at the medical college of fayoum university in Egypt. It includes 35 consecutive patients with first episode of acute IWMI within 24 h of symptoms onset and admission to the coronary care unit.

Inferior wall myocardial infarction was defined as ischemic cardiac pain lasting more than 30 min, characteristic ST-segment elevation of 0.1 mv or more in two or more inferior leads, and ck-mb elevation more than twice the upper reference limit. RV infarction was defined as ST-segment elevation 0.1 mv or more in V4R in ECG taken within 6 h of symptoms onset.

Significant proximal RCA stenosis was defined in coronary angiogram by the presence of occlusion 70% stenosis or more, acute thrombosis or dissected plaque in RCA before the origin of the RV branch.

3. Exclusion criteria

Previously documented; Abnormal ventricular function, Left bundle branch block, Atrial fibrillation, Valvular heart disease more than mild. Pulmonary hypertension with RV systolic pressure more than 40 mmhg, Pulmonary embolism, and poor echo window.

4. All patients underwent

Full history taking, Electrocardiogram(left and right side ECG), Cardiac enzymes, troponin I and Echocardiographic assessment of RV function were done within 24 h of onset of symptoms. Echocardiographic measurement was performed according to guidelines of American society of echocardiography [10] for assessment of RV function the following parameters were measured: TAPSE, MPI and tissue doppler velocities from RV free wall.

4.1. TAPSE

In apical 4-chamber view, M-mode cursor was placed through tricuspid annulus at lateral RV free. From M-mode tracing the amount of longitudinal motion of annulus at peak systole was measured.

4.2. MPI by pulsed-wave Doppler method (MPI-PW)

In apical 4-chamber view, pulsed wave Doppler transtricuspid flow velocities are recorded by placing the sample volume between the leaflet tips in the center of the flow stream. Doppler beam was aligned parallel to RV inflow and measurements were taken at end expiration. Transtricuspid early rapid filling velocity (E), peak atrial filling velocity (A) and tricuspid valve closure opening time (TCO) were measured as the time interval from tricuspid valve closure marked at the end of A wave to tricuspid valve opening marked at the beginning of E wave in the next cardiac cycle in pulsed wave doppler tracing.

Pulsed Doppler of RV outflow was taken by placing the sample volume in RV outflow tract. Ejection time (ET) was calculated as time from onset to cessation of flow. Beats with less than 5% variation in R–R interval were taken to allow accurate measurement of myocardial performance index (MPI). MPI was calculated as TCO-ET divided by ET.

Pulsed wave tissue Doppler was acquired by placing TDI cursor on the right ventricular free wall at the level of tricuspid annulus. A major positive velocity (S′) was recorded with the movement of annulus toward the apex during systole.

With the movement of annulus toward the base during diastole, two major negative waves were recorded-one during early diastole (E′) and one during late diastole (A′), (S′) duration was measured as ejection time (ET), the time between the end of (S′) and the beginning of (E′) as isovolumic relaxation time (IRT), and time between end of (A′) and beginning of (S') as isovolumic contraction time (ICT). Right ventricular MPI is calculated as (IRT + ICT)/ET (see Fig. 1).

4.3. Coronary angiogram

Within one month of inferior wall MI. Patients were divided into two groups according to angiographic findings, group A with significant proximal RCA stenosis, and group B without significant proximal RCA stenosis.

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