

A Study of Clinical and Echocardiographic evaluation of Right ventricular function in patients of first acute

Inferior wall myocardial infarction with or without Right ventricular myocardial infarction

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Abstract

Aims and objectives: Right ventricular (RV) function has not been studied widely after a myocardial infarction (MI). The current study was undertaken to study the RV function by tissue doppler imaging (TDI) in patients with inferior wall MI (IWMI) with or without right ventricular involvement (RVMI).

Material And Results: Sixty patients with a first episode of acute MI (isolated IWMI:35, IWMI with RVMI: 25) and 60 healthy controls were included in the study. Association of RVMI was defined as a presence of ≥ 1 mm ST segment elevation in lead V4R of the ECG. From the echocardiographic apical 4-chamber view, the systolic motion of the tricuspid annulus, Peak systolic and Peak early and late diastolic velocities of the tricuspid annulus was recorded at the RV free wall with the use of 2-dimensional guided M-mode recordings and pulsed-wave Doppler tissue imaging respectively. Patients having both IWMI with RVMI as compared to patients with IWMI without RVMI had significantly less TAPSE (12.90 ± 3.64 mm vs. 16.76 ± 5.05 mm). TAPSE was reduced in IWMI with and without RVMI patients as compared to controls as compared to controls. Mean Peak Systolic velocity, Mean Peak early and late diastolic velocity were significantly low ($p < 0.05$) in patients of IWMI with RVMI as compared to patient of IWMI without RVMI [Sm- 0.10 ± 0.028 m/s vs. 0.13 ± 0.07 m/s, E'- $0.084 \pm$

0.034 m/s vs. 0.10 ± 0.038 m/s, A'- 0.11 ± 0.05 m/s vs. 0.15 ± 0.08 m/s]. The value of these velocities were significantly low [$p < 0.05$] when patients of each of these groups was compared to their respective controls.

Conclusion: Thus, TAPSE and TAV by using TDI can be used to assess RV function in patients with IWMI with or without RVMI. These parameters are significantly reduced in IWMI patients as compared to controls.

Keywords: Right Ventricular Infarction, Right Ventricular Function, Tissue Doppler imaging, Inferior Wall Myocardial Infarction.

Introduction

Isolated right ventricular infarction is rare and usually occurs in association with inferior myocardial infarction (MI). The incidence of right ventricular (RV) infarction in such cases ranges from 10-50% in different series¹. Unlike left ventricular function, right ventricular (RV) function has not been widely studied after a myocardial infarction (MI). The current study was undertaken to study the RV function determined by tricuspid annular motion and tricuspid annular velocity after MI with following aims and objectives.

Aims and objectives

A) To study the clinical profile of acute first inferior wall myocardial infarction patients with or without right ventricular myocardial infarction

B) To evaluate right ventricular function by two dimensional echocardiography and tissue Doppler imaging

c) To compare right ventricular function between the patients of inferior wall myocardial infarction with or without right ventricular myocardial infarction against controls

Methods

This is hospital based case control study including 60 patients with a first acute inferior MI were prospectively studied. Patients with inferior MI were divided into 2 subgroups: those with and those without electrocardiographic signs of RV infarction. Inclusion criteria was as follows i) Patient with history of chest pain less than 48 hours, admitted to the ICCU of our institute study. ii) Patient having chest pain lasting for > 30 minutes, with ST segment elevation of ≥ 1 mm in two or more inferior deviation (lead II, III, aVF) on ECG². iii) clinical signs in the form of raised jugular venous pressure (JVP), clear lung fields and hypotension with 12 lead ECG showing ST segment elevation of > 0.1mv in two or more inferior deviation (lead II, III, aVF) on electrocardiography suggestive of IWMI were evaluated. iv) Patients who were having ST segment elevation of ≥ 0.1 mV or ≥ 1 mm in V4R were diagnosed to have RVMI.³⁻⁹ Echocardiography was performed with machine Philips HD 11 XE by single observer on admission or within 24 hours of admission. TAPSE was measured with the use of two dimensional guided M-mode recordings in patients of both the groups and controls in the apical four-chamber view. TAPSE was measured as the total displacement of the tricuspid annulus (centimeters) from end-diastole to end-systole, with values representing TAPSE¹⁰. Echocardiographic data also included tissue Doppler imaging (TDI) of tricuspid annulus. Peak systolic, peak early and late diastolic velocities of tricuspid annulus (Sa, E' and A' respectively) were

recorded from the lateral RV wall. In accordance with various studies conducted TAPSE1 TAPSE ≤ 16 , Sa < 12m/s, E', 10m/s was considered abnormal. To decrease intra-observer variability echocardiographic values were presented as the average of three measurements.

Statistical analysis

Continuous variables were presented as Mean \pm SD. Categorical variables were expressed in frequency and percentages. Continuous variables were compared between inferior MI with and without RV infarction by independent t-test for normalized data. For non-normalized data, mann-whitney test was applied. Categorical variables were compared by pearsons chi2 test. For small sample, Fisher exact test was used. P < 0.05 was taken as statistical significance. Statistical software STATA version 14.0 was used for data analysis.

Results

In IWMI without RVMI there was a male preponderance (77.14% males vs. 22.85% females) while in IWMI with RVMI there was a slight female preponderance (52% females vs. 48% males).

Mean age of patients of IWMI without RVMI was 55.6 ± 9.84 years, while those with IWMI with RVMI was 58.2 ± 10.11 years.

Major symptom on presentation was chest pain (97.14% in IWMI without RVMI and 96% in IWMI with RVMI). While other symptoms like palpitation and syncope was more in patients of IWMI with RVMI as compared to IWMI without RVMI i.e. 56% vs. 42.85% and 72% vs. 37.14% respectively. Oedema feet was present in IWMI without RVMI (8.57%) but none of the patient of IWMI with RVMI had oedema feet. [Table 1]

Raised jugular venous pressure (JVP), Hypotension and Bradycardia was present in 0% vs. 68% (p=0.000, HS), 14.28% vs. 44% (p=0.010, S), 8.57% vs. 40% (p=0.004, HS) respectively in IWMI without

RVMI vs. IWMI with RVMI patients. Raised jugular venous pressure (JVP), Hypotension and Bradycardia was more commonly seen in patients of IWMI with RVMI as compared to IWMI without RVMI and this comparison was statistically significant ($p < 0.05$).

In our study risk factors like Hypertension, Diabetes mellitus and Smoking was present in 71.42% vs. 80% ($p = 0.4497, NS$), 22.85% vs. 44% ($p = 0.0826, NS$), 28.57% vs. 40% ($p = 0.355, NS$) patients of IWMI without RVMI vs. IWMI with RVMI patients respectively.

Heart blocks (Type I & Type II AV block), CHB and in-hospital mortality was present in 5.71% vs. 28% ($p = 0.017, S$), 0% vs. 12% ($p = 0.035, S$), and 0% vs. 8% ($p = 0.089, NS$) patients of IWMI without RVMI vs. IWMI with RVMI patients respectively. [Table 2] So complications like Heart blocks (type I and type II AV blocks), CHB, was predominantly more common in patients of IWMI with RVMI as compared to IWMI without RVMI and it was statistically significant ($p < 0.05$). In-hospital Mortality was also higher in patients of IWMI with RVMI as compared to IWMI without RVMI.

Regional wall motion abnormality (RWMA) of right ventricle was present in 2.85% vs. 64% patients of IWMI without RVMI vs. IWMI with RVMI. When both the groups were compared, RWMA of right ventricle was present more in IWMI with RVMI as compared to IWMI without RVMI and it was statistically highly significant ($p = 0.000$).

Mean tricuspid annular plane systolic excursion (TAPSE), Mean Peak systolic velocity (Sa) and Mean Peak early (E') and late diastolic (A') velocity was significantly decreased in patients of IWMI with RVMI as compared to IWMI without RVMI [TAPSE- 12.90 ± 3.64 mm vs. 16.76 ± 5.05 mm ($p = 0.0019, HS$), Sa - 0.10 ± 0.028 m/s vs. 0.13 ± 0.07 m/s ($p = 0.0368, S$), E' - 0.084 ± 0.034 m/s vs. 0.10 ± 0.038 m/s ($p = 0.0430, S$), A' - 0.11 ± 0.05 m/s vs.

0.15 ± 0.08 m/s ($p = 0.0445, S$)] and the difference was statistically significant ($p < 0.05$). [Table 3]

As depicted in Table 4 and Table 5 the echocardiographic parameters were statistically significant in patients of IWMI with or without RVMI as compared to controls.

The Sensitivity, Specificity, Positive and Negative predictive value of TAPSE ≤ 16 mm in predicting impaired right ventricular systolic function associated with IWMI was 76%, 42.8%, 48.7%, 71.4% respectively.

The Sensitivity, Specificity, Positive and Negative predictive value of Peak early diastolic velocity (E') < 0.10 m/s in predicting RVMI associated with IWMI was 76%, 51.4%, 52.8%, 75% respectively.

The Sensitivity, Specificity, Positive and Negative predictive value of Peak systolic velocity (Sa) < 0.12 m/s in predicting RVMI associated with IWMI was 64%, 48.6%, 47%, 65.4% respectively.

Discussion

The results of this study demonstrated that, tricuspid annular movement and velocity measurements by means of transthoracic echocardiography might contribute to echocardiographic diagnosis of right ventricular involvement in patients of IWMI.

Patients of IWMI with RVMI were found to have significantly lower TAPSE measurements and tricuspid annular velocities comparing with IWMI patients without RVMI.

Isolated RV infarction is extremely rare. RVMI usually complicates 10-50% of inferior wall myocardial infarcts¹. Right ventricular involvement in patients with acute inferior MI is a clinically important problem. Patients with inferior MI who have RVMI appear to have a worse prognosis than those who do not have RV involvement¹¹⁻¹³. These patients are at increased risk of death, shock, and arrhythmias¹³⁻¹⁴. Currently ST segment elevation in the right precordial leads, particularly RV4, is the most powerful predictor of RV involvement in the setting of

inferior wall MI¹⁵⁻¹⁶. The sensitivity of this finding is lower than specificity and even when strictly employed, however, the criteria lead to underestimation of the true incidence of right ventricular infarction. Although RV infarction is clinically evident in a sizeable number of cases, the incidence is considerably higher at autopsy. A major reason for this discrepancy is the lower sensitivity of electrocardiographic criterion for detection of RV infarction comparing with post-mortem analysis.¹⁷⁻¹⁸ In our study the criteria for diagnosis of RVMI associated with IWMI was ST segment elevation of in V4R lead. During recent years, echocardiography has made major advancement in the diagnosis of patients with right ventricular infarction.¹⁹

A different quantitative approach to assess RV function is the measurement of the tricuspid annular plane systolic excursion (TAPSE). The tricuspid annular plane systolic excursion (TAPSE) estimates RV systolic function by measuring the level of systolic excursion of the lateral tricuspid valve annulus towards the apex in the four chamber view. An excellent correlation between the tricuspid annular plane systolic excursion (TAPSE) and RV ejection fraction as assessed by radionuclide angiography was shown. The approach appears reproducible and proved to be a strong predictor of prognosis in heart failure.²⁰⁻²²

Recently, the use of tissue Doppler in echocardiography has also increased, providing another means to detect right ventricular infarction. A decrease in the systolic velocity at the tricuspid annulus not only allows for diagnosis of right ventricular infarction but also suggests worse mortality outcome²³.

Alam et al. (2000)²⁴ studied RV function determined by tricuspid annular motion after MI. The peak systolic velocity of the tricuspid annulus and TAPSE was significantly reduced in inferior MI compared with that in healthy individuals and patients with anterior MI. In our

study TAPSE and peak systolic and peak early and late diastolic velocity was decreased in patients of IWMI with RVMI as compared to IWMI without RVMI.

When both the groups i.e. IWMI without RVMI and IWMI with RVMI were compared for the presence of TAPSE value ≤ 16 mm which predicted impaired right ventricular systolic function, the comparison was not statistically significant ($p=0.131, NS$) which could be explained as follows. As per the inclusion criteria in our study, patient presenting within 48 hours of onset of symptoms were included. Since diagnostic criteria for RVMI associated with IWMI in our study was electrocardiogram (E.C.G) and as stated by Braat et al. (1983)³ duration of ST elevation in right sided leads could be short in few cases which could have led to missing of these cases and labeling them wrongly as pure IWMI without RVMI. Also few cases in IWMI with RVMI group had TAPSE >16 mm inspite of positive electrocardiogram (E.C.G) criteria, which could be because in many patients study was performed after thrombolysis which could have led to partial recovery of right ventricular function. So coronary angiography was required to confirm these cases as RVMI associated with IWMI by looking for the Proximal RCA involvement however it could not be done in our study due to some technical issues.

The Sensitivity, Specificity, Positive Predictive value and Negative predictive value of TAPSE and Peak systolic velocity (Sa) in diagnosing RVMI associated with RVMI was low in our study, which could be because in majority of the patients echocardiographic study was performed after thrombolysis.

Limitation of study

TAPSE and tissue Doppler velocities in the patients before and after thrombolysis could not be compared as Majority patients were taken after thrombolysis. Also due to some

technical and financial reasons coronary angiography could not be done in all subjects.

Conclusion

Tricuspid annular movement and velocity measurement by echocardiography may contribute to echocardiographic diagnosis of RV involvement. Patients with RVMI had significantly reduced tricuspid annular motion and velocities compared to patients without RVMI before and after thrombolytic therapy.

2D Echo is easily available tool and immediate echo examination on admission by tissue Doppler for RVMI diagnosis with simpler parameters like TAPSE and Peak Systolic velocity(Sa) should be done to plan management.

Conflicts of interest: None

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