



ORIGINAL RESEARCH PAPER

Cardiology

PROXIMAL RIGHT CORONARY ARTERY INVOLVEMENT IN ACUTE INFERIOR WALL MYOCARDIAL INFARCTION. A CORRELATIVE STUDY OF A NEW ECHOCARDIOGRAPHIC INDEX WITH CORONARY ANGIOGRAPHY.

KEY WORDS:

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Introduction

Infarct related artery occlusion management is the preferred strategy in the modern era of primary percutaneous intervention for the management of acute myocardial infarction. Outcome of inferior wall myocardial infarction is influenced by the association of RV involvement. A lesion in the proximal RCA may result in right ventricle infarction. Multiple ECG algorithms were proposed to identify the culprit artery in the setting of acute inferior wall myocardial infarction. Specific criteria were suggested to identify whether proximal or distal RCA is the culprit vessel. These ECG findings were present for shorter duration which affects their sensitivity. Few echocardiographic methods to predict the culprit artery were proposed in many clinical studies. Largely these studies lack validities. Also, only fewer data is available to predict proximal RCA lesion by echocardiographic methods. In this study, we had tried to assess the validity of a novel echocardiographic parameter of RV echo assessment, the tricuspid annulus peak systolic tissue velocity to RV MPI ratio for prediction of proximal RCA lesion in patients with inferior wall MI.

MATERIALS AND METHODS

We screened 76 consecutive patients with clinical diagnosis of acute inferior wall myocardial infarction admitted in coronary care unit at Madras Medical College, 45 patients were selected and included in the study by applying specific inclusion and exclusion criteria from the period of January to June 2017, at department of cardiology, Madras Medical College, Chennai.

Inclusion criteria

ECG criteria for inferior wall myocardial infarction
Significant RCA lesion at coronary angiography

Exclusion criteria

Patients with significant left anterior descending, left circumflex artery lesion, diffuse RCA lesion, or multi-vessels disease.

Patients with significant pulmonary hypertension, pulmonary embolism, cor-pulmonale, Atrial fibrillation, valvular heart disease, previous MI and cardiomyopathy with severe LV dysfunction.

They had undergone the required diagnostic tests and treatment without any modification. Routine clinical examination and ECG was taken. Right sided ECG was taken to look for RVMI. Blood parameters were sent which included either CK MB or Troponin.

Baseline echocardiographic parameters were acquired by using PHILIPS HD 11XE ultrasound system.

Using the RV focused apical 4 chamber view, by placing the doppler sampling volume over anterior tricuspid annulus, with proper alignment of the cursor parallel to TV annulus, and with higher frame rates, pulsed tissue doppler velocities are recorded. The peak systolic velocity S', early diastolic velocity e' and atrial systolic velocity a' can be measured.

Using the similar recording techniques and views, the time

duration between the end of a' to starting of the systolic wave was measured (isovolumetric contraction time (IVCT). Then, time interval between end of the systolic wave to onset of e' wave was measured, which is isovolumetric relaxation time (IVRT). The time duration of entire systolic wave was measured which is Ejection time (ET). MPI is calculated as the ratio between (IVRT+IVCT+ET) and ET.

As the patients had undergone coronary angiogram as per coronary care protocol of the institute within 24 hours, their angiographic findings were collected. Coronary angiography was analyzed using modified gensin scoring, a significant stenosis was defined as 50% or more coronary luminal narrowing. Any luminal narrowing before the origin of acute marginal branch (for practical purposes due to consistent landmark) is defined as proximal right coronary artery lesion.

After enrolling 45 patients, at the end of coronary angiography, based on the coronary angiographic findings, they were divided into two groups based on the presence of proximal right coronary artery lesion or not. Patients were advised follow up and repeat echocardiographic parameter were acquired after 4 weeks.

Statistical analysis

Baseline variables were presented as percentage and numerical variables were presented as averages, according to their distribution. Comparison between the groups were analyzed. Sensitivity and specificity were calculated for cut off value of Sm/MPI for prediction of proximal RCA lesions.

Table 1: Baseline characteristics

PARAMETERS	WITHOUT proximal RCA (N=20)	WITH proximal RCA (N=25)	P Value
Age(mean+sd)	54.97±12.4	59.39±12.8	P = 0.2479
Women(n)	7	9	P = 0.9451
Men(n)	13	16	P = 0.94
HTN %	40	32	P = 0.5817
DM%	20	28	P = 0.5395
dyslipidemia (%)	15	24	P = 0.4583
Smoking (%)	20	24	P = 0.7511
Heart rate (mean)	74±11.6	71±7.7	P = 0.3044
arrhythmias (%)	10	24	P = 0.22
RVMI (%)	25	52	P = 0.0693

Table 2: Statistical value of Sm/MPI value <17 to predict proximal RCA disease

Statistical Parameter	Value	95% CI
Sensitivity	84%	63.92% to 95.46%
Specificity	80%	56.34% to 94.27%
Positive Likelihood Ratio	4.20	1.72 to 10.26
Negative Likelihood Ratio	0.20	0.08 to 0.50
Negative Predictive Value	80.00 %	61.34% to 90.98%
Positive Predictive Value	84.00%	68.25% to 92.77%
Accuracy	82.22%	67.95% to 92.00%

Totally 45 patients were enrolled. All had significant right coronary artery disease. Our study population had clear male preponderance (29 men and 16 women). These patients were divided into two groups based on the presence of significant lesion in the proximal right coronary artery. 2 groups are, those who had proximal RCA lesion (N=25 (16 men and 9 women with a mean age of 55.91 ± 11.4 years) and those without proximal RCA stenosis N=20 (13 men and 7 women with a mean age of 56 ± 13.5 years).

Incidence of ischemic heart disease risk factors, systolic blood pressure, diastolic blood pressure, or heart rate between patients with proximal RCA stenosis and patients without proximal RCA stenosis were similar. Patients with proximal RCA stenosis had higher incidence of RVMI (52% vs. 25%, $P = 0.0693$). They also had higher rates of arrhythmia (24% versus 10%). When compared with patients with proximal RCA stenosis, patients without proximal RCA disease showed significantly higher Sm (12.02 ± 2.74 cm/s vs 10.33 ± 2.44 cm/s) and longer ET (288.11 ± 49.17 ms vs 228.28 ± 44.90 ms). Longer isovolumetric times (IVRT 94.14 ± 18.45 ms, IVCT (80.12 ± 20.33 ms) were seen in patients with proximal RCA lesion. MPI were significantly higher (0.88 ± 0.14 vs. 0.46 ± 0.10), in patients with proximal RCA disease when compared to those without proximal RCA lesion. Systolic pulmonary artery pressure, right ventricular dimensions and left ventricular ejection fraction did not differ between the two groups. A cut-off value of 17 for Sm/MPI had a sensitivity of 84% and specificity of 80% for the diagnosis proximal RCA with Negative Predictive Value of 80.00% (CI: 61.34% to 90.98%) and Positive Predictive Value of 84.00% (CI: 68.25% to 92.77%).

DISCUSSION

The mortality increases from 3.5% for isolated inferior wall MI to 16% in patients with IWMI with RVMI. (1). Hence, culprit artery localization is an important risk stratification strategy in acute coronary care. ECG criteria to localize the culprit artery into RCA or LCX had been proposed with low sensitivity. Further localization into proximal or distal segments of RV by ECG criteria is affected by their transient nature.

Role of echocardiography in assessing the RV function had been established. Many parameters were suggested to correlate the right coronary artery involvement like, McConnell sign, TAPSE, tissue doppler velocities and myocardial performance index. Limited data available for the echocardiographic methods to identify the proximal coronary lesion.

In this study, we aimed to assess the validity of a novel index which incorporates two already established echo indices namely, tissue Doppler peak systolic velocity (Sm) and myocardial performance index (RV MPI), the ratio of peak tricuspid annulus systolic velocity to RV myocardial performance index (Sm/RV MPI) for the prediction of proximal RCA lesion.

In our study, there was no significant difference in baseline risk factors between patients with proximal and distal RCA lesions. We had noted 20% higher the incidence of arrhythmias (brady and tachy arrhythmias combined) in patients with proximal RCA and cardiogenic shock was higher too.

We also noted that the proximal RCA involvement lead to higher incidence of RVMI than patients with distal RCA. In our study, while TAPSE was able to predict RCA involvement, it did not differentiate the proximal or distal right coronary lesion. This can be explained as TAPSE is more of a global RV parameter than a segmental one.

While, Wang et al. had reported the accuracy of Sm to predict RV systolic function by comparing tricuspid Sm with RVEF by cardiac magnetic resonance, Alam et al (6), had reported that Sm and TAPSE were useful to assess RV function in association with IWMI. In addition, Dokainish et al. (3) had observed that tricuspid Sm can predict RVMI. Ozdemir et al. (4) had reported that Sm correlated with proximal RCA lesion in patients with IWMI. In our study, peak tricuspid annulus systolic velocity (Sm) was higher in those without proximal RCA lesions. In our study, Sm was significantly lower in patients with proximal RCA lesion.

Any increase in RV end-systolic pressure causes prolonged isovolumetric relaxation thereby prolonging the IVRT. In patients with IWMI, a prolonged RV IVRT is most often due to associated RVMI.

While MPI >0.58 had predicted proximal RCA disease in a small study (9) and MPI >0.70 was used to predict RCA disease in a much bigger studies (4,7). In our study, patients with proximal RCA lesion had longer IVCT, shorter ET and higher MPI.

Kakouros et al showed peak systolic tissue velocity to myocardial performance index ratio (Sm/MPI) was a very accurate echo parameter to predict proximal right coronary artery disease. (8).

In our study, mean Sm/MPI in patients with proximal RCA disease was 14.1 ± 2.9 and those without proximal RCA disease had a mean of 17.8 ± 2.8 , with a statistical significance of $P = 0.0001$, (95% CI: 11.97 to 5.4281). When we applied the Sm/RV MPI ratio, a cut off value 17 separated the patients with and without proximal RCA disease. This ratio (Sm/RV MPI) had a sensitivity of 85% and specificity of 80% for the prediction of angiographic proximal RCA disease. This ratio had Negative Predictive Value of 80.00% (CI: 61.34% to 90.98%) and Positive Predictive Value of 84.00% (CI: 68.25% to 92.77%).

However small sample size of our study is a limitation and necessitates further clinical data.

Conclusion

Clinical, ECG, and existing echocardiographic parameters have limited value in localization of infarct related artery. Hence, a newer tissue doppler echo parameter, Sm/RV MPI may be a useful in the prediction of presence of proximal RCA disease. This ratio also predicted the presence of RVMI in patients with IWMI. Being a safe, cost effective, non-invasive tool which can be performed easily at bedside, this simple echocardiographic parameter can add additional clinical benefits, though further data is needed.

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