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Hospital Outcome of Right Ventricular Infarction in Patients with Acute Inferior Myocardial Infarction at Rajshahi Medical College Hospital, Rajshahi

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Abstract:
Background: *Right ventricular infarction (RVI) is a recognized prognostic factor in acute myocardial infarction but is often goes unrecognized in clinical practice. This study aimed to assess the impact of RVI on in-hospital outcomes among patients with acute inferior myocardial infarction (IWMI).*
Methods: *In this prospective study, 120 patients admitted with acute IWMI at Rajshahi Medical College Hospital were stratified into two groups based on the presence (Group A) or absence (Group B) of RVI, as determined by ST-segment elevation in right precordial leads.The risk factors, in hospital mortality rates, the incidence of cardiogenic shock, arrhythmias, and other complications, has been assessed comparing the two groups using chi-square and logistic regression analyses.*
Results: *Patients with RVI (Group A) exhibited a significantly higher hospital mortality rate (23.7%) compared to those without RVI (Group B, 3.7%). Group A patients had significantly lower hypotension and bradycardia compared to group B patients. Laboratory findings showed that Troponin-I levels were significantly higher in patient without RVI Group B, while random blood sugar levels were higher in Group A. The incidence of cardiogenic shock (44.7% p=0.002) and atrioventricular blocks (21.1%, p=0.002) was also higher in Group A which attributed to this mortality. This study identified RVI as a significant independent predictor (OR=15.869, p=0.001) of hospital mortality after adjusting the other risk factors.*
Conclusion: *RVI significantly increases the risk of adverse in-hospital outcomes in patients with IWMI. These findings emphasize the importance of early recognition and targeted intervention for RVI to improve the prognosis of IWMI patients. The study underscores the need for heightened awareness and appropriate management strategies for this high-risk subgroup.*
Keywords: *Right Ventricular Infarction, Inferior Myocardial Infarction, Hospital Mortality, Cardiogenic Shock, Acute Coronary Syndrome.*

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I. Introduction

Coronary heart disease (CHD) stands as a leading cause of mortality and a major public health challenge for both developed and developing countries. The most serious clinical manifestation of coronary artery disease, acute myocardial infarction (AMI), accounts for substantial annual mortality rates worldwide. The global burden of cardiovascular disease (CVD) has significantly increased, with estimates indicating around 523 million cases reported in 2019. Concurrently, deaths attributed to CVD have also risen to about 18.6 million by 2019 [1]. In the last two decades, 75% of deaths caused by coronary heart disease (CHD) have taken place in countries with low to middle-income countries [2].

Among all sites, inferior wall myocardial infarction (IWMI) is typically associated with a favorable prognosis due to the smaller myocardial area at risk but the involvement of the right ventricle infarction significantly alters this outlook leading to increased mortality. Earlier studies have shown that approximately one-third of acute IWMI patients present with RVI [3].

RVI can lead to a significant mortality with IWMI as right ventricle has a vital role in preserving appropriate cardiac output. Impairment of the RV, which pumps venous blood into the pulmonary circulation, can cause a decrease in left ventricular preload and consequent hypotension. Furthermore, proximal right coronary artery blockage, which can potentially impact the atrioventricular (AV) node and result in arrhythmias and heart blocks, is a common cause of right ventricular arrest. When combined, these factors greatly impair the patient's hemodynamic status, raising the possibility of cardiogenic shock and, eventually, death-especially if the condition is not identified and treated quickly.

RVI has a significant predictive influence in the setting of inferior wall LV MI, albeit it does not correspond to the mortality rates reported in anterior wall LV MI. According to Zehender et al. (1993), RV involvement has a negative predictive value and is associated with a higher risk of major in-hospital complications [4]. High mortality rate has been reported in patients with cardiogenic shock due to RVI, despite seemingly favorable clinical parameters.

Understanding the outcomes and identifying predictors for right ventricular infarction (RVI) is crucial because of the unique challenges RVI presents while accompanying IWMI. Identifying predictors for RVI allows for earlier recognition and tailored interventions to mitigate its high-risk complications, such as cardiogenic shock and AV block. Knowledge of these predictors aids clinicians in stratifying patients based on their risk and optimizing care, which is essential for improving survival rates and reducing the morbidity associated with this condition.

Against this backdrop, this study aimed to compare the outcome and complications of patients with IWMI, both with and without RVI, contributing to a more profound understanding of this cardiac event and improving patient outcomes. Given the profound implications of RVI on patient survival and the potential for hemodynamic deterioration, this study elucidated the outcome and mortality associated with RVI in acute IWMI. It aimed to compare the in hospital major complications in patients with IWMI, both with and without RVI which is essential for the patient monitoring, the administration of initial fluid and appropriate antiarrhythmic treatments.

II. Methods

Study participants selection: This prospective study was conducted at the Department of Internal Medicine and Cardiology, Rajshahi Medical College Hospital, from July 2020 to June 2021. A purposive sampling technique was utilized to select 120 patients. Inclusion criteria were a recent onset of chest pain, electrocardiographic changes suggestive of inferior wall infarction, and raised cardiac enzyme levels. Patients with prolonged chest pain, other myocardial infarction, pericarditis, left bundle branch block, chronic lung disease, and a previous myocardial infarction.

Participants were categorized into two cohorts: Group A consisted of patients who had an inferior myocardial infarction (MI) accompanied by right ventricular infarction (RVI), while Group B included those who had an inferior MI without evidence of RVI.

Sample size calculation: In this research, the sample size was calculated considering the anticipated probabilities of key outcome. A mortality rate of Acute Inferior Myocardial Infarction with RV Infarction, estimated at 16%, and Acute Inferior Myocardial Infarction without Right Ventricular Infarction, estimated at 3.5% were used [5].

The calculated sample size was determined to be 116, indicating the minimum number of participants needed for the research. A total of 120 patients were decided to be included in the study where Group A included 38 patients with RVI and Group B comprised 82 patients without RVI.

Diagnosis and definitions of the patient:

Inferior STEMI was defined by symptoms produced due to occlusion of the right coronary artery, or less commonly the left circumflex artery, leading to infarction of the inferior wall of the heart. Inferior STEMI displays ST-elevation in leads II, III, and aVF [6]. Right ventricular infarction was identified when there was ST segment elevation of greater than 0.1 mV (1 mm) in any one or more of the leads V3R or V4R [7].

Study procedures:

In the assessment of myocardial infarction, this study ensured the immediate recording of a 12-lead ECG upon patient admission. Additional ECG focusing right-sided precordial leads was done for those presenting symptoms with inferential wall infarction. All participants were stratified into two cohorts: Group A, exhibiting ST segment elevation in V4R or V3R suggestive of right ventricular (RV) infarction, and Group B,

presenting with an isoelectric ST segment in the same leads, indicating absence of RV infarction. Serial ECG monitoring at admission, 6 hours, 12 hours, until the ST segment turned to isoelectric in the right precordial leads. ECGs were also repeated responsively to any reports of chest pain. For patients who have been treated with thrombolytic therapy, post-thrombolytic ECG evaluations were conducted 90 minutes following treatment.

In addition, patients were undergone some diagnostic imaging including two-dimensional (2D), M-mode, and Doppler echocardiography. Echocardiography was performed within 72-hour from the onset of chest pain, focusing on the left ventricular ejection fraction (LVEF) and the presence of any mechanical complications. Additionally, the right ventricular function was assessed using the biplane Simpson's method in apical four-chamber view and other view.

Data collection: Data were collected using a semi-structured questionnaire covering socio-demographic characteristics, clinical characteristics, biochemical parameters, and hospital outcomes. Data regarding demographic profile (age, sex, height, weight), clinical profile (pulse, blood pressure, New York Heart Association (NYHA) functional class, cardiogenic shock, arrhythmia, heart block), risk factor profile (smoking, hypertension, diabetes mellitus (DM), dyslipidemia & known family history of heart diseases, medications (present and recent use of drugs) were recorded.

Outcome of the patient:

The study evaluated a number of important outcomes for acute Inferior MI in both groups. These included the length of hospital stay, the incidence of arrhythmia, hypotension, cardiogenic shock, in hospital mortality and development of heart failure.

Data analysis: Statistical analyses were performed using SPSS version 23 (IBM Corp., Armonk, NY). Continuous variables were described using means and standard deviations, while categorical variables were expressed as frequencies and percentages. Chi-square and independent samples t-tests were applied for categorical and normally distributed continuous variables, respectively, with the Mann-Whitney U test for non-normally distributed data. Logistic regression analysis were carried out to determine the predictors for in-hospital mortality, with a significance level set at $p<0.05$. Statistical significance was set as 95% confidence level.

Ethics Statement: The study received approval from the Ethical Review Committee of Rajshahi Medical College Hospital (RMC/IRB/2020/20—24/73). Informed consent was obtained from all subjects, documented in writing to affirm their voluntary participation and understanding of the study's scope and procedures. Confidentiality was maintained to participant identities and personal data, ensuring restricted access to authorized personnel only.

III. Result:

In this prospective study conducted at the cardiology department of Rajshahi Medical College Hospital, 120 patients with acute inferior wall myocardial infarction (IMWI) were categorized into two groups based on the presence of right ventricular infarction (RVI). Group A included 38 patients with RVI, while Group B comprised 82 patients without RVI. Demographically, the majority of the patients were in between the 51-60 years, with a significantly higher mean age in Group A (62.42±8.89 years) compared to Group B (57.41 ± 8.94 years). The study population was predominantly male in both groups. A notable finding was the higher mean body mass index (BMI) in both Group A (29.93 ± 0.62) and in Group B (29.32 ± 0.88). Risk factors such as smoking, diabetes mellitus, hypertension, dyslipidemia, and family history of coronary artery disease were similarly distributed across both groups **(Table 1).**

Table 1: Basic characteristics of study participants (n=120)

	Group A IMWI with RVI n=38 (%)	Group B IMWI without RVI n=82 (%)	p value
Age group (years)			
≤50	4 (10.5)	24 (29.3)	
51-60	13 (34.2)	29 (35.4)	0.013*
61-70	12 (31.6)	24 (29.3)	
>70	9 (23.7)	5 (6.1)	
Mean±SD	62.42 ± 8.89	57.41 ± 8.94	0.003**
Sex			
Male	26 (68.4)	52 (63.4)	0.6*
Female	12 (31.6)	30 (36.6)	

BMI (kg/m²)	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
Dyslipidaemia	25(65.8)	44(53.7)	0.2
Family history of coronary artery disease	24(63.2)	40(48.8)	0.14

Chi square test* and **Independent student t test was performed to compare between two groups
Group A: patients with Inferior wall myocardial infarction+ Right Ventricular infarction
Group B: patients with Inferior wall myocardial infarction only.

Clinically, Group A patients had significantly lower heart rate (82.47± 7.43 vs 89.85± 6.42 bpm) , systolic BP (96.8±4.72 vs 119.5±4.8 mmHg) and diastolic BP (66.6±3.27 vs 78.3±2.4 mmHg) compared to group B patients ($p<0.05$). Laboratory findings showed that Troponin-I levels were significantly higher in Group B, (4.06±1.4 vs 0.99±0.14 ng/mL, $p<0.001$) while random blood sugar levels were higher in Group A (233.8±19.6 vs 205±6.5 mg/dL , $p<0.001$) **(Table 2).**

Table 2: Clinical features and laboratory investigations of study population (n=120)

Clinical Signs	**Group A n=38**	**Group B n=82**	**p value***
	Median	**Median**	
Heart rate (bpm)	81.50	92.00	< 0.001
Systolic BP (mmHg)	96.50	120	< 0.001
Diastolic BP (mmHg)	66.50	78	< 0.001
Troponin I (ng/ml)	0.95	4.01	< 0.001
Random Blood Glucose (mg/dL)	240.3	205.2	< 0.001

*Independent samples Mann-Whitney U test was performed to compare between two groups
Group A: patients with Inferior wall myocardial infarction+ Right Ventricular infarction
Group B: patients with Inferior wall myocardial infarction only.

The study revealed a significantly higher hospital mortality rate in Group A (23.7%) compared to Group B (3.7%). Additionally, Group A patients exhibited a higher prevalence of complications, such as cardiogenic shock (44.7% vs. 18.3%), atrioventricular blocks (21.1% vs. 3.7%), and arrhythmias (39.5% vs. 22%), though the incidences of post-myocardial infarction angina and ventricular tachycardia were less variable between the groups

In terms of hospital outcomes, Group A had a higher incidence of complications and a significantly higher mortality rate. However, the average hospital stay was shorter in Group A (3.47±1.1 days) than in Group B (4.24±1.03 days) **(Table 3)**.

Table 3: Complications and in hospital mortality of study participants

	Group A IMWI with RVI n=38 (%)	**Group B IMWI without RVI n=82 (%)**	**p value**
Heart failure (NYHA functional status)			
Class II	39.5	45.9	0.8*
Class III	50	43.1	
Class IV	10.5	11	
Post myocardial infarction angina	8 (21.10)	15 (18.30)	0.7*
Ventricular Tachycardia	1 (2.60)	6 (7.30)	0.3*
Cardiogenic shock	17 (44.7%)	25 (18.3%)	0.002*
Atrioventricular block	8 (21.1%)	3 (3.7)	0.002*

hypotension	9 (23.7)	12 (14.6)	0.2*
Other arrythmia	15 (39.5)	18 (22)	0.05
Outcome: In hospital mortality	9 (23.7)	3 (3.7))	<0.001*

Chi square test* was performed to compare between two groups
Group A: patients with Inferior wall myocardial infarction+ Right Ventricular infarction
Group B: patients with Inferior wall myocardial infarction only.

Multivariate logistic regression analysis showed that right ventricular infarction was the significant independent predictors of hospital mortality (OR=15.869, p-value 0.001) after adjusting for age, gender, smoking, diabetes, hypertension and dyslipidemia. The study highlighted the importance of assessing all IMWI patients with immediate right-sided ECG and emphasized comprehensive treatment and immediate management to reduce mortality and morbidity **(Table 4)**.

Table 4: Multivariate analysis of factors for predictors for hospital mortality (n=120)

Variables	Odds ratio	95% CI		p value
		Lower	Upper	
Age >60 years	0.378	.081	1.766	0.216
Male	1.116	.138	9.051	0.918
Smoking	1.504	.179	12.647	0.707
Diabetes Mellitus	.453	.106	1.933	0.285
Hypertension	1.217	.272	5.452	0.797
Dyslipidemia	.304	.052	1.765	0.184
Presence of right ventricular infarction	15.869	3.095	81.375	0.001**

IV. Discussion

Right Ventricular Myocardial Infarction (RVMI) complicates the clinical course of inferior myocardial infarction (MI), significantly increasing in-hospital mortality and morbidity. This study sheds light on the prognostic impact of RVMI in patients with acute inferior MI. Right ventricular infarction is a strong predictor of hospital mortality and was associated with several complications, including cardiogenic shock, arrythmia etc.

The age distribution between the cohorts indicates a statistically significant higher mean age in the RVI group (Group A) compared to the non-RVI group (Group B). This finding is in line with established research suggesting that older age is associated with a greater risk of adverse cardiovascular events, presumably due to the progressive decline in cardiac function and increased comorbidity burden with advancing age [8].

Despite a slight male predominance in both groups, the sex distribution was not significantly different, indicating that gender did not play a major role in the occurrence of RVMI in the context of inferior myocardial infarction. Biological differences play a significant role, where the protective effects of endogenous oestrogens in premenopausal women contribute to a lower risk of atherosclerosis and subsequently CVD [9]. However, Women's health issues often receive less priority, which may result in underdiagnosis or late presentation of CVD in females. Body Mass Index (BMI) shows a statistically significant difference ($p < 0.001$), with Group A having a slightly higher mean BMI, which could imply a correlation between higher BMI and RVMI incidence, reflecting the well-established link between obesity and mortality of cardiovascular disease [10,11,12]. However, we found that body mass index (BMI) had a significant, albeit complex, association with outcomes. While obesity is a known risk factor for cardiovascular morbidity, the 'obesity paradox'—lower mortality risk in overweight individuals—was also evident in earlier study [12]. The present study also represents there's no such association found between higher body mass index (BMI) and in hospital adverse outcomes such as mortality risk.

In terms of risk factors, there was no significant difference between the two groups regarding smoking, diabetes, hypertension, dyslipidaemia, and family history of coronary artery disease suggesting that these factors are equally distributed among RVMI patients. However, the lack of significant differences in these risk factors also points to the potential for other, less well-understood variables to contribute to the occurrence of RVMI.

The comparison of clinical signs between Group A and Group B reveals statistically significant differences in heart rate and blood pressure, indicating a more compromised hemodynamic state in those with RVI. Specifically, Group A exhibited a notably lower mean heart rate, mean systolic blood pressure compared

to Group B. The presence of these clinical features of RV involvement in inferior MI is a strong predictor of increased morbidity and mortality due to their direct correlation with patient prognosis. RV infarctions can exacerbate the hemodynamic instability typically associated with inferior MI, leading to unique clinical presentations such as hypotension, bradycardia, and jugular venous distension, which may not respond to conventional MI therapies. Recognizing these features is crucial for initiating appropriate management strategies, such as volume loading and the use of inotropic support, which are tailored to the specific challenges of RV dysfunction.

Our study demonstrated a significant elevation in mean random blood glucose (RBG) levels upon admission in patients with right ventricular infarction (RVI) (233.8±19.6 mg/dL) compared to those without RVI. This finding is consistent with existing literature that identified hyperglycemia as a significant predictor of increased mortality [13]. The pathophysiological mechanism underlying this association may involve hyperglycemia-induced insulin deficiency, which necessitates a metabolic shift in myocardial energy substrate from glucose to free fatty acids. This metabolic response may impair myocardial contractility and predispose to cardiac pump failure and arrhythmias, underscoring the prognostic significance of elevated RBG in AMI.

Furthermore, we observed that mean troponin I levels were significantly higher in patients without RVI (Group B: 4.06±1.4 ng/ml) compared to those with RVI (Group A), which could reflect the extent of myocardial damage. Although troponin I is a well-established marker for myocardial injury, its elevation alone did not correlate with adverse outcomes in our study. Instead, the incidence of RMI appeared to be a more reliable predictor of hospital mortality, as supported by previous studies.

Our study revealed that post-myocardial infarction angina rates did not differ significantly between the two groups, indicating that the presence of RV infarction does not necessarily exacerbate this particular complication. However, the occurrence of cardiogenic shock and atrioventricular blocks was significantly higher in Group A, underscoring the clinical severity associated with RV involvement. The incidences of ventricular tachycardia, hypotension, and arrhythmias were statistically similar between the groups, which is in line with previous evidences [14].

our study identified that right ventricular infarction (RVI) as a significant independent predictor of hospital mortality, with an odds ratio of 15.869 (p=0.001), after adjusting for conventional risk factors such as age, gender, smoking, diabetes, hypertension, and dyslipidemia. While traditional risk factors such as advanced age, male gender, and comorbidities like diabetes mellitus and dyslipidemia were not independently associated with mortality in our study, the overwhelming influence of RVI underscores its critical role in patient prognosis. This reinforces the clinical imperative for early identification and aggressive management of RVI in patients with myocardial infarction to improve survival rates.

V. Limitations:

A relatively small sample size from a single medical center, is limiting the generalizability of the results. The purposive sampling technique poses a risk of selection bias, potentially affecting the representativeness of the study cohort. As the study was conducted in a government healthcare center, the outcomes may be influenced by specific clinical practices of respective center, which might not be applicable for specialized or private healthcare setting. Furthermore, the diagnostic tools used may not represent the most advanced or varied technologies available for the management of myocardial infarction. Future studies could address these limitations by incorporating a multicenter approach.

VI. Conclusion:

In conclusion, this study highlights the significant impact of right ventricular infarction on the outcomes of patients with acute inferior wall myocardial infarction. The presence of RVI is associated with increased in-hospital mortality and a higher incidence of cardiogenic shock and arrhythmias, underscoring the need for prompt diagnosis and specialized management. These findings underscore the clinical importance of considering RVI in the treatment strategy of inferior MI patients to improve their prognosis. Future research should focus on this area for better management of these patients.

Declarations:

Ethical Approval: The study received approval from the Ethical Review Committee of Rajshahi Medical College Hospital. Informed consent was obtained from all subjects, documented in writing to affirm their voluntary participation and understanding of the study's scope and procedures. Confidentiality was maintained to participant identities and personal data, ensuring restricted access to authorized personnel only

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