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Right Ventricular Infarction in Acute Inferior Myocardial Infarction: A Study of Clinical Course and Mortality at Rajshahi Medical College Hospital

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ABSTRACT: ***Background:*** Right ventricular infarction (RVI) frequently complicates acute inferior myocardial infarction (AIMI) and is associated with increased morbidity and mortality. This prospective cohort study aimed to determine the prevalence of RVI in patients with AIMI and assess its impact on in-hospital outcomes. ***Methods:*** A total of 120 patients admitted with AIMI to the coronary care unit of Rajshahi Medical College Hospital (RMCH) were enrolled over twelve months following ethical approval. RVI was assessed using a 12-lead ECG. Patients were divided into two groups based on the presence (Group A) or absence (Group B) of RVI. Demographic, clinical, and biochemical data were recorded, and in-hospital complications were compared between groups. ***Result:*** RVI was identified in 31.7% of AIMI patients. Patients with RVI exhibited significantly lower systolic (96.8±4.7 vs 119.5±4.8 mmHg) and diastolic blood pressure (66.6±3.3 vs 78.3±2.4 mmHg) and lower heart rates (82.5± 7.4 vs 89.9± 6.4 bpm) compared to those with AIMI alone ($p<0.05$). Troponin-I levels were significantly lower in group A (0.99±0.1 vs 4.06±1.4 ng/mL, $p<0.001$). Complications such as cardiogenic shock (44.7% vs 18.3%) and atrioventricular blocks (21.1% vs 3.7%) were significantly more frequent in the RVI group ($p<0.05$). The mean duration of hospital stay was significantly shorter in Group A ($p<0.05$). In-hospital mortality was substantially higher among RVI patients (23.7% vs 3.7%, $p<0.05$). Multivariate logistic regression identified RVI as a significant independent predictor of in-hospital mortality (OR=15.87, p=0.001). ***Conclusion:*** This study demonstrates that RVI is a common and significant determinant of adverse in-hospital outcomes in patients with AIMI at RMCH. Prompt recognition and management of RVI are crucial to reducing morbidity and mortality in this vulnerable population.

Keywords: Right Ventricular Infarction (RVI), Acute Inferior Myocardial Infarction (AIMI).

Article at a glance:

Study Purpose*: To evaluate the prevalence and clinical impact of right ventricular infarction in patients presenting with acute inferior MI.*

Key findings: *RVI occurred in 31.7% of AIMI patients and significantly increased in-hospital complications and mortality.*

Newer findings: *The study identified RVI as an independent predictor of mortality with an OR of 15.87, strengthening its prognostic value.*

Abbreviations: *RVI – Right Ventricular Infarction, AIMI – Acute Inferior Myocardial Infarction, ECG – Electrocardiogram.*

INRODUCTION

Coronary heart disease (CHD) remains a leading global cause of mortality and morbidity, reaching epidemic proportions worldwide. Acute myocardial infarction (AMI), a severe manifestation of CHD, significantly contributes to this burden.[1] While historically, myocardial infarction (MI) was

primarily considered a left ventricular (LV) disease, the involvement of the right ventricle (RV), specifically right ventricular infarction (RVI), has emerged as a critical determinant of clinical outcomes in patients with acute inferior wall myocardial infarction (IWMI).[2-4] Right ventricular infarction occurs due to the occlusion of the proximal right coronary artery (RCA), which supplies blood to the inferior wall and the right ventricle. This event impairs RV function and ultimately reduces left ventricular preload, leading to hemodynamic instability and subsequent fall of cardiac output.[5, 6] Although isolated right ventricular infarction has been reported in autopsy studies as accounting for less than 3% of all acute myocardial infarctions, its occurrence in conjunction with inferior wall myocardial infarction is significantly higher, ranging between 30% and 50%.[3, 4] The clinical consequences of this association lead to severe consequences such as hypotension, cardiogenic shock, and atrioventricular (AV) conduction disturbances.[7] The triad of hypotension, elevated jugular venous pressure, and clear lung fields is a hallmark of RVI and requires distinct therapeutic strategies.[8] Unlike isolated IWMI, patients with RVI require careful fluid resuscitation and avoidance of excessive vasodilators or diuretics, which may exacerbate hypotension and compromise cardiac output.

The clinical significance of RVI extends beyond its prevalence. Inferior wall myocardial infarction (IWMI) constitutes nearly 40% of all myocardial infarctions (MIs) and is generally considered to have a more favorable prognosis than anterior wall MI.[7] This is because the amount of myocardium supplied by the right coronary artery or the left circumflex artery is much less than the left anterior descending artery.[9] However, the presence of concomitant RVI significantly alters this favorable trajectory. Patients with RVI experience an increased risk of hemodynamic instability, arrhythmias, and in-hospital mortality.[10] Data suggests that the mortality rate associated with isolated IWMI is approximately 3.5%, which escalates substantially to 16% when RVI is present.[10] This marked increase in mortality underscores the importance of identifying and appropriately managing RVI in patients presenting with IWMI. In clinical practice, the presence of RVI in IWMI is often overlooked, leading to suboptimal management and increased in-hospital complications. The early recognition and differentiation of RVI from isolated IWMI are crucial for targeted intervention, particularly in resource-constrained settings. Despite the established association between RVI and adverse outcomes in patients with IWMI, data regarding the prevalence, clinical characteristics, and in-hospital outcomes of RVI in the Bangladeshi population remains limited. This lack of data hinders clinicians' ability to adopt evidence-based strategies for their management. Studies from other regions indicate that RVI patients experience higher morbidity (cardiogenic shock in 44.7% of cases) and mortality (23.7% vs. 3.7% in IWMI-only patients). Given the potential differences in patient demographics, access to healthcare resources, and management strategies, it is crucial to investigate the local impact of RVI on patients with acute IWMI. In this study, we aimed to evaluate the in-hospital outcomes of right ventricular infarction in patients with acute inferior myocardial infarction. Moreover, we sought to determine the prevalence of right ventricular infarction in patients with IWMI, assess and compare the in-hospital clinical course, complications (e.g., cardiogenic shock, atrioventricular blocks, arrhythmias), and mortality rates between patients with AIMI and RVI and those with AIMI alone, and identify independent predictors of in-hospital mortality in patients with RVI and AIMI.

METHODOLOGY

Study Design and Setting

This study was designed as a prospective cohort study and conducted at Rajshahi Medical College Hospital (RMCH) for 12 months. The study population comprised patients admitted to the Coronary Care Unit (CCU) of RMCH with a diagnosis of acute inferior myocardial infarction (AIMI) during the study period.

Inclusion Criteria

Age: >18 years
Recent history of onset of typical chest pain suggestive of myocardial ischemia of more than 30 min duration
Recent electrocardiographic changes suggestive of inferior wall infarction, i.e. S-T segment elevation > 0.1mV (1mm) in leads II, III and aVF
Raised level of cardiac enzymes suggestive of AMI
Willing to participate

Exclusion Criteria

History of chest pain of more than 24 h duration.

Patients whose initial ECG's showed an anteroseptal or anterior wall myocardial infarction
Patients with pericarditis
Patients with left bundle branch block
Patients with chronic lung disease with corpulmonale
Patients with a previous history of a myocardial infarction.
Unwilling to participate

Study Procedure

Patients admitted to the CCU of RMCH were selected based on predefined inclusion and exclusion criteria. Eligible patients or their attendants were approached, and informed written consent was obtained before enrollment. Each participant underwent a detailed clinical evaluation, including a comprehensive medical history and thorough physical examination. Data were systematically recorded in a pre-designed case record form, capturing information on demographics (age, sex, height, weight), clinical profile (pulse, blood pressure, NYHA functional class, cardiogenic shock, arrhythmias, heart block), risk factors (smoking, hypertension, diabetes mellitus, dyslipidemia, family history of coronary artery disease), and medication history. Clinical assessment also focused on detecting signs of right ventricular failure, left ventricular failure, hypotension, and cardiogenic shock upon admission.

A standard 12-lead ECG was performed. Right-sided precordial leads (V3R, V4R) were additionally recorded for patients exhibiting inferior wall infarction on the initial ECG. Patients were then categorized into two groups based on the presence or absence of ST-segment elevation in V4R or V3R:
Group A: Patients with ST-segment elevation in V4R or V3R (indicative of right ventricular infarction).
Group B: Patients with iso-electric ST segments in V4R or V3R (without right ventricular infarction).

Serial ECGs were performed at admission, 6 hours, 12 hours, and daily until ST-segment normalization. Additional ECGs were conducted whenever patients experienced chest pain. In thrombolysis-treated patients, a post-thrombolysis ECG was recorded 1.5 hours after thrombolytic therapy. Echocardiographic assessments (2D, M-mode, and Doppler echocardiography) were performed within 72 hours of symptom onset to evaluate left ventricular ejection fraction (LVEF) and mechanical complications. Right ventricular function was assessed using the biplane Simpson's method in the apical four-chamber view. Throughout hospitalization, patients were closely monitored for complications such as cardiogenic shock, arrhythmias, conduction abnormalities, and mortality outcomes. Standardized treatment protocols, including reperfusion therapy, anticoagulation, antiplatelet therapy, and supportive care, were followed in accordance with institutional guidelines. The duration of hospitalization and the need for intensive care unit (ICU) admission were also documented. The study procedure ensured systematic follow-up and documentation of in-hospital outcomes for all participants.

Ethical Considerations

Ethical approval for the study was obtained from the Institutional Review Board (IRB) of RMCH, ensuring compliance with ethical standards for human research. Written informed consent was obtained from all participants prior to study enrollment, and confidentiality of patient data was strictly maintained throughout the research process.

Data Processing and Analysis

Data was entered and analyzed using Statistical Package for Social Sciences (SPSS) version 23. Continuous variables were expressed as mean ± standard deviation (SD). Categorical variables were presented as frequencies and percentages. Differences between groups were assessed using appropriate statistical tests, such as independent samples t-test for continuous variables and chi-square test for categorical variables. Univariate and multivariate logistic regression analyses were performed to identify independent predictors of in-hospital mortality. All the tests were two-sided, and a p-value of <0.05 was considered statistically significant.

RESULT

Baseline Characteristics

Table 1 & figure 1 presents the baseline characteristics of participants. A total of 120 patients diagnosed with acute inferior myocardial infarction (IWMI) were enrolled in the study. Among them, 38 patients (31.7%) were identified with right ventricular infarction (RVI) (Group A), while 82 patients (68.3%) had isolated IWMI without RVI (Group B) (Figure 1).

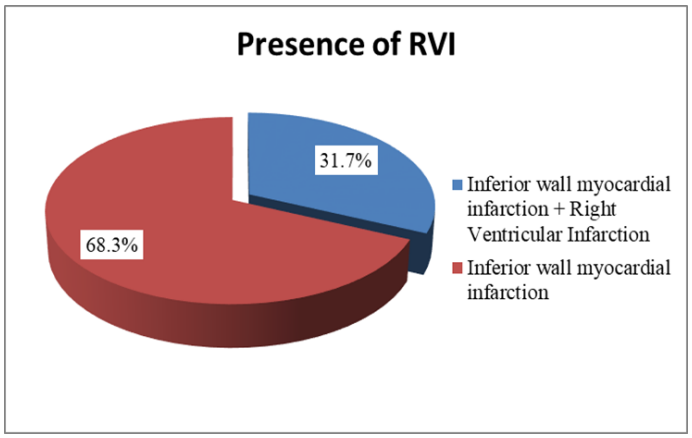

Figure 1: Frequency Of Right Ventricular Infarction in Patients with Acute Inferior Myocardial Infarction

The mean age of the study population was 62.42 ± 8.89 years in group A and 58.4 ± 10.2 years in group B, with a predominance of participants aged between 51-60 years in both groups. The age difference between the groups was statistically significant. Regarding sex distribution, males constituted the majority in both groups. Body mass index (BMI) was also significantly higher in Group A (29.93 ± 0.62) compared to Group B (29.32 ± 0.88), with a p-value less than 0.001. Among the risk factors, the prevalence of smoking, diabetes mellitus, hypertension, dyslipidemia, and family history of coronary artery disease was assessed. Although smoking, diabetes mellitus, and hypertension were slightly more common in Group B, the differences were not statistically significant. Dyslipidemia and family history of coronary artery disease were observed more frequently in Group A.

Table 1: Baseline Characteristics of the Participants

Variables	Group A (38)	Group B (82)	p-value
Age (years)			
Mean (SD)	62.42 ± 8.89	57.41 ± 8.94	0.003
Age groups			
≤50	4 (10.5%)	24 (29.3%)	0.013
51-60	13 (34.2%)	29 (35.4%)	
61-70	12 (31.6%)	24 (29.3%)	
>70	9 (23.7%)	5 (6.1%)	
Sex			
Male	22 (68.3%)	52 (63.4%)	0.6
Female	12 (31.7%)	30 (36.6%)	
BMI			
Mean (SD)	29.93 ± 0.62	29.32 ± 0.88	<0.001
Risk factors			
Smoking	16(42.1)	37(45.1)	0.76
Diabetes mellitus	22(57.9)	42(51.2)	0.5
Hypertension	18(47.4)	44(53.7)	0.5
Dyslipidemia	25(65.8)	44(53.7)	0.2
Family history of coronary artery disease	24(63.2)	40(48.8)	0.14

Clinical and Hemodynamic Characteristics

Table 2 presents a comparative analysis of clinical signs and laboratory findings between the two groups of patients. Heart rate was significantly lower in Group A compared to Group B. Both systolic and diastolic blood pressure were also significantly lower in Group A compared to Group B. Conversely, serum Troponin I levels were significantly lower in Group A compared to Group B. Random blood glucose levels were significantly higher in Group A compared to Group B. There was no statistically significant difference in NYHA heart failure class distribution between the two groups (p=0.8).

Table 2: Clinical and hemodynamic characteristics of the study participants

Variables	Group A (38)	Group B (82)	p-value
Heart rate (bpm)			
Mean (SD)	82.47 ± 7.43	89.85 ± 6.42	<0.001
Blood pressure (mmHg)			
Systolic	96.8 ± 4.72	119.5 ± 4.8	<0.001
Diastolic	66.6 ± 3.27	78.3 ± 2.4	<0.001
NYHA heart failure			
Class II	19 (50.0%)	36 (43.9%)	0.8
Class III	4 (10.5%)	9 (11.0%)	
Class IV	15 (39.5)	37 (45.1)	
Laboratory result			
Troponin I (ng/ml)	0.99 ± 0.14	4.06 ±1.4	<0.001
Random blood glucose (mg/dL)	233.8 ± 19.6	205 ± 6.5	<0.001

In-Hospital Outcomes

The mean duration of hospitalization was significantly shorter in Group A compared to Group B. Regarding in-hospital outcomes; Group A exhibited significantly higher incidences of cardiogenic shock and atrioventricular (AV) blocks compared to Group B. Mortality was also significantly higher in Group A (23.7%) compared to Group B (3.7%, p<0.001). While there were numerical differences in the rates of post-myocardial infarction angina, ventricular tachycardia, hypotension, and arrhythmia between the groups, these differences did not reach statistical significance (p>0.05) (Table 3).

Table 3: In-Hospital Outcomes of the Participants

Variables	Group A (38)	Group B (82)	p-value
Duration of hospital stay (days)			
Mean (SD)	3.47 ± 1.1	4.24 ± 1.03	0.001
In-hospital outcomes			
Post myocardial infarction angina	8 (21.1%)	15 (18.3%)	0.7
Ventricular tachycardia	1 (2.6%)	6 (7.3%)	0.3
Cardiogenic shock	17 (44.7%)	15(18.3%)	0.002
Atrioventricular blocks	8 (21.1%)	3 (3.7%)	0.002
Hypotension	9 (23.7%)	12 (14.6%)	0.2
Arrhythmia	15 (39.5%)	18 (22.0%)	0.05
Mortality	9 (23.7%)	3 (3.7%)	<0.001

Predictors of In-Hospital Mortality

Table 4 presents the results of univariate and multivariate logistic regression analyses examining predictors of in-hospital mortality in patients with acute inferior myocardial infarction (AIMI), with and without right ventricular infarction (RVI). In the univariate analysis, the presence of RVI demonstrated a statistically significant association with increased in-

hospital mortality (OR=8.172, 95% CI: 2.068-32.296, p=0.003). However, age >60 years, male sex, smoking, diabetes mellitus, hypertension, and dyslipidemia did not show statistically significant associations with in-hospital mortality in the univariate analysis (p>0.05). In multivariate analysis, after adjusting for other variables, the presence of RVI remained a statistically significant independent predictor of in-hospital mortality (OR=15.869, 95% CI: 3.095-81.375, p=0.001). The other variables, including age >60 years, male sex, smoking, diabetes mellitus, hypertension and dyslipidemia, were not statistically significant predictors of in-hospital mortality in the multivariate analysis (p>0.05).

Table 4: Univariate and Multivariate Analysis for the Predictors of In-Hospital Mortality

Variables	Univariate		Multivariate	
	Odds ratio	p-value	Odds ratio	p-value
Age >60 years	0.674 (0.19-2.37)	0.54	0.378 (0.08-1.77)	0.216
Male	1.696 (0.43-6.64)	0.45	1.116 (0.14-9.05)	0.918
Smoking	0.77 (0.23-2.54)	0.67	1.504 (0.18-12.65)	0.707
Diabetes Mellitus	1.686 (0.50-5.65)	0.4	0.453 (0.11-1.93)	0.285
Hypertension	1.077 (0.33-3.55)	0.9	1.217 (0.27-5.45)	0.797
Dyslipidemia	1.4 (0.42-4.62)	0.58	0.304 (0.05-1.77)	0.184
Presence of Right ventricular infarction	8.172 (2.07-32.30)	0.003	15.869 (3.10-81.38)	0.001

DISCUSSION

This study highlights the significant impact of right ventricular infarction (RVI) on clinical outcomes in acute inferior myocardial infarction (IWMI) patients. RVI was associated with older age, higher BMI, and greater hemodynamic instability, including significantly lower systolic and diastolic blood pressures and increased risk of cardiogenic shock (44.7% vs. 18.3%, p=0.002). Additionally, AV blocks and arrhythmias were markedly higher in RVI patients, reinforcing the importance of early ECG and echocardiographic evaluation. The presence of RVI was the strongest independent predictor of in-hospital mortality (OR=15.869, p=0.001), while traditional risk factors such as age, smoking, diabetes, hypertension, and dyslipidemia did not significantly influence mortality. Despite lower troponin I levels in RVI patients, their clinical course was more complicated due to worse hemodynamic profiles and conduction disturbances. These findings emphasize the need for early identification, aggressive hemodynamic support, and continuous cardiac monitoring in RVI cases. Routine right-sided ECG and echocardiography should be standard practice in IWMI patients to improve risk stratification. Future research should focus on long-term outcomes and optimal management strategies, particularly regarding fluid resuscitation, pacing, and targeted interventions to reduce mortality in this high-risk subgroup. This study aimed to evaluate the in-hospital outcomes of patients with acute inferior myocardial infarction (IWMI) with and without right ventricular infarction (RVI) and identify predictors of in-hospital mortality. The findings indicate that RVI is a significant determinant of worse clinical outcomes, including increased risk of cardiogenic shock, arrhythmias, atrioventricular blocks, and mortality.

The study revealed that older age and higher BMI were significantly associated with RVI in IWMI patients.[11, 12] The mean age was significantly higher in Group A (62.42 ± 8.89 years) compared to Group B (57.41 ± 8.94 years, p=0.003), suggesting that advanced age may contribute to the increased susceptibility of RVI.[13, 14] Additionally, BMI was significantly higher in Group A (p<0.001), potentially indicating a link between obesity and right ventricular dysfunction. Previous studies also reported that obesity is associated with adverse outcomes, including mortality.[15-17] However, traditional cardiovascular risk factors such as smoking, diabetes mellitus, hypertension, dyslipidemia, and family history of coronary artery disease did not show statistically significant differences between the groups, suggesting that RVI may be influenced by additional pathophysiological mechanisms beyond conventional risk factors.[18] Patients with RVI exhibited significantly lower systolic and diastolic blood pressure (p<0.001), reinforcing the well-established association between RVI and hypotension due to reduced preload dependency. The mean heart rate was also

significantly lower in Group A (82.47 ± 7.43 bpm vs. 89.85 ± 6.42 bpm, p<0.001), likely due to conduction system involvement, which is common in right coronary artery occlusions.[19] Serum troponin I levels were markedly lower in Group A compared to Group B (p<0.001), suggesting that RVI is associated with smaller infarct sizes but worse hemodynamic consequences.[20] Conversely, random blood glucose levels were significantly higher in Group A (233.8 ± 19.6 mg/dL vs. 205 ± 6.5 mg/dL, p<0.001), potentially indicating a stress-related hyperglycemic response in patients with RVI.[21, 22]

The study demonstrated that RVI patients had significantly higher incidences of cardiogenic shock (44.7% vs. 18.3%, p=0.002) and atrioventricular (AV) blocks (21.1% vs. 3.7%, p=0.002), consistent with previous findings that proximal right coronary artery occlusion can impair AV nodal conduction and right ventricular function.[23, 24] The increased risk of arrhythmias in RVI patients (39.5% vs. 22.0%, p=0.05) further underscores the importance of continuous cardiac monitoring in these individuals.[19] While there were no statistically significant differences in the incidence of post-myocardial infarction angina, ventricular tachycardia, or hypotension, these complications were numerically more frequent in the RVI group, suggesting a trend toward worse clinical outcomes. The in-hospital mortality rate was significantly higher in Group A (23.7%) compared to Group B (3.7%, p<0.001), indicating that RVI is a major determinant of mortality in IWMI patients. The univariate analysis identified RVI as a strong predictor of in-hospital mortality (OR=8.172, p=0.003), and multivariate regression analysis further confirmed that RVI remained an independent predictor of mortality after adjusting for confounding variables (OR=15.869, p=0.001). Other traditional risk factors, including age, sex, smoking, diabetes mellitus, hypertension, and dyslipidemia, were not significantly associated with in-hospital mortality in this study. The findings from this study highlight the importance of early identification and aggressive management of RVI in IWMI patients. Given the high prevalence of hypotension, conduction disturbances, and cardiogenic shock, prompt hemodynamic stabilization, judicious fluid resuscitation, and pacing support should be considered in RVI cases. The significantly higher mortality risk associated with RVI underscores the need for routine right-sided ECGs and echocardiographic assessment of right ventricular function in all IWMI patients. Despite the study's strengths, including its prospective design and comprehensive evaluation of hemodynamic and clinical outcomes, certain limitations should be acknowledged. First, the sample size was relatively small, which may limit the generalizability of findings. Second, long-term follow-up data were not available, preventing an assessment of post-discharge outcomes. Future research should focus on larger, multicenter studies to validate these findings and investigate therapeutic strategies tailored for RVI patients, including optimal fluid management, vasopressor use, and targeted revascularization approaches.

CONCLUSION

In summary, this study demonstrates that right ventricular infarction is a critical determinant of poor prognosis in IWMI patients, with significantly higher risks of cardiogenic shock, conduction abnormalities, and in-hospital mortality. These findings reinforce the need for heightened clinical awareness, early diagnosis, and targeted management strategies to improve outcomes in this high-risk population. Right ventricular infarction is a frequent yet underdiagnosed complication of inferior myocardial infarction, carrying a significantly higher risk of mortality and major complications. Early recognition through right-sided ECG, echocardiography, and appropriate management is crucial to improving patient outcomes. This study will provide region-specific insights into epidemiology, clinical outcomes, and prognostic indicators of RVI at RMCH, guiding future therapeutic strategies and improving patient care.

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