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"Right Ventricular Echocardiographic Parameters for Prediction of Proximal Right Coronary Artery Lesion in Patients with Acuteinferior Wall Myocardial Infarction: A Study in National Institute of Cardiovascular Diseases and Hospital, Dhaka, Bangladesh"

Dr. Md. Abul Kalam Azad[1] Dr. Shahriar Kabir[2]DR. Lakshman Chandra Barai[3]
Dr. Md. Farabi Halim[4]

[1] *Medical Officer (Cardiology), MBBS, D.CARD, National Institute of Cardiovascular Diseases and Hospital, Dhaka, Bangladesh.*
[2] *Assistant Registrar, MBBS, D.CARD, National Institute of Cardiovascular Diseases and Hospital, Dhaka, Bangladesh.*
[3] *Assistant Professor, Cardiology, MBBS, D.CARD, MCPS, National Institute of Cardiovascular Diseases and Hospital, Dhaka, Bangladesh.*
[4] *Emergency Medical Officer, MBBS, D.CARD, National Institute of Cardiovascular Diseases and Hospital, Dhaka, Bangladesh.*
Corresponding Author:Dr. Md. Abul Kalam Azad

Abstract:***Introduction:*** *Classifying the location of an occlusion in the culprit artery during ST-elevation myocardial infarction is important for risk stratification to optimize treatment.*
Objectives: *To compare the validity of echocardiographic parameters assessing right ventricular (RV) function for the prediction of proximal right coronary artery (RCA) lesion in patients with inferior wall myocardial infarction.*
Methods: *The study included 76 patients after their first episode of acute inferior myocardial infarction with significant RCA lesion (43 patients with proximal RCA stenosis and 33 patients with distal RCA stenosis). Full echocardiographic examination was done before revascularization, including RV dimension, tricuspid annular plane systolic excursion, and tissue Doppler imaging of RV free wall at the level of the tricuspid annulus and recording the following variables: peak systolic velocity (Sm), peak early diastolic velocity, peak late diastolic velocity, ejection time (ET), isovolumetric relaxation time (IVRT), isovolumetric contraction time (IVCT), and myocardial performance index (MPI), which was calculated as (MPI = IVRT + IVCT/ET).*
Results: *Patients with proximal RCA showed significantly lower Sm (10.44 ± 2.61 cm/s vs. 12.11 ± 2.94 cm/s, p = 0.013) and shorter ET (224.18 ± 49.96 ms vs. 280.90 ± 46.12 ms, p = 0.001). While IVRT, IVCT, and MPI were significantly higher (95.25 ± 19.22 ms vs. 68.48 ± 12.77 ms, p = 0.001; 81.62 ± 23.59 ms vs. 60.90 ± 17.38 ms, p = 0.001; and 0.82 ± 0.222 vs. 0.47 ± 0.10, p = 0.001, respectively) when compared with patients with distal RCA stenosis. Multiple regression analysis including (tricuspid annular plane systolic excursion, Sm, and MPI) showed that the most independent predictors for proximal RCA lesions were MPI (p = 0.0001). The receiver operator characteristic curve for MPI showed areas under the curve of 97% and a confidence interval of 93%. A cut-off value of 0.58 for MPI had a sensitivity of 95% and specificity of 97% for the diagnosis proximal RCA.*
Conclusions: *The most independent predictors for proximal RCA lesion is MPI.*
Keywords: *Echocardiography, Right coronary artery.*

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I. Introduction

In patients with acute inferior wall myocardial infarction (IWMI), the infarct related artery could be the right coronary artery (RCA) or left circumflex artery [1]. Acute occlusion of the RCA proximal to the right ventricular branches may result in right ventricle infarction (RVI) [2–6]. This identifies a significant subgroup of patients that are associated with considerable immediate morbidity and mortality [7–11]. The diagnosis of acute ST-elevation IWMI depends mainly on specific electrocardiographic (ECG) criteria. Predicting the culprit artery in IWMI has been proposed using multiple ECG algorithms, with adequate sensitivity only in patients with extensive ST-segment deviation [12, 13]. There are only limited studies validating the usefulness of various

echocardiographic parameters of RV function in predicting proximal RCA stenosis. Most of them assessed only a single parameter of RV function and many lacked angiographic correlation [14]. Moreover, there are no available data comparing these parameters in predicting proximal RCA stenosis.

II. Objective

To compare the validity of different echocardiographic parameters assessing RV function for prediction of proximal RCA stenosis in patients with inferior wall MI.

Patients

We screened 88 patients who were referred to National Institute of Cardiovascular Diseases and Hospital, Dhaka, Bangladesh.With acute for coronary angiography and possible percutaneous coronary intervention during the period from October 2016 to February 2018. According to our inclusion criteria we enrolled 76 nonconsecutive patients (57 men and 19 women with a mean age of 58.84 ± 12.78 years) Inclusion criteria:

1. Significant RCA lesion at coronary angiography.
2. Good echocardiographic window.

Exclusion criteria:

1. Patients who were candidates for primary per-cutaneous coronary intervention or patients with hemodynamic instability.
2. Patients with significant left anterior descending, left circumflex artery lesion, diffuse RCA lesion, or multi-vessels disease.
3. Poor echo window.
4. Patients with previous MI, corpulmonale, atrial fibrillation, or significant valvular lesion.

According to angiographic findings, the patients divided into Group A included 43 patients with proximal RCA stenosis (34 men and 9 women with a mean age of 56.88 ± 12.4 years) and Group B included 33 patients with distal RCA stenosis (23 men and 10 women with a mean age of 61.39 ± 12.8 years).All patients gave informed consent, and ethical approval was obtained from the Internal Review Board at our institution.

III. Methods

Clinical evaluation

For detection of right ventricular failure (RVF) defined as hypotension and elevated jugular venous pulse in the presence of clear lung fields [15].

ECG

Twelve-lead ECG includingV3R and V4R were used for diagnosis of IWMI, arrhythmias (bradycardia, high-degree atrioventricular block, atrial fibrillation, and ventricular tachycardia), and right ventricular infarction which defined as ST-segment elevation of more than 0.1 mV in V3R and V4R in ECG taken within 6 hours of onset of symptoms [16].

Laboratory tests

Blood samples were taken for measurement of cardiac biomarkers (troponin I), lipid profile (totalcholesterol, low density lipoprotein, high density lipoprotein, and triglycerides), and random blood sugar.

Transthoracic Echocardiography

Complete conventional (two dimensional, M-mode, and Doppler) echocardiographic exami-nation was done before coronary angiography using iE33 ultrasound system (Philips Healthcare, USA), equipped with a fully sampled matrix transthoracic transducer (xMATREX, X5-1). Standard views were obtained in the left lateral supine position according to recommendations of the American Society of Echocardiography [17].

Conventional Echocardiography

Right ventricular systolic pressure (RVSP) was determined from peak tricuspid regurgitation (TR) jet velocity using the simplified Bernoulli equation and combining this value with an esti-mate of the RA pressure, which was estimated from inferior vena cava diameter and respiratory changes [18].RV dimension was estimated at the end-diastole from a right ventricle-focused apical four-chamber view, demonstrating the maximum diameter of the RV, while the crux and apex of the heart are in the view [18].

RV function parameters

Tricuspid annular plane systolic excursion (TAPSE) was acquired by placing an M-mode cursor through the tricuspid lateral annulus in an apical four-chamber view and measuring the amount of longitudinal motion of the annulus at peak systole [18].

Pulsed tissue Doppler imaging

Images were obtained from an apical four-chamber window with a tissue Doppler mode and the region of interest highlighting the RV free wall. The pulsed Doppler sample volume was placed at the tricuspid annulus of the basal segment of the RV free wall (at the end of expiration to minimize translational motion); specific soft-ware then generates velocity profiles over the car-diac cycle as follows:

1. One major positive peak systolic velocity as the annulus moves towards the apex during systole (Sm).
2. One negative early diastolic myocardial velocity as the annulus ascends away from the apex (Em).
3. Another negative late diastolic myocardial velocity (Am).
4. The velocities profile of Sm, Em, and Am waves were recorded.
5. Sm duration was measured as the ejection time (ET).
6. The time between the end of the Sm and the beginning of the Em was measured as isovolu-mic relaxation time (IVRT).

The time between the end of am and the beginning of Sm was measured as isovolumic con-traction time (IVCT).Myocardial performance index (MPI): The MPI is defined as the ratio of isovolumic times divided by ET. MPI = [(IVRT + IVCT)/ET] [18].Coronary angiography was done within 1 week of admission:Significant stenosis was defined as 50% or greater coronary lumen stenosis, acute throm-bosis, or dissected plaque.Proximal RCA lesion defined as RCA lesion before the origin of acute marginal branch.

Statistical analysis

"STATA" software system version 11 (SPSS Iraqi National Congress., Chicago, IL) was used for applied math analyses. For descriptive functions, categorical variables were given as percentages, and numerical variables were given as mean ± variance or median and vary, in keeping with their distribution. Comparison between teams was done victimisation Student t take a look at or Mann–Whitney take a look at (according to information distribution) for continuous variables and by Chi-square take a look at for categorical variables. Multiple correlation analysis was per-formed together with parameters of self-propelled vehicle operate (TAPSE, Sm, and MPI) to explore the parameters most helpful for the prediction of proximal RCA ische-mia. Receiver operator graph was made for the foremost freelance predictors for proximal RCA lesions. Youdon's equation was wont to verify the most effective cut-off price for the helpful parameters to administer equal weight to sen-sitivity and specificity.

IV. Results

Our study population included 76 patients with significant RCA lesions (57 men and19 women with a mean age of 58.84 ± 12. 78 years) divided into Group A including 41 patients with proximal RCA stenosis (32 men and 9 women with a mean age of 56.88 ± 12.4 years) and Group B including 35 patients with distal RCA stenosis (25 men and10 women with a mean age of 61.39 ± 12.8 years). The patient's sex version men 75.0% and women 25.0% **figure 2.**The study group showed no significant difference in the incidence of ischemic heart disease risk factors, systolic blood pressure, diastolic blood pressure, or heart rate between patients with proximal RCA stenosis (Group A) and distal RCA stenosis (Group B). The incidence of RVMI was significantly higher in Group A (69.7% vs. 18.1%, p = 0.2) and troponin level was significantly higher in Group A (25.39 ± 47.83 ng/mL vs. 12.76 ± 33.48 ng/mL, p = 0.03). In Group A, the occurrence of arrhythmia (complete heart block or bradycardia) and RVF was numerically higher but not statistically significant when compared with Group B. Arrhythmia and RVF were 25.6% and 11.6% versus 15.2% and 6.1% in Groups A and B, respectively **Table 1.** When compared with Group B, Group A showed significantly lower Sm (10.44 ± 2.61 cm/s vs. 12.11 ± 2.94 cm/s, p = 0.013) and shorter ET (224.18 ± 49.96 ms vs. 280.90 ± 46.12 ms, p = 0.001), while IVRT, IVCT, and MPI were significantly. (Higher 95.25± 19.22 ms vs 68.48± 12.77ms P=0.001; 81.62± 59ms vs 60.90± 17.38ms P=0.001; and 0.82± 0.222 vs 0.47 ± 0.10; P=0.001 respectively).

There were no important variations between patient's teams relating to left cavum ejection fraction, heartbeat arteria pulmonalis pressure, right cavum dimensions, and TAPSE (Table 2). Indices of RV perform (TAPSE, Sm, and MPI) were entered at the same time into a variable regression model. It showed that MPI was the sole parameter that maintained its important association with proximal RCA lesions inform to that being associate freelance predictor (p = 0001) (Table 3). The receiver operator characterisic function for MPI showed areas below the curve of ninety seven and a confidence interval of ninety three. A cut-off price of 0.58 for MPI had a sensitivity of ninety fifth and specificity of ninety seven for the identification proximal RCA (Fig. 1, Table 4).

Table 1: Patient characteristics (n=76).

	A (43 patients)		B (33patients)	p value
Age (years, mean ± SD)	**6.88**	**± 12.4**	**61.39 ± 12.8**	**0.12**
Sex				
Men	34(79.1%)		23(69.7%)	0.35
Women	9(20.9%)		10(30.3%)	
DM (n, %)	24(55.8%)		19(57.6%)	0.87
HTN (n, %)	23(56.1%)		23 (69.6%)	0.16
Smoking (n, %)	32(74.4%)		23 (69.6%)	0.45
Cholesterol mg/dL (mean ± SD)	166.4	± 43.18	165.7 ± 44.06	0.94
LDL mg/dL (mean ± SD)	108.71 ± 48.96		100.14 ± 32.98	0.39
HDL mg/dL (mean ± SD)	35.68	± 9.93	38.71 ± 11.9	0.26
Triglyceride mg/dL (mean ± SD)	132.28 ± 72.35		145.78 ± 74.79	0.46
Tropnin I ng/mL (median, range)	6.05(0.98–118)		4.6(0.8–44)	0.03
SBP (mmHg, mean ± SD)	123.9	± 17.64	125.59 ± 17.58	0.71
DBP (mmHg, mean ± SD)	72.35	± 9.88	71.59 ± 13.51	0.80
HR (B/M, mean ± SD)	74.79	± 15.68	73.39 ± 14.40	0.69
RVMI (n, %)	30 (69.7%)		6 (18.1%)	0.001
Thrombolytic therapy (n, %)	31(72%)		23(69.6%)	0.42
No thrombolytic therapy (n, %)	12(27.9%)		10(33.3%)	0.39
Arrhythmia (n, %)	11(25.6%)		5 (15.2%)	0.26
RVF (n, %)	5(11.6%)		2 (6.1%)	0.40
Cardiogenic shock (n, %)	3(7.0%)		1(3.0%)	0.4

DBP = diastolic blood pressure; DM = diabetes mellitus; HDL = high density lipoprotein; HR = heart rate; HTN = hypertension; LDL = low density lipoprotein; RVF = right ventricular failure; RVMI = right ventricular myocardial infarction; SBP = systolic blood pressure; SD = standard deviation.

V. Discussion

Identifying the perpetrator artery is vital for risk stratification and optimizing treatment ways for patients with acute IWMI. The mortality for IWMI with RVI thanks to proximal RCA lesions is high it's 16% Factor Questionnaire compared with 3.5% for isolated inferior MIs [19]. EKG directs the emergency treatment pathways and helps with predicting the perpetrator artery. However, the sensitivity for standard EKG criteria is low for characteristic the perpetrator artery in inferior STEMI [20–24].

Table 2: Echocardiographic parameters of patient groups (n=76).

	A (41 patients)		B (35 patients)p value	
LVEF (%)	47.44	± 6.11	46.72	± 7.500.64
SPAP mmHg (mean ± SD)	27.48	± 5.90	27.18	± 7.720.84
RVD mm (mean ± SD)		34.97 ± 5		33.30 ± 50.188
TAPSE mm (mean ± SD)	20.28	± 7.78	20.51	± 5.510.89
Sm cm/s (mean ± SD)	10.44	± 2.61	12.11	± 2.940.013
Em cm/s (mean ± SD)	9.05	± 3.32	9.17	± 2.380.86
Am cm/s (mean ± SD)	11.51	± 3.67	14.43	± 3.150.5
IVRT ms (mean ± SD)	95.25	± 19.22	68.48	± 12.770.001
IVCT ms (mean ± SD)	81.62	± 23.59	60.90	± 17.380.001
ET ms (mean ± SD)	224.18	± 49.96	280.90	± 46.120.001
MPI	0.82	± 0.222	0.47	± 0.100.001

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.

Table 3: Multiple regression analysis (n=76).

Variables	B	SD	Wald	Sig	Exp(B)	95% C.I for EXP(B)	
						Lower	Upper
MPI	23.162	6.049	14.660	0.000	1.1146E+10	8174.294	1.615E+15
TAPSE	0.114	0.093	1.494	0.222	0.892	0.743	1.071
Sm	0.119	0.195	0.374	0.541	1.126	0.769	1.649
Constant	12.895	4.314	8.937	0.003	0.000		

C.I. = confidence interval; df. = difference; MPI. = myocardial performance index; S.E. = standard error; Sig. = significance; Sm. = peak systolic velocity; TAPSE. = tricuspid annular plan systolic excursion.

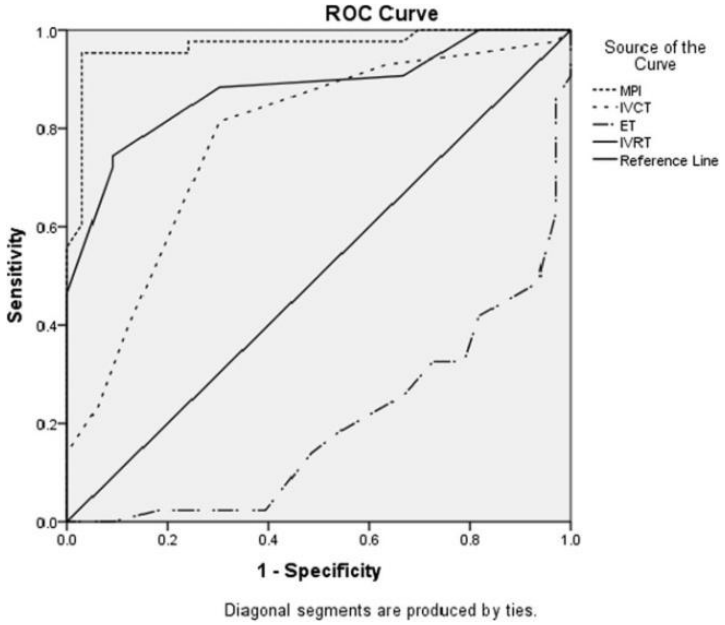

Figure 1: Receiver operator characteristic curve for myocardial performance index. MPI = myocardial performance index; ROC = receiver operator characteristic.

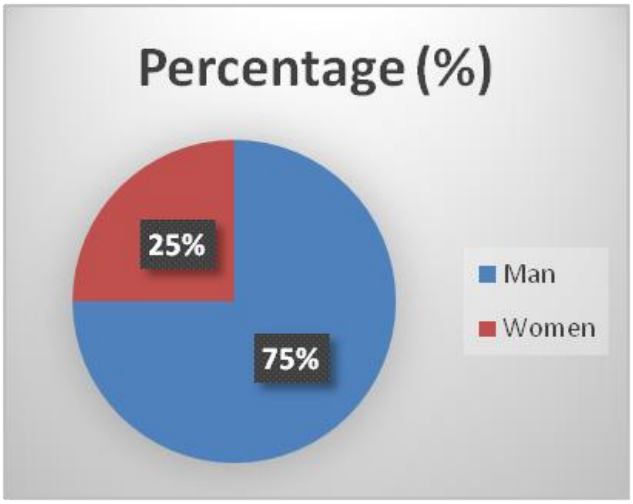

Figure 2: Sex variation of patients.

Table 4: ROC of MPI showed area under curve 97% and significance 0.001 (n=76).

Variable(s)	Area	Std. error	Sig.	95% Confidence interval	
				Lower bound	Lower bound
MPI	0.967	0.021	0.001	0.927	1.000

MPI = myocardial performance index; Sig. = significance; Std. = standard.

Echocardiography has become the mainstay within the analysis of the self-propelled vehicle in daily clinical observe. However, the advanced self-propelled vehicle pure mathematics poses vital difficulties within the assessment of self-propelled vehicle perform [25, 26]. Restricted studies corroborative the utility of assorted Echocardiographic parameters of self-propelled vehicle perform in patients with proximal RCA pathology. During this study, we have a tendency to aim to assess the validity of various cardiogram parameters assessing self-propelled vehicle perform for the prediction of proximal RCA lesion. In our study, there was no vital distinction in anemia heart condition risk factors between patients with proximal and distal RCA pathology, and also the incidence of heart disease was 25.6% in patients with proximal RCA; this is often in accordance with a previous study [27]. Troponin i used to be considerably higher in patients with proximal RCA lesions compared with patients with distal RCA lesions. This is often due to larger heart muscle at hazard in proximally set offender lesions. At the time of presentation, there have been no vital variations in hemodynamics, left cavum, ejection fraction, and self-propelled vehicle dimension between patients with proximal and distal RCA lesions. Will be explained by the very fact that RVMI can cause numerous degrees of heart muscle anemia and doesn't perpetually cause hemodynamic impairment [28, 29]. Moreover, there was no vital distinction in RVSP derived from TR between patients with proximal versus distal RCA pathology. The self-propelled vehicleSP derived from TR is principally load-dependent and doesn't replicate the contracted standing of the RV muscle [30]. Self-propelled vehicle perform parameters in our study, the proximal RCA cluster had a considerably higher incidence of RVMI than patients with distal RCA. This is often in accordance with previous studies [31], and this will make a case for the reduction of self-propelled vehicle perform parameters during this subgroup of patients. In our study, there was no vital distinction between TAPSE measurements in patients with proximal and distal RCA pathology. This will be explained by the very fact that TAPSEs carry the inherent limitation of estimating international perform of a fancy structure from a single-segment analysis [18]. Also, TAPSE bring to an end features a high specificity however low sensitivity to differentiate abnormal from nor-mal patients [32]. In our study, Sm was considerably lower in patients with proximal RCA compared to those with distal RCA lesions and therefore was ready to differ-entiate proximal from distal RCA pathology. this is often in accordance with a previous study by Ozdemir et al. [33]who declared that Sm considerably correlates with proximal RCA in patients with IWMI; this is often additionally in accordance with Dokainish et al. [34], United Nations agency concluded that angulate Sm will predict RVMI, and Wang et al. [35], United Nations agency compared angulate Sm with self-propelled vehicle ejection fraction evaluated with viscus mag-netic resonance and located that angulate Sm presented the most effective correlation with RVEF with viscus resonance. Also, Alam et al. [36] ended that Sm and TAPSE may be wont to assess self-propelled vehicle perform in association with IWMI. In traditional self-propelled vehicle with preserved ability and below traditional loading conditions, the tip of sys-tolic movement is instantly followed by early filling, and also the self-propelled vehicle IVRT is incredibly short or might even be absent. Therefore, a measurable IVRT is associate degree indicator of elevated end-systolic self-propelled vehicle pressure [37]. In our study, the self-propelled vehicle IVRT was considerably prolonged and ET was considerably shorter in patients with proximal RCA compared with patients with distal RCA. This is often as a result of there was a considerably higher variety of RVMI in patients with proximal RCA. In our study, MPI was considerably higher in patients with proximal RCA. This was because of the prolongation of IVCT and shortening of ET. The MPI index springs from physiological instead of structural options and mixing data from each pulse and beat phases of the cycle [38]; thus, it will provides an international estimate of self-propelled vehicle perform with sensible sensitivity and specificity for predicting a proxi-mal RCA lesion. This is often in accordance with Moller et al. [39] United Nations agency ended that within the hyperacute part of MI, the MPI of each the ventricle and self-propelled vehicle is considerably higher compared with control patients [39]. Multiple correlation analysis showed that the foremost powerful predictor for proximal RCA was MPI. A cut-off worth of 0.58 for MPI had a sensitivity of 95% and specificity of 97% for the designation proximal RCA.

VI. Conclusion

MPI might facilitate within the prediction of proximal versus distal RCA lesions. Distinguishing such a subgroup of patients early within their presentation exploitation associate degree MPI cut-off worth might facilitate in the early assessment and management of RVI.

Recommendation: any study specializing in echocardiographic measurements when reperfusion treatment to research speed of recovery.

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