Original Article

Right Ventricular Infarction in Patients with Inferior Wall Myocardial Infarction and its Association with Various Risk Factors

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ABSTRACT

Background: Right ventricular infarction (RVI) is a significant complication of inferior wall myocardial infarction (IWMI), associated with increased mortality, cardiogenic shock, and ventricular arrhythmias. Despite its clinical importance, the detection and management of RVI remain challenging, underscoring the need for further investigation into its prevalence and associated risk factors.

Objective: This study aims to assess the prevalence of RVI among patients with IWMI and to identify the major risk factors contributing to the development of RVI, thereby providing insights into more effective management strategies.

Methods: A prospective descriptive study was conducted at a military hospital over a period of one year, involving 114 patients diagnosed with IWMI. Patients were screened for RVI using right-sided precordial leads in electrocardiograms. Data on demographics, risk factors, and clinical outcomes were collected. Statistical analyses, including chi-square and Student's t-tests, were employed to identify significant associations between RVI and potential risk factors.

Results: Of the 114 patients with IWMI, 42 (36.8%) were diagnosed with RVI. The mean age of participants was 53.17 ± 9.06 years, with a predominance of males (61.4%). Hypertension was identified as the most significant risk factor for RVI, with 65.2% of hypertensive patients developing RVI compared to 17.6% of non-hypertensive patients ($p < 0.001$). Other significant associations included smoking (56.7% of smokers had RVI, $p = 0.008$) and diabetes mellitus (58.3% of diabetics had RVI, $p = 0.014$), while gender and dyslipidemia were not statistically significant predictors.

Conclusion: The study highlights a substantial prevalence of RVI among patients with IWMI, with hypertension emerging as the most critical risk factor. These findings underscore the importance of comprehensive screening and management of hypertension and other modifiable risk factors in patients with IWMI to reduce the incidence of RVI and improve clinical outcomes.

Keywords: Right Ventricular Infarction, Inferior Wall Myocardial Infarction, Hypertension, Risk Factors, Electrocardiogram, Cardiogenic Shock, Ventricular Arrhythmias.

INTRODUCTION

Historically, the investigation into right ventricular infarction (RVI) was predominantly confined to postmortem analyses until recent clinical recognitions identified the right ventricle as a significant locus of acute myocardial injury. This realization emerged from a meta-analysis which underscored the considerable impairment of right ventricular function following an acute myocardial infarction (MI) affecting the inferior wall. This condition often leads to pronounced deterioration in blood circulation and a higher susceptibility to ventricular arrhythmias, thereby elevating the mortality rates among hospitalized patients (3). Consequently, the right ventricle, once an overlooked aspect of myocardial infarction studies, has now become a focal point of research, prompting a renewed interest in understanding the mechanisms and outcomes of RVI (4).

It is estimated that nearly half of the patients diagnosed with ischemic myocardial injuries exhibit some degree of right ventricular dysfunction (5). This condition is largely attributed to the shared blood supply between the posterior wall of the right ventricle and the inferior wall of the left ventricle by the right coronary artery (6). The involvement of the right ventricle, however, shows considerable variability, a factor attributed to several key elements. These include the inherently lower oxygen demands of the right ventricle, the existence of a well-developed collateral circulation system, the thin structure of the right ventricle which facilitates nutrient extraction directly from blood within its chamber, and the systolic compressive loads exerted by the left ventricle. These compressive loads create a protective effect, limiting the impact on the left coronary arteries and enhancing blood flow from the left to the right coronary arteries during ventricular contraction (8).

This study aims to delineate the prevalence of right ventricular infarction among patients with inferior wall MI and to identify the constellation of risk factors precipitating the involvement of the right ventricle. By doing so, this research seeks to augment the current understanding of RVI, thereby illuminating pathways for improved clinical management and patient outcomes in the context of myocardial infarction.

MATERIAL AND METHODS

A prospective descriptive study was conducted to investigate the incidence of right ventricular infarction (RVI) among patients with inferior wall myocardial infarction (MI). This research took place in the Department of Medicine at the Combined Military Hospital in Nowshera, covering a timeframe from May 2022 to April 2023. Participants included both male and female patients aged 40 to 80 years, diagnosed with inferior wall MI. Diagnosis was based on the patient's report of chest pain characteristic of cardiac origin, corroborated by electrocardiogram (ECG) changes and elevated cardiac enzymes. Specifically, inferior wall involvement was verified through ST segment elevation in leads II, III, and aVF. The study further assessed the presence of RVI, defined by ST segment elevation in the right chest leads V1, V2, V3r, and V4r. Exclusion criteria encompassed individuals with chronic obstructive pulmonary disease (COPD), a previous history of myocardial infarction, any prior cardiac surgery, or percutaneous coronary intervention (PCI).

The research protocol was rigorously reviewed by the hospital's research ethics committee to ensure compliance with ethical standards and the protection of patient rights, adhering to the Declaration of Helsinki principles. Upon securing ethical approval, the study proceeded with data collection, ensuring the confidentiality of patient information throughout the process.

Data was meticulously gathered from patients admitted to the coronary care unit who met the inclusion criteria. Initial registration captured baseline demographics such as age, gender, and duration of pain. A comprehensive history focused on the pain and any related symptoms was documented. Physical examinations were conducted to evaluate pulse rate, rhythm, and the presence of pulsus paradoxus, alongside blood pressure measurements to identify hypotension. Additional examinations included assessing jugular venous pressure (JVP), examination of the precordium, and the back of the chest. A 12-lead ECG was performed for all patients, with a specific focus on the right chest leads (V1, V2, V3r, V4r) to evaluate ST segment elevation indicative of right ventricular involvement. All data were systematically recorded on a designated proforma.

For the analysis, data were entered into SPSS version 25. Continuous variables were summarized as means ± standard deviation (SD), while categorical variables were expressed in frequencies and percentages. The heterogeneity of continuous data means was examined using the Student's t-test, whereas the chi-square test was employed for the comparison of categorical data. A p-value of ≤0.05 was considered statistically significant, ensuring that all analyses were conducted with a rigorous statistical methodology to ascertain the association between inferior wall MI and the occurrence of RVI, alongside the impact of various risk factors on this relationship.

RESULTS

In this study, a total of 114 patients diagnosed with inferior wall myocardial infarction were meticulously evaluated, among which 42 participants, accounting for 36.8%, were observed to have right ventricular infarction (RVI). The demographic analysis revealed an average age of 53.17 years among the participants, with a standard deviation of 9.06 years, highlighting a significant representation of middle-aged to older adults in this cohort. Notably, a majority of 68 participants (59.6%) were categorized within the age group of 40 to 60 years, while the remaining 46 patients (40.4%) fell into the 61 to 80 years age bracket. The distribution of RVI across these age groups indicated a slightly higher incidence in the younger cohort, with 26 out of 68 patients (38.2%) in the 40 to 60 years group experiencing RVI, compared to 16 out of 46 patients (34.8%) in the 61 to 80 years group. However, the difference in RVI occurrence between these age groups was not statistically significant, as evidenced by a chi-square statistic of 0.140 and a p-value of 0.707 (Table 1).

Gender-wise, the study had a greater proportion of male participants, with 70 out of the total (61.4%) being males, resulting in a male to female ratio of 1.6:1. Among these, RVI was significantly more prevalent in males, with 32 out of 70 male participants (45.7%)

exhibiting RVI, in contrast to 10 out of 44 female participants (22.7%) (Table 1). The statistical analysis underscored the significance of gender as a risk factor for RVI, with a chi-square statistic of 6.13 and a p-value of 0.013, denoting a statistically significant difference (Table 2).

Further scrutiny into risk factors revealed hypertension as a notable contributor to RVI occurrence. Out of the 46 patients identified with hypertension, a substantial 65.2% (30 patients) were found to have RVI, a stark contrast to the 17.6% (12 patients) RVI incidence among the 68 non-hypertensive patients. This association between hypertension and RVI was statistically significant, with a chi-square value of 26.7 and a p-value of less than 0.001 (Table 2), underscoring the critical impact of hypertension on the risk of developing RVI.

Table 1: General Characteristics of Participants

Characteristic	Total Participants (n=114)	Participants with RVI (n=42)	Percentage with RVI
Age Group 40-60 years	68	26	38.2%
Age Group 61-80 years	46	16	34.8%
Male	70	32	45.7%
Female	44	10	22.7%
Hypertension	46	30	65.2%
Non-Hypertension	68	12	17.6%
Smokers	30	17	56.7%
Non-Smokers	84	25	29.8%
Diabetes Mellitus	24	14	58.3%
Non-Diabetics	90	28	31.1%
Dyslipidemia	14	8	57.1%
Non-Dyslipidemia	100	34	34.0%

Table 2: Statistical Analysis of Risk Factors for RVI

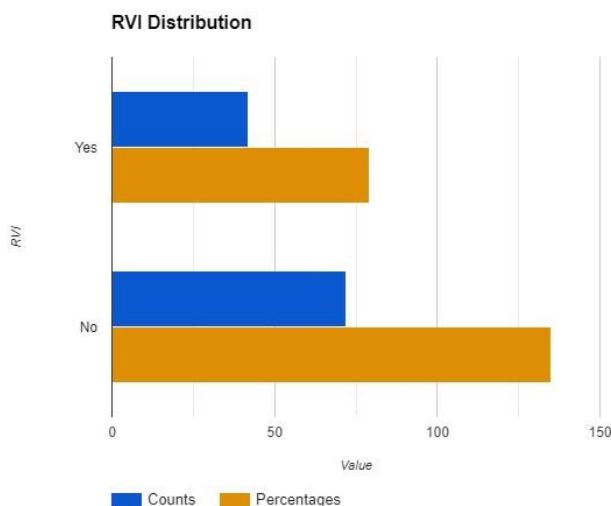| Risk Factor	Chi-Square Value	p-Value	Significance
Age	0.140	0.707	Not Significant
Gender	6.13	0.013	Significant
Hypertension	26.7	<0.001	Significant
Smoking	6.87	0.008	Significant
Diabetes Mellitus	-	0.014	Significant
Dyslipidemia	-	0.092	Not Significant

Figure 1 RVI Distribution

The analysis also delved into lifestyle factors such as smoking, revealing that 30 participants (26.3%) were smokers. Within this subgroup, 17 smokers (56.7%) were diagnosed with RVI, compared to 25 out of 84 non-smokers (29.8%), presenting a significant association with a chi-square value of 6.87 and a p-value of 0.008 (Table 2). Diabetes mellitus was another risk factor evaluated, with 24 patients (21.0%) testing positive. Among these, a higher prevalence of RVI was observed, with 14 diabetic patients (58.3%) exhibiting RVI, compared to 28 out of 90 non-diabetics (31.1%), yielding a statistically significant association (p-value of 0.014) (Table 2). Conversely, dyslipidemia, present in 14 patients (12.3%), did not show a statistically significant association with RVI, with 8 dyslipidemic patients

(57.1%) having RVI compared to 34 out of 100 non-dyslipidemic patients (34.0%), as the chi-square p-value was 0.092, indicating no significant difference (Table 2).

DISCUSSION

The findings of this study elucidate the clinical ramifications of right ventricular infarction (RVI) in the context of inferior wall myocardial infarction (IWMI), underscoring the heightened risk of severe outcomes such as mortality, cardiogenic shock, and ventricular rhythm disturbances associated with RVI. Previous research aligns with our observation, indicating that the dysfunction of the right ventricle significantly contributes to the adverse prognosis in patients with RVMI (9). This study advocates for the inclusion of right-sided precordial leads in electrocardiograms (ECGs) for all patients presenting with acute IWMI, a practice that diverges from the current approach of limiting this measure to those suspected of extensive infarctions. Implementing this broader screening strategy could facilitate the early identification of individuals with RVMI, who are at an increased risk for critical complications, thereby potentially justifying the adoption of more aggressive therapeutic measures.

Despite the advancements in understanding acute clinical presentations, the long-term clinical consequences of RVI remain largely obscure (10). Emerging evidence suggests that RVI could serve as a predictor for severe in-hospital complications and might even be an independent risk factor for long-term mortality (11). Furthermore, patients with RVMI are thought to be particularly susceptible to developing right heart failure, a postulation that warrants further investigation through long-term follow-up studies to elucidate this relationship more clearly (12).

The subgroup of patients presenting with IWMI and concurrent RVI, especially those who develop cardiogenic shock, has drawn particular attention due to their notably worse prognosis (13). Our study reported a low mortality rate among patients with cardiogenic shock attributable to RVI, emphasizing the critical nature of early detection and management in these cases. Effective management strategies for RV infarction, especially when accompanied by haemodynamic instability, include the careful administration of inotropic agents and measures aimed at reducing right ventricular afterload, such as the utilization of aortic balloon counterpulsation and vasodilators like sodium nitroprusside. Reperfusion strategies, including thrombolytic therapy or direct angioplasty, play a pivotal role in treatment protocols (15). Additionally, maintaining atrio-ventricular synchrony through AV sequential pacing in the event of complete heart block, and prompt cardioversion for atrial fibrillation and ventricular arrhythmias, are crucial interventions (16-19).

The investigation revealed that approximately one-third of patients with IWMI also experienced RVI, highlighting the importance of identifying risk factors in such patients to determine those at heightened risk for developing RVI. Among the risk factors analyzed, hypertension emerged as the most significant predictor for RVI, suggesting that timely intervention for hypertension and other risk factors could mitigate the incidence of RVI and its associated complications (20).

This study's strengths lie in its systematic approach to identifying and analyzing the prevalence and risk factors of RVI in IWMI patients, providing valuable insights that could enhance clinical outcomes. However, limitations include its single-center design, which may restrict the generalizability of the findings. Additionally, the study did not encompass a long-term follow-up to assess the chronic implications of RVI. Future research should focus on multi-center studies to validate these findings across diverse populations and incorporate long-term follow-up to explore the chronic effects of RVI on patient health and survival. Moreover, further studies are recommended to evaluate the efficacy of the proposed management strategies for RVI, especially in the context of reducing long-term mortality and preventing the progression to right heart failure.

CONCLUSION

This study's findings illuminate the significant occurrence of right ventricular infarction (RVI) in a third of patients with inferior wall myocardial infarction (IWMI), underscoring the critical need for early detection and intervention. Particularly, hypertension emerged as a notable risk factor for RVI, highlighting the importance of managing this and other risk factors to potentially reduce the incidence of RVI and alleviate associated complications. The clinical implications of this research emphasize the necessity for healthcare providers to incorporate comprehensive screening and proactive management strategies in the care of IWMI patients to improve outcomes and mitigate the risk of severe sequelae associated with RVI, thus enhancing patient care and outcomes in the realm of cardiac health.

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