# Assessment of Clinical Profile and Echocardiographic Parameters of Right Ventricle in Correlation with Proximal RCA Lesion in Patients with Inferior Wall Myocardial Infarction

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**Abstract:** _Background & Objective: Myocardial infarction is decreased or complete stoppage of blood to a part of the myocardium. The 65th WHA raised to act on NCD deaths and fixed a target of 25% reduction in the premature deaths due to the non - communicable diseases by 2025. We assessed 1. Echocardiographic parameters of RV in proximal RCA lesion in patients with IWMI.2. the usefulness and association of these parameters in predicting IWMI patients with proximal RCA lesion. Material and Methods: We did a cross - sectional study in patients with IWMI. Convenience sampling was followed. The study duration was six months from July 2022 to December 2022. Results: The results of the study showed that non - smokers had more proximal lesion 30 (77%) in the RCA as compared to non - smokers 16 (48%) which is statistically significant. Peak systolic velocity (9.84 Vs 10.54) and ejection time (221 Vs 267) were less in the proximal group while isovolumic relaxation time (86 Vs 67), isovolumic contraction time (81 Vs 62) and myocardial performance index (0.57 Vs 0.37) were more in the proximal group and the difference is statistically significant. Conclusion: Echocardiographic parameters Sm, ET, IVRT, IVCT and MPI are useful parameters in predicting proximal RCA lesion._

**Keywords:** Myocardial Infarction, Echocardiography, Electrocardiography, South India, Echo Parameters

## 1. Introduction

Myocardial infarction is decreased or complete stoppage of blood to a part of the myocardium. The most important cause being disease in the coronary artery (1). In 2021, cardiovascular deaths accounted for 20.5 million deaths worldwide. There are more than half a billion people who are affected by cardiovascular diseases in the whole world. The number of deaths were about one - third of the total deaths in the world (2). The cardiovascular diseases are mainly attributed to non - communicable diseases like diabetes, systemic hypertension, hypercholesterolemia and metabolic syndrome.

The leading seven out of ten causes of deaths worldwide were due to non - communicable diseases in 2019. They account for 74% of worldwide deaths (3). The 65th World Health Assembly (WHA) raised to act on NCD deaths and fixed a target of 25% reduction in the premature deaths due to the non - communicable diseases by 2025 (4). The Disability Adjusted Life Years (DALY) due to cardiovascular diseases namely ischemic heart disease was 2.9% in 1990 and increased to 6.6% in 2016 in India.

As per our sustainable development goals targets, we have planned to reduce pre - mature deaths due to non - communicable diseases by one - third in 2030 (5, 6). The prevalence of the same disease in India is reported in younger age groups as compared to the western World. The inferior wall myocardial infarction is most commonly caused by obstruction in the right coronary artery or the left circumflex artery which is a branch of left coronary artery (7).

Chest pain is the most common presentation in ST elevation myocardial infarction. The acute chest pain arising from the heart are collectively known as "Acute Coronary Syndrome" (8). The STEMI diagnosis depends on the time to reach hospitals for Primary Percutaneous Coronary Intervention (PPCI). The delay limit as per guidelines in hospitals with PPCI is 60 minutes and for those who should be shifted from home or hospitals without PPCI is 120 minutes. If the delay is going to be prolonged, it is advised to start fibrinolytic therapy within 10 minutes from the diagnosis of STEMI (9).

There are evidences from published research articles that right ventricular function indices like Tricuspid Annular Plane Systolic Excursion (TAPSE), Myocardial Performance Index by Tissue Doppler imaging (MPI_TSI) and peak systolic velocity (Sm) are consistent to prove proximal stenosis of right coronary artery in Inferior wall myocardial infarction (10, 11).

Most of the Indian population live in rural areas and the rural urban distribution was 68.8% in rural areas and 31, 2% in urban areas (12). The time delay advised by the European

Society of Cardiology is a far - fetched one for most of the Indian population. The electrocardiogram for patients with inferior wall myocardial infarction portrays ST elevation in lead II, III and aVF. This displays minor changes depending on the occluded artery (8).

There is also paucity of evidence on the trends of echocardiogram in our geographical setting. There are evidences involving single or a few parameters. Hence our study is done with the objective
1) To assess Echocardiographic parameters of right ventricle in proximal RCA lesion in patients with Inferior wall myocardial infarction.
2) To study the usefulness and association of these parameters in predicting IWMI patients with proximal RCA lesion at the very outset.

## 2. Material and Methods

We did a cross - sectional study in the patients attending Cardiology Department, Government Medical College, Chengalpattu with symptoms suggestive of coronary artery syndrome with inferior wall myocardial infarction. This is a tertiary care Hospital. The population in this District is 25, 56, 244. We followed convenience sampling.

The patients reported to the hospital were diagnosed with ECG and if the patient has arrived in less than 12 hours of infarction, we initiated thrombolysis. Echocardiography will be done within 12 hours of patient arrival to the hospital. Coronary angiography was done 7 to 15 days post fibrinolysis and based on the findings the patients were divided into proximal and non - proximal groups. One arm with patients having proximal RCA lesion and the other arm with non - proximal RCA lesion. The study was done for six months from July 2022 to December 2022. We evaluated the socio - demographic details as well as the clinical characteristics of the patients. The echocardiographic parameters were also assessed and tabulated.

**Inclusion Criteria:** Those with significant RCA lesion at coronary angiography and good echocardiographic window were included. Patients with inferior wall myocardial infarction with or without right ventricle myocardial infarction.

**Exclusion Criteria:** Those patients who were candidates for primary PCI or patients with hemodynamic instability. The patients with significant LAD, LCX, Diffuse RCA lesion or multivessel disease. The patients with previous MI, cor - pulmonale, atrial fibrillation or significant valvular lesion. Patients with poor echo window were excluded from the study.

**Ethics Clearance**
The ethics clearance was obtained from the institutional ethics committee after clearance from the institutional scientific review committee. Love, beneficence and justice were followed with all the study participants. Information sheet regarding the study was given to all the study participants and written informed consent was taken before the start of the study.

**Statistical Analysis**
The data was entered in Microsoft Excel and data analysis was done using SPSS 22.0.1 software (SPSS Inc., Chicago, Illinois, USA) package. Mean and proportion were used respectively for continuous and categorical variables. The level of statistical significance was set at 0.05. confidence interval of 95% was used. The test of significance used for comparison were student "t" test, chi - square test and Wilcoxon rank sum test at appropriate places of need.

**Table 1:** Patient characteristics of the patients with proximal and non - proximal right coronary artery lesion in inferior wall myocardial infarction at Department of Cardiology, Government Medical College, Chengalpattu.

| Patient characteristics | A (proximal) n=39 | B (non – proximal) n=33 | p value |
|---|---|---|---|
| **Age (years, mean ± SD)** | **54 (9)** | **52 (9)** | **0.5** |
| **Sex** | | | |
| Men | 12 (31%) | 11 (33%) | 0.8 |
| Women | 27 (69%) | 22 (67%) | |
| **DM (n, %)** | | | **0.9** |
| Yes | 15 (38) | 13 (39) | |
| No | 24 (62) | 20 (61) | |
| **HTN (n, %)** | | | **0.7** |
| Yes | 17 (44) | 16 (48) | |
| No | 22 (56) | 17 (52) | |
| Smoking (n, %) | | | **0.02*** |
| Yes | 9 (23) | 16 (48) | |
| No | 30 (77) | 17 (52) | |
| **Tropnin T ng/mL (mean±sd)** | 3.82±1.72 | 2.78±1.2 | 0.09 |
| **SBP (mmHg, mean ± sd)** | 103±11 | 101±14 | 0.4 |
| **DBP (mmHg, mean ± sd)** | 67±11 | 65±9 | 0.3 |
| **RVMI (n, %)** | | | **0.9** |
| Yes | 32 (82) | 27 (82) | |
| No | 7 (18) | 6 (18) | |
| **Thrombolytic therapy (n, %)** | | | **0.6** |
| Yes | 3 (7.7) | 1 (3) | |
| No | 36 (92) | 32 (97) | |
| **Arrhythmia (n, %)** | | | **0.3** |
| Yes | 23 (59) | 15 (45) | |
| No | 16 (41) | 18 (55) | |
| **RVF (n, %)** | | | **0.9** |
| Yes | 6 (15) | 5 (15) | |
| No | 33 (85) | 28 (85) | |
| **Cardiogenic shock (n, %)** | | | **0.2** |
| Yes | 33 (85) | 24 (73) | |
| No | 6 (15) | 9 (27) | |
| DBP = diastolic blood pressure; DM = diabetes mellitus; HR = heart rate; HTN = hypertension; RVF = right ventricular failure; RVMI = right ventricular myocardial infarction; SBP = systolic blood pressure; SD = standard deviation. **\*p value less than 0.05 considered statistically significant** | | | |

The two arms proximal had 39 patients and non - proximal arm had 33 patients. Among the respondents who smoke, more patients had non - proximal lesion in RCA as compared to those with proximal lesion in RCA. Those who did not smoke had more proximal lesion in RCA as compared to those with non - proximal lesion in RCA. This difference is statistically significant.

**Table 1:** Echocardiographic parameters of the patients with proximal and non - proximal right coronary artery lesion in inferior wall myocardial infarction at Department of Cardiology, Government Medical College, Chengalpattu

| Echocardiographic parameters of patient groups. | A (proximal) N=39 | B (non - proximal) N=33 | p value |
|---|---|---|---|
| PASP mmHg (mean ± SD) | 26.2±2.76 | 25.54±2.87 | 0.3 |
| RVD mm (mean ± SD) | 33.5±3.2 | 33.7±3.5 | 0.9 |
| TAPSE mm (mean ± SD) | 15.65 (0.79) | 17.78 (1.89) | 0.01* |
| Sm cm/s (mean ± SD) | 9.84 (0.91) | 10.54 (1.2) | 0.005* |
| Em cm/s (mean ± SD) | 9.35 (0.37) | 9.4 (0.32) | 0.5 |
| Am cm/s (mean ± SD) | 13.08 (1.09) | 12.73 (1.03) | 0.14 |
| IVRT ms (mean ± SD) | 86 (9) | 67 (5) | 0.001* |
| IVCT ms (mean ± SD) | 81 (7) | 62 (7) | 0.001* |
| ET ms (mean ± SD) | 221 (5) | 267 (21) | 0.001* |
| MPI | 0.57 (0.07) | 0.37 (0.05) | 0.001* |
| ET = ejection time; IVCT = isovolumic contraction time; IVRT = isovolumic relaxation time; LVEF = left ventricular ejection fraction; MPI = myocardial performance index; RVD = right ventricular dimension; SPAP = systolic pulmonary artery pressure; TAPSE = tricuspid annular plan systolic excursion. Wilcoxon rank sum test, Chi - square test | | | |

Among the patients SM, ET are more in the non - proximal lesion group (10.54 ± 1.2, 267 ± 21) as compared to those in the proximal group (9.84 ± 0.91, 221± 5) which is statistically significant. The patients in the proximal group (86±9, 81±7, 0.57±0.07) have more IVRT, IVCT and MPI as compared to those in the non - proximal group (67±5, 62±7, 0.37±0.05) which is statistically significant.

## 3. Discussion

The results of the study showed that non - smokers had more proximal lesion 30 (77%) in the right coronary artery as compared to non - smokers 16 (48%) which is statistically significant. Peak systolic velocity (9.84 Vs 10.54) and ejection time (221 Vs 267) were less in the proximal group while isovolumic relaxation time (86 Vs 67), isovolumic contraction time (81 Vs 62) and myocardial performance index (0.57 Vs 0.37) were more in the proximal group and the difference is statistically significant.

The whole problem revolves around identification of the diseased artery and initiating appropriate management to protect it as far as possible from complications. The right coronary artery is divided into three parts namely proximal, mid and distal divisions. In our study, we have categorized both mid and distal divisions as non - proximal. The branches from the proximal part of RCA supply the infundibulum of the right ventricle and the SA node. The mid RCA gives a marginal branch which is used as a marker in angioplasty to identify the inferior border of the heart. The distal terminal branches are posterior descending artery and the right posterolateral artery which branch off at the crux cordis which is a landmark in angiography (13). We will discuss the complications based on the branch providing blood supply and the level of the occlusion identified by coronary angiography.

We judge the arterial lesion with the help of STEMI in the precordial chest leads. The occlusion of the left anterior descending artery as well as the occlusion of the proximal right coronary artery show ST elevation in V1 to V3 chest leads. Patients may present with chest pain and ventricular fibrillation with STEMI in V1 to V3 and V4R in ECG. Normally, RCA lesion will present with ST elevation in inferior leads. There is a possibility of atrial fibrillation as well as ventricular fibrillation in myocardial infarction. Echocardiography findings showed normal left ventricle ejection fraction and slight right ventricle dilatation. Coronary angiography needs to be done to confirm the particular arterial occlusion which is the gold standard choice. PCI needs to be done to relieve the symptoms (14). We reported patients with both arrythmia and cardiogenic shock but the difference in the presentation between proximal and non - proximal groups is not statistically significant. Our findings warrant a large - scale prospective cohort study to validate the reported findings.

The right ventricle ischemia and infarction is due to decreased right ventricle contractile power. This decreases the blood flow to the lungs and in - turn to the left side of the heart. The symptoms are peripheral edema, elevated jugular venous pressure, hypotension and hypoxia. The triad of hypotension, elevated JVP and clear lung fields is pathognomonic of right ventricular dysfunction. Echocardiography is useful in detecting right ventricle myocardial dysfunction or infarction in clinical practice. (15)

RVMI is associated with more in - hospital mortality. RVMI is associated with infarction in the IWMI in 25 – 50% of the cases. More proximal lesions in RCA compromise RV filling and RV function resulting in hemodynamic compromise. (16). We reported 85% of those patients with RVMI proximal lesion in RCA had cardiogenic shock. There is poor prognosis for RVMI in cardiogenic shock (17, 18).

In our study, the smokers had more proximal occlusion and the difference is statistically significant. A higher sample size would have given a better association between them and the risk of other behavioural patterns were not included in the study. This could even have biased the results.

In our study, we have reported higher Troponin T value (3.82±1.2) in proximal RCA stenosis as compared to non - proximal RCA stenosis. This could be attributed to the involvement of a bigger muscle mass in the previous group. Though, the difference is not statistically significant. The reported arrythmia in proximal RCA stenosis 23 (59%) is comparatively higher in this group. These findings are consistent with the reports in other similar studies (10, 11)

Rajesh et al did a similar study in Kozhikode and reported that TAPSE, Sm were less in the proximal stenosis group and MPI was more in the same group. We know that RV functional parameters can be used to predict RV infarction and predict RCA lesion with a good sensitivity and specificity. We could have got better results if our sample size had been more and if we could have matched for age, sex, limited the time interval between the ECG and echocardiographic evaluation in all patients. This time difference could have contributed for the fact of statistically insignificant difference in TAPSE values (11).

We know that RV contraction in normal conditions (IVRT), the systolic phase is followed by immediate filling and the value is very less or immeasurable. A measurable IVRT is contributed by increased end systolic right ventricle pressure. In our study we found that the IVRT was prolonged and ET was small in patients with proximal RCA stenosis. This difference is statistically significant. This projects that higher number of patients with RVMI were present in proximal RCA stenosis. These findings were found in other similar studies also (10).

In our study, we found that MPI was significantly higher in patients with proximal stenosis as compared to those with non - proximal stenosis. The myocardial performance index (MPI) is the agglomeration of the physiological function in both systolic and diastolic phase. This is proposed by many studies that MPI of both ventricles are higher in patients with myocardial infarction (19).

## 4. Limitations

The number of patients included in the study was less in the six months study duration. Age sex matching alongwith equal representation in both the groups could have given us better association among the variables of interest.

## 5. Conclusion

Echocardiographic assessment parameters Sm, ET, IVRT, IVCT and MPI are useful parameters in predicting proximal right coronary artery lesion.

## 6. Recommendations

Echocardiographic assessment can be extended to resource poor settings for early prediction of the right coronary artery lesion and establishing prompt and early referral to save lives of many patients. A prospective cohort study involving all the risk factors would probably answer our research question systematically.

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