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Original Article

Usefulness of Pulmonary Regurgitation Doppler Tracings in Predicting Outcome in Patients with Acute Inferior Wall Myocardial Infarction

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Abstract

Background: Pulmonary regurgitation (PR) flow-derived Doppler curve is useful in recognizing RV involvement during the first 24 hours of AMI. A PR Doppler pattern depends mainly on the diastolic RV pressure pattern, which is altered during AMI. So modification of RV pressure modifies the regurgitant flow pattern.

Aim of the Study: To evaluate the doppler predictors of PR and to assess its prognostic implications in acute MI patients.

Materials and Methods: This is a prospective study conducted in ICCU of Rajiv Gandhi government hospital. Detailed history, physical examination, ECG and two dimensional and Doppler echo and coronary angiography was done for all patients. The prognostic implication of RV involvement was derived by electrocardiographic and echocardiographic criteria.

Results: Out of 94 patients, "Group 1" had 53 patients with PHT ≤ 150 ms & Group 2 had 41 patients with PHT > 150 ms. Statistically significant difference seen in RV dimension, RV/LV ratio, RV FAC, RV ejection fraction, TAPSE, MASV and RV Tei index. Peak PR velocity and end diastolic velocity does not vary between both groups significantly. Mid diastolic minimum velocity has a mean of 0.33 m/sec in Group 1 and 0.69 m/sec in Group2 (p 65 years (p = 0.049), ST elevation in V4R (*P* = 0.011), RV dilatation in echocardiography (p = 0.018), Doppler criteria indicating RV involvement such as PR pressure half time ≤ 150 msec (0.018) and combined V_{min} / V_{max} ≤ 0.5 and PR PHT ≤ 150 msec (*P* = 0.042). The in-hospital events are also associated significantly with the presence of triple vessel disease in coronary angiogram.

Conclusion: In patients with acute IWMI, flow Doppler tracings of PR are useful in the prediction of in-hospital complications. PR derived parameters (PHT of PR ≤ 150 ms and V_{min} /V_{max} ≤ 0.5) are the excellent predictors of overall in-hospital complications.

Key words: Fractional area change, Inferior wall myocardial infarction, Pressure half-time, Pulmonary regurgitation

INTRODUCTION

Right ventricular (RV) acute myocardial infarction (AMI) occurs almost exclusively in setting of inferior wall left ventricular (LV) AMI.[1-4] It is known that impaired LV function is a major determinant of prognosis in patients surviving AMI. However, little and controversial information is available on the relationship between RV dysfunction and mortality. In a recent report focusing on the relationship between RV ejection fraction and long-term prognosis in patients with MI, Pfisterer *et al.*[5] concluded that RV dysfunction contributes to the occurrence of cardiac death after MI independent of and in addition to LV impairment.

Non-invasive hemodynamic diagnostic criteria, available at the bedside, may be useful in the acute phase of MI to allow recognition of high-risk patients with RV involvement. Zehender *et al.*[6,7] reported that ST-segment elevation in lead V4R at the time of admission was a strong predictor of in hospital complications. However, the diagnostic accuracy of non-invasive diagnostic criteria varies in different studies.[7-13]

RV echocardiographic study may represent a valuable alternative. Evaluation of RV systolic function, as well as wall

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motion abnormalities or global RV function index, is difficult because of inadequate apical windows and the unusual geometry of the right side of the heart. Continuous wave Doppler tracings of physiologic pulmonary regurgitation (PR) are highly promising tools because PR flow is directly related to the pressure gradient between the pulmonary artery and the right ventricle by the Bernoulli equation.[14]

PR flow-derived Doppler curve was useful in recognizing RV involvement during the first 24 h of AMI. A PR Doppler pattern depends mainly on the diastolic RV pressure pattern, which is altered during RV ischemia and characterized by a disproportionate increase of RV end diastolic pressure. This physical relation led us to hypothesize that a modification of RV pressure could modify the regurgitant flow pattern.

To test this hypothesis, the present study was designed to systematically search for the presence of a pulmonary regurgitant jet in patients with inferior wall AMI and to compare the modifications of the flow pattern with clinical outcome.

Aims of the Study

1. To evaluate the Doppler predictors of physiological PR in patients with RVMI in the setting of acute inferior wall AMI.
2. To assess the prognostic implications of Doppler characteristics of physiological PR with PR pressure half time (PHT) ≤ 150 ms and the ratio between minimum and maximum $V_{min}/V_{max} < 0.5$ with respect to in-hospital events in patients with acute inferior wall MI.

MATERIALS AND METHODS

Study Design

The present study was a prospective study conducted in the Department of Cardiology, Madras Medical College and Rajiv Gandhi Government General Hospital, Chennai, for a period of 3 months. Informed written consent was obtained from all patients before the start of the study. Institutional Ethics Committee approval was obtained.

Study Population

A total of 112 consecutive patients admitted with acute inferior wall ST elevation MI in the coronary care unit are included as study population for 3 months from January 2014. Among 112 patients, 18 patients were excluded as they did not fulfill the criteria to be included.

Inclusion Criteria

1. Presence of physiological PR
2. Prolonged chest pain >30 min
3. Electrocardiographic (ECG) evidence of ≥1 mm ST elevation in ≥2 inferior leads (II, III, aVF)
4. Positive creatine kinase-MB or troponin - *t*-test
5. Sinus rhythm at the time of echocardiography.

Exclusion Criteria

1. Severe PR or no PR
2. Pulmonary hypertension
3. Not willing for angiography
4. Allergic to contrast dye.

Methods

All the patients underwent a detailed history taking, physical examination, electrocardiogram, and biochemical investigations. Patients who were eligible for reperfusion were treated with streptokinase.

Echocardiographic Examination

Two dimensional and Doppler echocardiographic examinations of the patients were done with Esaote MyLab echo machine for all patients.

The probe placed in left parasternal space and shot axis view is obtained. Color Doppler was applied to find out physiological PR and continuous wave Doppler recordings done across PR jet yielding a positive flow spectrum during normal respiration. The following variables had been measured. Peak velocity of PR jet (V_{max}), minimum velocity in mid diastole just before the onset of A wave (V_{min}), PHT of PR. The ratio between the maximum and minimum velocities (V_{max}/V_{min}) was calculated.

The other parameters studied are RV size and dilatation in apical 4 chamber view, RV wall thickness, LV diameter, LV ejection fraction, RV ejection fraction, RV fractional area change, RV tricuspid annulus planar systolic excursion (TAPSE), RV myocardial performance index (MPI), and tricuspid annular peak systolic velocity (s').

The tricuspid valve is interrogated in A4C view, and tricuspid regurgitation was recorded and quantified using color Doppler. Inferior vena cava diameter was recorded in both inspiration and expiration in subcostal view.

ECG Data

Right precordial leads V4R and posterior leads were recorded in all patients. RV involvement was suspected in electrocardiogram when there is ST elevation ≥1 mm seen in V4R and similarly posterior wall MI is suspected when similar magnitude of ST elevation is seen in posterior leads.

Cardiac Catheterization

Coronary angiography is performed in all patients during the period of admission within 7 days to assess the extent of coronary artery lesion. Significant coronary artery disease in a vessel is defined as the presence of significant (≥50%) stenosis on a main branch of the coronary

angiogram. Patients are classified as having 1, 2, or 3 vessel disease according to the presence of lesions.

In-hospital Events

The prognostic implication of RV involvement as derived by ECG and ECG criteria; in the short term was evaluated for the following events:

1. Death
2. Severe arrhythmia (sustained ventricular tachycardia, and ventricular fibrillation)
3. High degree atrioventricular block
4. Sinus node dysfunction
5. Need for temporary pacing implantation
6. Low output syndrome (systolic blood pressure <90 mmHg, reduced urine output, need for volume loading, and inotropic support)
7. Ischemic events.
   a. Angina pain
   b. MI
   c. Revascularization (coronary artery bypass grafting/percutaneous coronary intervention).

The patient's clinical details and ECG values were entered in a pro forma and later tabulated using Microsoft Excel 2007 for statistical analysis.

Statistical Analysis

The patients were grouped according to the Doppler flow characteristics. PR PHT ≤ 150 ms was set as a cutoff value. The patients having PHT ≤ 150 ms were classified as Group 1 and those having PHT > 150 ms were classified as Group 2. Variables between these groups were compare using Chi-square test or Fisher's exact test. Continuous variables are tabulated as a mean and standard deviation. Mann–Whitney *U*-test had been used for the analysis of the continuous variables as the test is very robust particularly in non-normal or skewed distributions compared to unpaired student *t*-test. The univariate analysis was performed to predict in-hospital and 7 days overall events. The statistical analysis was performed by utilizing statistical package for the social sciences (SPSS) version 17.0.

RESULTS AND ANALYSIS OF OBSERVED DATA

A total number of patients in our study is 94. Among these patients, 2 groups have been divided according to the presence of PR PHT ≤ 150 ms. The first group named "Group 1" has 53 patients who have PHT ≤ 150 ms and a second group who have PHT > 150 was named as "Group 2."

Among Group 1, 69.8% were males and among Group 2 75.6% were males. There is no statistically significant difference between two groups regarding to sex distribution of the patients ($P = 0.533$). The details of the gender distribution of the patients are tabulated in Table 1 and depicted in Chart 1.

The mean age of patients in Group 1 is about 56.6 years and in Group 2 is 55.5 years. Among total 8 patients who are below the age of 40 years, 2 patients are in Group 1. The patients above the age of 75 years have been considered as high risk for in-hospital and follow-up events. The differences in age wise distribution of the patients between two groups are not significant statistically ($P = 0.625$). The age wise distribution of the patients is shown in Table 2 below and depicted pictorially in Chart 2.

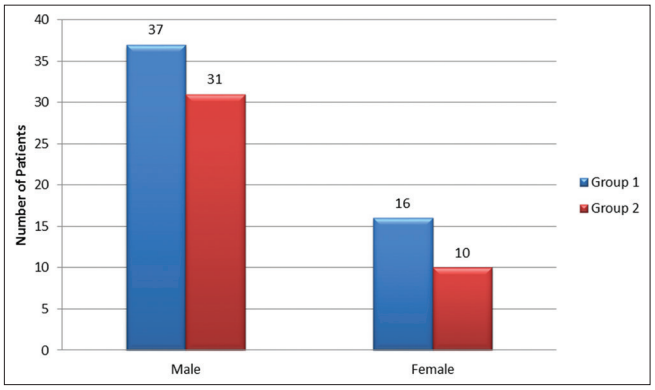

Chart 1: Gender wise distribution of patients

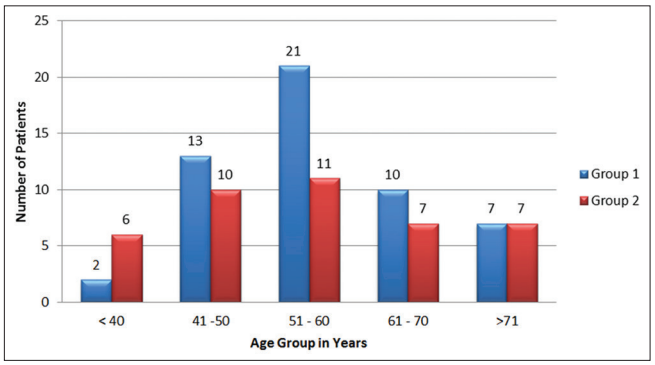

Chart 2: Age wise distribution of patients

Table 1: Sex wise distribution of patients

Group	Male		Female		Total	*P* value
	Number of patients	Percentage	Number of patients	Percentage		
Group 1	37	69.8	16	31.2	53	0.533
Group 2	31	75.6	10	24.4	41	
Total	68	72.3	26	28.7	94	

The patients admitted to coronary care unit with various duration of chest pain. No patients had come to cardiac care unit (CCU) with chest pain <1 h duration. The minimum duration of chest pain which brought the patient to CCU was 2 h.

A total of 51 patients were presented within initial 6 h after onset of chest pain. 12 patients presented more than a day after onset of chest pain. In between groups, the average duration of chest pain in Group 1 is 8.7 h compared to 12.0 h in Group 2. Even though there appears to be having a difference between averages, the difference is statistically not significant ($P = 0.339$). The results are shown in Table 3 and depicted in Chart 3.

Comparing the risk factors between the two groups, 30.1% of patients in Group 1 are diabetics and 28.8% of patients in Group 2 are diabetics. The difference between these groups is statistically not significant. 17 patients in Group 1 who constitute about 31.8% are having systemic hypertension and in Group 2, 15 patients are hypertensives who constitute about 36.5% of the Group 2 population. 22.6% of patients in Group 1 are smokers and in Group 2, 26.8% patients are smokers.

In Group 1, 35.8% patients are having serum cholesterol level >200 mg/dl and in Group 2, 41.46% patients are having serum cholesterol >200 mg/dl. The differences between individual risk factors between both groups were analyzed, and all found to be statistically not significant ($P > 0.05$). The risk factor distribution is depicted in Table 4 and Chart 4.

A total of 43 patients out of total 53 patients in Group 1 were thrombolyzed who constitute about 81.1%. 32 patients out of total 41 patients in Group 2 were thrombolyzed constituting about 78%. A total number of patient's thrombolyzed in our study were 75 constituting about 79.7% of the whole study population. The difference between groups was not statistically significant ($P = 0.910$). The thrombolysis details are shown in Table 5 and Chart 5.

ST segment elevation in electrocardiogram ≥1 mm is seen in the right sided V4R lead in 98.1% patients in Group 1. One person in Group 1 does not show ST elevation in V4R. In contrary, only one person in Group 2 has shown significant ST elevation in V4R. This observation of the difference between the groups is statistically significant ($P < 0.0001$). Posterior wall MI as diagnosed by ST elevation ≥1 mm in posterior leads such as V9 is seen in 16 patients in Group 1 and in 13 patients in Group 2 which are statistically not significant. Similarly, the presence of significant ST elevation in V6 suggesting associated lateral wall involvement is seen in 3 patients in Group 2 and in only one person in Group 1 which is also not significant statistically. The details are shown in Table 6 and Chart 6. Various echo parameters between Groups 1 and 2 is shown in Table 7.

Mean RV wall thickness is 2.9 mm in Group 1 and 2.9 mm in Group 2 patients. Mean RV dimension was 36.6 mm in Group 1 patients and 25.7 mm in Group 2 patients. The mean LV end diastolic dimension was 36.1 mm in Group 1 whereas 37.9 mm in Group 2 patients. LV ejection fraction

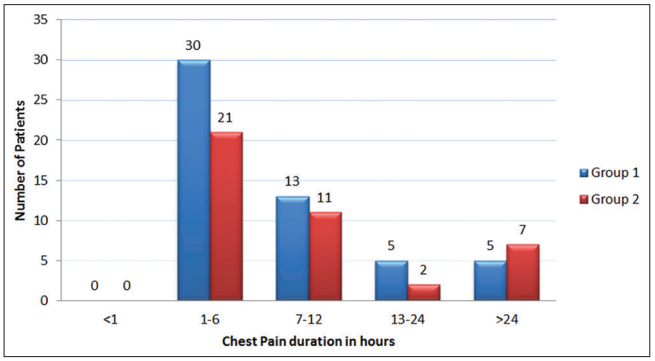

Chart 3: Chest pain duration in hours - distribution

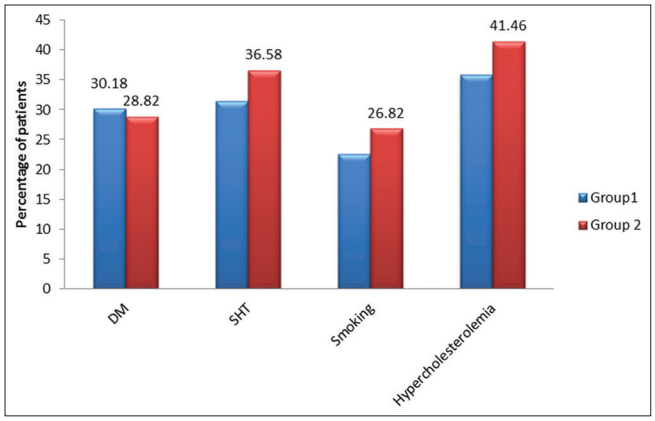

Chart 4: Risk factors comparison

Table 2: Age wise distribution of patients

Group	Age group of patients in years					Mean±SD	*P* value
	<40	41-50	51-60	61-70	>70		
Group 1	2	13	21	10	7	56.62±10.37	0.625 mann
Group 2	6	10	11	7	7	55.56±13.16	
Total	8	23	33	17	14		

SD: Standard deviation

Table 3: Chest pain duration

Group	Chest pain duration in hours					Mean±SD	*P* value
	<1	1-6	7-12	13-24	>24		
Group 1	0	30	13	5	5	8.73±7.86	0.339
Group 2	0	21	11	2	7	12.02±13.49	
Total	0	51	24	7	12		

SD: Standard deviation

Table 4: Risk factors

Risk factors	Group 1		Group 2		*P* value
	Number of patients	Percentage	Number of patients	Percentage	χ
Diabetes	16	30.18	11	28.82	0.932
SHT	17	31.48	15	36.58	0.765
Smoking	12	22.64	11	26.82	0.821
Serum cholesterol>200 mg/dl	19	35.84	17	41.46	0.732

Table 5: Thrombolyzed status

Group	Thrombolyzed		Not thrombolyzed		Total	*P* value
	Number of patients	Percentage	Number of patients	Percentage		
Group 1	43	81.1	10	18.9	53	0.910
						χ
Group 2	32	78.0	9	22.0	41	
Total	75	79.7	19	20.3	94	

Table 6: ECG changes ST elevation leads

Group	V4R		V9		V6	
	Number of patients	Percentage	Number of patients	Percentage	Number of patients	Percentage
Group 1	52	98.12	16	30.18	1	1.88
Group 2	1	2.43	13	31.70	3	7.31
Total	53	56.38	29	30.85	4	4.25
P value	<0.0001		0.946		0.436	

ECG: Electrocardiographic

Table 7: Echo parameters

Parameters	Units	Mean±SD		*P* value Mann
		Group 1	Group 2	
RV wall thickness	mm	2.90±0.79	2.97±0.87	0.747
RV dimension	mm	36.62±5.09	25.78±3.37	<0.0001
LVID days	mm	36.11±5.11	37.90±4.46	0.096
LV EF	%	54.98±6.16	51.07±12.26	0.159
RV/LV ratio	Ratio	1.01±0.07	0.68±0.11	<0.0001
RV FAC	%	26.37±5.24	41.18±7.78	<0.0001
RV EF	%	32.44±4.40	44.74±6.18	<0.0001
TAPSE	mm	12.74±3.26	19.11±3.70	<0.0001
TASV (S')	cm/s	7.91±2.46	14.32±3.61	<0.0001
RV MPI (Tei index)	-	0.49±0.08	0.30±0.11	<0.0001
IVC diameter Inspiration	mm	8.09±2.68	8.65±3.04	0.316
IVC diameter expiration	mm	19.81±4.21	18.09±4.13	0.031

SD: Standard deviation, PR: Pulmonary regurgitation, PHT: Pressure half time, RV: Right ventricular, LV: Left ventricular, IVC: Inferior vena cava, MPI: Myocardial performance index, TAPSE: Tricuspid annulus planar systolic excursion, LVID: Left ventricular internal diameter, FAC: Fractional area change, EF: Ejection fraction, TASV: Tricuspid annular systolic velocity

does not significantly differ between both groups. The RV/LV ratio in Group 1 patient has mean of 1.01 whereas, in Group 2, it is 0.68. Mean RV fractional area change in Group 1 is 26.3% and in Group 2 the mean right ventricular fractional area change is 41.1%. Mean RV ejection fraction in Group 1 patients is 32.4% and in Group 2 is 44.7%. The measurement of TAPSE has a mean of 12.7 mm in Group 1 patients and Group 2 patients is 19.1 mm. The tissue Doppler derived the value of tricuspid annular systolic velocity (TASV) (S') differ in both groups with a mean of 7.9 cm/s in Group 1 and 14.3 cm/s in Group 2.

The RV myocardial performance index (Tei index) is different in both groups with a mean of 0.49 in Group 1 and mean of 0.3 in Group 2. Statistical analysis of all the above parameters shows that the following parameters are statistically significant in the following - RV dimension, RV/LV ratio, RV FAC, RV ejection fraction, TAPSE, mitral annular systolic velocity, and RV Tei index. Others are not statistically significant.

PR Doppler flow characteristics are compared between two groups. Peak PR velocity does not vary significantly between two groups. Similarly, the end diastolic velocity does not vary between both groups significantly. Mid diastolic minimum velocity has a mean of 0.33 m/s in Group 1 and 0.69 m/s in Group 2. The difference between the groups is statistically significant with $P < 0.0001$. The ratio between V_{max}/V_{min} is different between the two groups. The difference is statistically significant ($P < 0.0001$). The mean PHT in Group 1 is 100.1 ms and in Group 2 is 229 ms. The values are tabulated in Table 8.

Tricuspid regurgitation was not present in all cases. TR is present in only in 32.0% of patients in Group 1 and only 17.0% in Group 2 patients. The difference between these observations was not statistically significant ($P = 0.156$).

Regarding severity of TR, severe TR was present in four persons in Group 1 accounting for 7.54%, and No patient in Group 2 had any severe TR. The difference in the presence of severe TR does not achieve statistical significance.

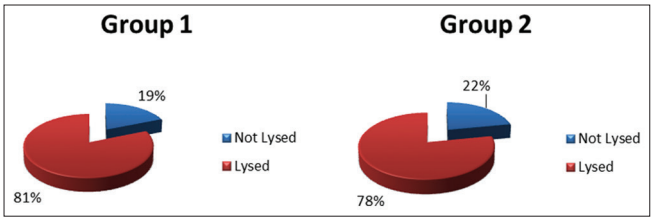

Chart 5: Thrombolyzed status

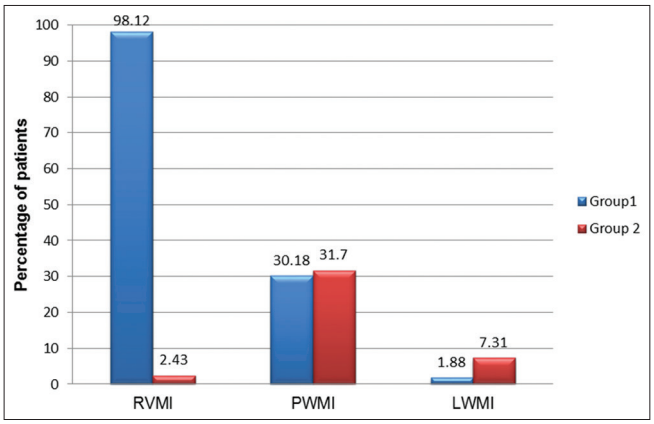

Chart 6: Electrocardiographic changes

Table 8: Echo parameters - pulmonary regurgitation

Parameters	Unit	Mean±SD		*P* value Mann
		Group 1	Group 2	
Peak PR velocity	m/s	1.41±0.41	1.33±0.28	0.331
End diastolic PR velocity	m/s	0.72±0.27	0.70±0.27	0.752
Mid diastolic minimum	m/s	0.45±0.19	0.89±0.31	<0.0001
V_{min}/V_{max}	Ratio	0.33±0.15	0.69±0.31	<0.0001
PHT of PR	ms	100.1±29.5	229.2±55.5	<0.0001

SD: Standard deviation, PR: Pulmonary regurgitation, PHT: Pressure half time

Similarly, regarding PR severity, moderate PR was present in 3 of the patients of Group 1 and 1 of the patients of Group 2. There is no statistically significant difference between the two groups regarding the severity of PR. The results are displayed in Table 9.

A total of 40 out of the total 94 patients had in-hospital complications in the total study population. Percentage of the patients in Group 1 who had in-hospital complications is 54.7% and in Group 2 is 26.8%. When the number of overall in-hospital complications in each group was analyzed for a significant difference, it turned out to be statistically significant ($P = 0.012$). Hypotension was present in 11 patients, reduced urine output was present in 5 patients, and requirement of volume loading was present in 11 patients. 5 patients were in cardiogenic shock, and 6 patients were in congestive cardiac failure. Except for oliguria, all the above indices for low volume status have the statistically significant difference between two study groups.

Total number of in-hospital deaths in our study is 7. The mortality rate in our study population in the in-hospital set up is 7.44%. All deaths occurred in Group 1, and Group 2 does not have any in-hospital mortality. The statistical analysis showed that there is a significant difference in mortality between two groups with $P = 0.043$. Heart blocks occurred significantly in Group 1 patients were 7 of them developed this complication while none of the Group 2 patients developed any heart block. This occurrence of heart block in Group 1 patients is statistically significant with a $P = 0.043$.

Significant arrhythmias were seen in 6 patients out of whom 4 patients belong to Group 1 and 2 patients belong to Group 2. The difference was statistically not significant ($P = 0.92$). 9 out of total 94 patients received temporary pacemaker during the course of illness. 8 patients belonged to Group 1 and one patient belonged to Group 2. No statistical difference was made out in between these groups regarding temporary pacemaker insertion placement ($P = 0.08$).

Table 9: Echo parameters - regurgitation severity

Group	Group 1		Group 2		*P* value
	Number of patients	Percentage	Number of patients	Percentage	
TR present	17	32.07	7	17.07	0.156
TR severity					
Trivial	5	9.43	3	7.31	0.994
Mild	7	13.20	3	7.31	0.561
Moderate	1	1.96	1	2.43	0.576
Severe	4	7.54	0	0	0.200
PR severity					
Trivial	20	37.73	18	43.91	0.693
Mild	30	56.60	22	53.66	0.940
Moderate	3	5.67	1	2.43	0.797
Severe	0	-	0	-	-

Table 10: In-hospital complications

In-hospital Complications	Group 1		Group 2		Total	*P* value
	Number of patients	Percentage	Number of patients	Percentage		
Overall complications	29	54.71	11	26.82	40	0.012
Hypotension	10	18.86	1	2.43	11	0.032
Oliguria	5	9.43	0	0	5	0.119
Requirement for volume loading	12	22.64	2	4.87	15	0.035
Requirement for inotropes	9	16.98	1	2.43	11	0.053
Cardiogenic shock	5	9.43	0	0	5	0.119
CCF	3	5.66	3	7.31	6	0.919
Death	7	13.20	0	0	7	0.043
Heart block	7	13.20	0	0	7	0.043
Arrhythmia	4	7.54	2	4.87	6	0.920
Requirement for TPI	8	15.09	1	2.43	9	0.087
Recurrent angina	7	13.20	4	9.75	11	0.847
Recurrent MI	3	5.66	1	2.43	4	0.799
Revascularization	4	7.54	3	7.31	7	0.723

MI: Myocardial infarction, CCF: Congestive heart failure, TPI: Temoporary pacemaker insertion

Regarding clinical events, 11 patients developed angina chest pain during the stay in the hospital accounting for 11.7% of the study population. There is no statistically significant difference between two groups regarding recurrent angina ($P = 0.84$). The reinfarction rate in the study population was 4.25%. Three persons from Group 1 and one person from Group 2 has a recurrence of MI, and the difference is not statistically significant ($P = 0.79$). Revascularization was required in 7 patients in whom 4 belonged to Group1. No statistically significant difference was observed in between groups pertaining to revascularization ($P = 0.72$). The details of the in-hospital outcome group wise are shown in Table 9.

Univariate analysis showed that following variables were associated significantly with total in-hospital events - Age > 65 years ($P = 0.049$), ST elevation in V4R ($P = 0.011$), RV dilatation in echocardiography (p = 0.018), Doppler criteria indicating RV involvement such as PR PHT ≤ 150 ms (0.018) and combined $V_{min}/V_{max} \leq 0.5$ and PR PHT ≤ 150 ms ($P = 0.042$). The in-hospital events are also associated significantly with the presence of triple vessel disease in coronary angiogram ($P < 0.0001$). The odds ratio is highest for the presence of triple vessel disease for the occurrence of in-hospital events (relative risk = 3.5, CI = 1.2-9.9, $P < 0.0001$). Other factors which predict in-hospital events are age > 65 years, ST elevation in V4R and Doppler flow characteristics of PR. The odds ratios for the variables with confidence intervals are tabulated in Table 10.

Table 11: Univariate analysis of in-hospital events

Parameter	Odds ratio	95% confidence interval	*P* value
Age>65 years	1.6	0.9-7.1	0.049
Diabetes mellitus	1.0	0.6-1.7	0.925
SHT	0.7	0.4-1.1	0.229
Serum cholesterol>200 mg/dl	1.0	0.5-2.3	0.831
Smoking	1.0	0.6-1.9	0.792
Thrombolysis	0.8	0.4-1.6	0.645
ST elevation in V4R	1.5	1.1-2.1	0.011
ST elevation in V9	1.0	0.6-1.6	0.988
RV dilatation	1.9	1.0-3.3	0.018
TASV<10 cm/s	1.6	0.9-2.6	0.060
$V_{min}/V_{max} \leq 0.5$	1.3	0.7-2.2	0.275
PR PHT≤150 ms	1.9	1.0-3.3	0.018
PR PHT≤150 and $V_{min}/V_{max} \leq 0.5$	1.4	1.0-2.0	0.042
3 vessel CAD	3.5	1.2-9.9	<0.0001

RV: Right ventricular, PR: Pulmonary regurgitation, PHT: Pressure half time, CAD: Coronary artery disease, SHT: Systemic hypertension, TASV: Tricuspid annular systolic velocity

DISCUSSION

The present study is conducted to evaluate the prognostic implications of Doppler derived parameters of PR in cases of acute inferior wall MI. Univariate analysis of variables associated with total in-hospital events is shown in Table 11.

The non-invasive diagnostic criteria used in our study, which is based on validated hemodynamic and angiographic criteria, are highly sensitive of RV ischemia and therefore may be used as a more accurate method of differentiating patients with and without RV involvement.

The Doppler evaluation of PR was done in patients with acute inferior wall myocardial infarction (IWMI) by Cohen *et al*.[14] in 1995 which concluded that when the cut off for PR PHT was kept below 150 ms and ratio between minimum and maximum velocities $V_{min}/V_{max} \leq 0.5$, they indicated the presence of associated RV infarction with the sensitivity of 100% and specificity of 89%. The study was conducted with hemodynamic confirmation of RVMI in cases of IWMI. The same Doppler echocardiographic criteria applied in our study to analyze associated RVMI in IWMI patients and the prognostic impact of the RV involvement.

Bueno *et al.* showed that in patients with RVMI, in-hospital case fatality rate was 47% compared with 10% in patients without RV involvement ($P < 0.001$). The most common cause of death was non-reversible low cardiac output cardiogenic shock. In our study, the most common cause of death was refractory hypotension and ventricular arrhythmias.[15]

In our study, the mortality rate in acute IWMI is about 7.4% which is in contrast to the study conducted by Zehender *et al.* where the mortality rate in inferior wall infarction patients was 19%.[6] In the same study, the case fatality rate for RV involvement in acute IWMI was 31% compared to our study which is about 13.2%. The reduction of mortality after RVMI may be attributed to the early recognition of RVMI, better reperfusion strategies and improvement in the quality of care in coronary care units.[6]

The presence of ST elevation in V4R is an important clinical variable available at the bedside to assess the prognosis of the patient which predict in-hospital mortality with a relative risk of 7.7 and major complications with a relative risk of 4.7. In our study, the presence of ST elevation in V4R has prognostic implications for the major in-hospital events with an odds ratio of 1.5 which is statistically significant.

Results of our study are comparable to the study by Cohen *et al.*, in terms of in-hospital mortality. A study conducted by Cohen *et al.* found that the mortality in cases of IWMI was 6% which is in our study is 7.4%. But in that study, they cannot confirm the poor prognostic outcome of independent ST elevation in V4R which is demonstrated in our study.[16]

Among the risk factors, age > 65 years is the only risk factor which showed statistically significant association with in-hospital events. The other traditional risk factors of cardio vascular disease such as smoking, diabetes mellitus, systemic hypertension, and hypercholesterolemia were not able to demonstrate prognostic implications in our study. This may be due to a small number of the study population, and hence any small difference in prognosis may not be able to translate into statistical significance.

Recent studies have found out that the extent of RVMI and RV dysfunction as assessed by cine magnetic resonance imaging after ST-segment elevation MI, are prognostic indicators, which correlates with our study showing echocardiographic indices of RV dilatation and RV dysfunction such as TAPSE, and TASV are independent prognostic factors for early in-hospital events.[17]

CONCLUSIONS

1. In patients with inferior wall AMI, flow Doppler tracings of PR are useful in the prediction of in-hospital complications. PR derived parameters (PHT of PR ≤ 150 ms and $V_{min}/V_{max} \leq 0.5$) were the excellent predictors of overall in-hospital complications.
2. PHT ≤ 150 ms and the minimum velocity of PR tracings in mid diastole to the peak early diastolic velocity of PR ratio (V_{min}/V_{max}) ≤ 0.5 were excellent predictors of RV involvement in the setting of inferior wall MI.
3. Low output syndrome is a frequent, specific, and potentially severe complication of RV infarction.

Limitations of the study

1. The study population was small, hence it needs to be evaluated whether the results obtained in this study would generalize to other patient groups or not. Clinical trials with larger study populations are needed to assess this.
2. Long-term follow-up of patients was not done to assess the long-term prognosis.
3. The characteristics of the infarct related artery such as thrombus burden, lesion morphology, and TIMI flow grade are not taken into consideration for the study purpose.
4. The status of thrombolysis whether successful or failed is not considered in determining the prognosis, which might play a big role in determining in-hospital and long-term prognosis.
5. The exclusion of a sizeable number of patients who do not have physiological PR which may skew the results.

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