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Right ventricular myocardial infarction: A Review of 17 Cases

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Abstract

Right ventricular myocardial infarction (RVMI) is a rare but significant complication of inferior myocardial infarction (IMI), characterized by a sudden decrease in right ventricular function, which can lead to hemodynamic instability. This can range from mild dysfunction to severe hypotension, cardiogenic shock, and sudden cardiac death. RVMI is most often linked to occlusion of the right coronary artery (RCA), though it can also occur in the case of proximal left anterior descending (LAD) artery occlusion, particularly in large anterior infarctions.

Diagnosis can be challenging, as the electrocardiographic changes may be subtle or transient. The 12-lead ECG is the primary diagnostic tool, with right precordial leads (V3R and V4R) helping to improve sensitivity. Echocardiography, especially Doppler imaging, plays a crucial role in assessing right ventricular function and detecting complications like pericardial effusion and tricuspid regurgitation.

Treatment involves dual antiplatelet therapy, anticoagulation, and statins, with early reperfusion (thrombolysis or primary PCI) being key to improving outcomes. Volume resuscitation through intravenous fluids helps stabilize patients by ensuring adequate right ventricular preload.

The prognosis of RVMI depends on the severity of dysfunction, timely intervention, and the presence of complications. If treated promptly, patients can have favorable long-term outcomes, although delayed treatment or severe hemodynamic instability can lead to higher mortality. Further studies are needed to optimize management and understand long-term outcomes, particularly in patients with extensive infarctions or comorbidities.

Objective: The objective of the study is to describe the epidemiological, clinical, electrocardiographic, echocardiographic, and angiographic characteristics of myocardial infarction with right ventricular involvement, as well as its complications and therapeutic modalities.

Keywords: Right Ventricular Myocardial Infarction; TTE; Coronary Angiography; Coronary Angioplasty

1. Introduction

Coronary artery disease remains one of the leading causes of morbidity and mortality worldwide. While left ventricular myocardial infarction has been extensively studied, right ventricular myocardial infarction (RVMI) was only recognized as a distinct entity much later, in 1974 [1]. Isolated RVMI is rare [2, 3, 4] and is frequently associated with inferior-posterior MI, occurring in approximately one-third of patients [2, 5]. This association is linked to increase in-hospital morbidity and mortality due to hemodynamic and rhythm complications [4]. The culprit lesion is most often a proximal right coronary artery occlusion [2, 4, 6, 7]. However, the right ventricle is relatively resistant to infarction and can recover even after prolonged occlusion [8].

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Through this study, we aim to explore the epidemiological, clinical, electrocardiographic, echocardiographic, and angiographic characteristics of myocardial infarction with right ventricular involvement, along with its complications and therapeutic approaches.

2. Materials and methods

This is a retrospective, descriptive, single-center study conducted over a one-year period. It includes patients hospitalized in the Cardiology Department A of the Ibn Sina University Hospital Center in Rabat for left heart myocardial infarction extending to the right ventricle.

Patients of all ages, both male and female, were selected if they were hospitalized for left heart myocardial infarction, primarily involving the inferior wall of the left ventricle (LV), with electrocardiographic or echocardiographic criteria confirming right ventricular (RV) involvement. Patients with isolated inferior LV myocardial infarction without RV involvement were excluded.

The objective of the study is to describe the epidemiological, clinical, electrocardiographic, echocardiographic, and angiographic characteristics of myocardial infarction with right ventricular involvement, as well as its complications and therapeutic modalities.

3. Results

Between January 2018 and December 2019, 65 patients were admitted to the cardiology department A for a myocardial infarction of inferior topography, including 17 with an extension to the right ventricle, representing a frequency of 26.14%. 08 of them presented to the emergency in an array of acute coronary syndrome while 09 other patients arrived after the early revascularization deadlines.

The age of our patients is between 46 and 82 years old with an average of 62 years old. The peak frequency is between 60 and 70 years.

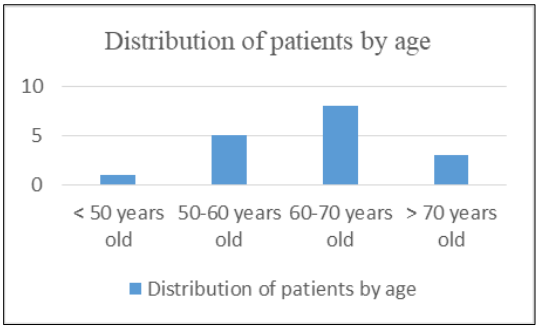

Figure 1 Distribution of our patients by age groups

Men constitute 82% of the population studied, while the frequency of women is 18% with a sex ratio M/F of 4.6.

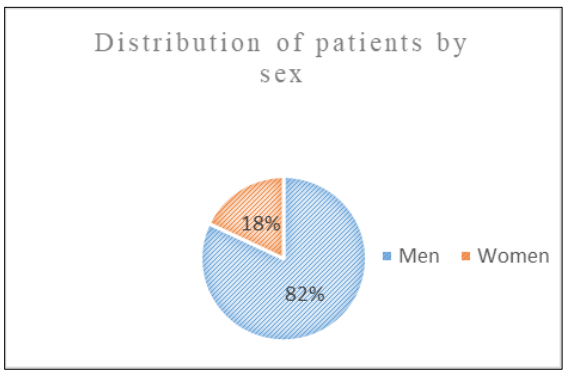

Figure 2 Distribution by Sex

The cardiovascular risk factors sought in our patients are: Hypertension (58%), Diabetes (52%), Smoking (70%), Dyslipidemia (11%), Obesity (5%) and Coronary heredity is found in 5%.

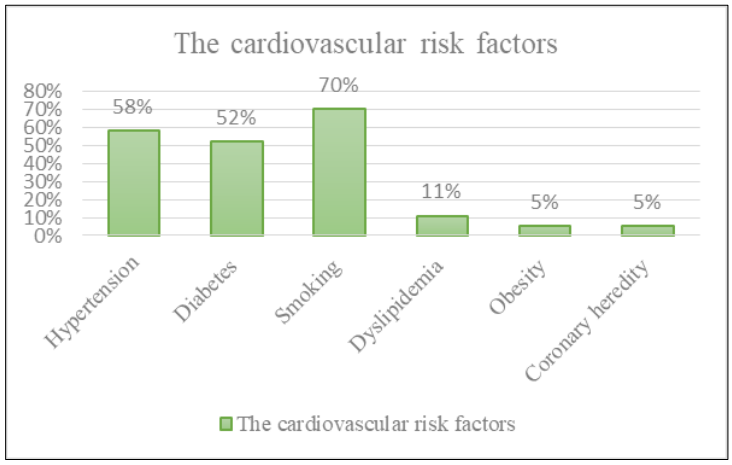

Figure 3 Distribution of the cardiovascular risk factors

About the Clinical profile of our patients a typical infarctoid chest pain was found in 76% and for the rest of the patients had atypical pain.

The clinical examination of our patients at admission revealed that 01 patient showed signs of right heart failure, 01 patients showed signs of left heart failure and 0 3 patients were admitted in an array of shock.

The ECG, done in all the patients on admission with realization of the right leads in only 9 of them, showed:

Table 1 Distribution of Patients According to ECG Abnormalities

ECG Abnormalities	**Number of patients**	**Percentage**
Repolarization disorders:		
ST segment elevation in V3R and V4R	9	52%
ST-segment elevation in DII, DIII, AVF	12	70%
ST segment elevation in V1 V2	1	5%
Arrhythmias:		
Ventricular Tachycardia	1	5%
Conduction disorders:		
2nd degree AV Block	1	5%
3rd degree AV Block	1	5%
Left Bundle Branch Block	2	

Doppler echocardiography was performed in all patients. The results demonstrated:

- Left ventricular ejection fraction (LVEF) was impaired in 8 patients (47%).
- Right ventricular systolic function was impaired in 9 patients (52%), primarily based on TAPSE and tricuspid S-wave parameters.
- Right ventricular segmental wall motion abnormalities:
    - Akinetic lateral wall of the RV (3 patients)
    - Akinetic inferior wall of the RV (1 patient)
    - Akinetic anterior wall of the RV (1 patient)
- Pericardial effusion was present in 1 patient.

- Doppler studies revealed tricuspid insufficiency in 3 patients.

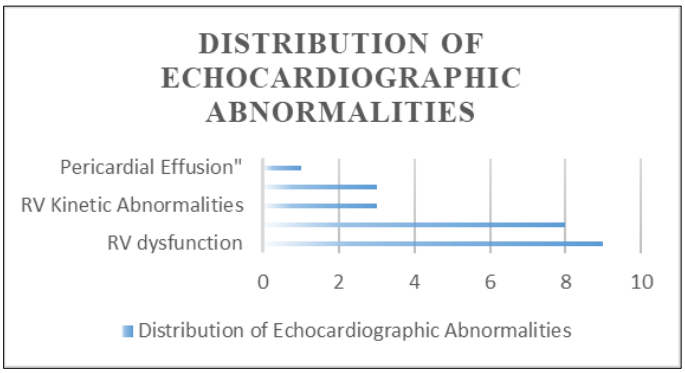

Figure 4 Echocardiographic Abnormalities

Sixteen patients were referred for coronary angiography. The various lesions identified are summarized in the following diagram:

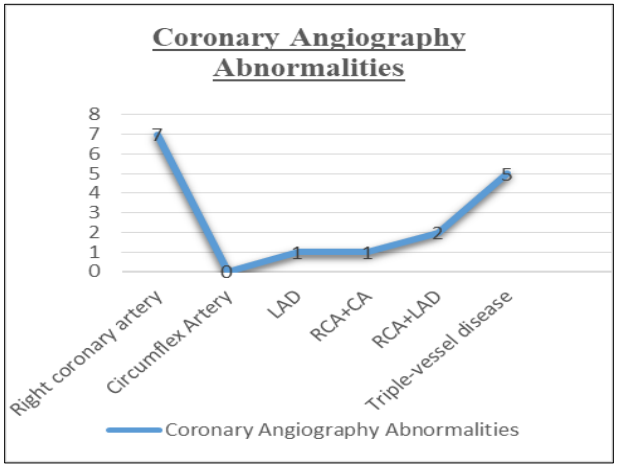

Figure 5 Coronary Angiography Abnormalities

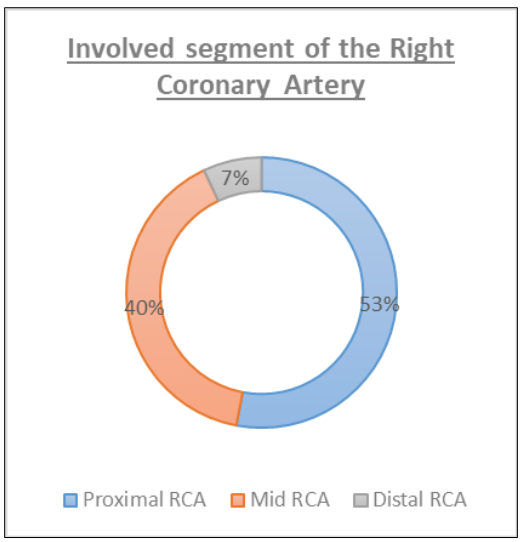

Figure 6 Involved segment of the RCA

Regarding therapeutic management, all patients received dual antiplatelet therapy, low-molecular-weight heparin, and a statin. Thrombolysis with Metalyse was indicated in three patients, while five patients required vascular filling. Dobutamine was administered to three patients, and atropine was used in one patient. Angiotensin-converting enzyme inhibitors (ACEIs) were prescribed for 14 patients, whereas beta-blockers (BBs) were administered to 10 patients.

Coronary angioplasty was performed in seven patients following coronary angiography. Additionally, one patient received an electro systolic pacing probe.

Only one patient underwent coronary artery bypass grafting

Only one patient succumbed during hospitalization due to a high-degree conduction disorder. Hemodynamic instability was observed in three patients, all of whom were successfully stabilized with medical therapy. Additionally, two patients experienced rhythm complications.

The length of hospital stay varied between 1 and 22 days, with an average duration of 8 days.

4. Discussion

Isolated RVMI is rare, with an incidence ranging from 0.5% to 2%. However, biventricular involvement is more common, not in anterior MI, where it is observed in only 5% of cases, but in posterior MI (inferior, infero lateral, infero basal), where it is present in 30% to 50% of cases. In our study, biventricular involvement was observed in all patients, with no cases of isolated RV infarction identified. Additionally, RVMI is associated with approximately 26% of inferior left ventricular infarctions, a finding consistent with various global studies [9]. Smoking was the most prevalent cardiovascular risk factor among our patients, followed by hypertension and diabetes, aligning with the study by S. Khan et al. [10], which also reported a marked male predominance.

Table 2 Comparative table of the incidence of FDR Cvx in two groups of patients in the S.KHAN study [10]

Risk factors (total number of patients)	**Groupe I (RVMI)* [%(n)]**	**Groupe II (RVMI)** [%(n)]**	**p-value**
Smoking (42)	39.4 (26)	47.1 (16)	Not significant
Hypertension (32)	34.8 (23)	26.5 (9)	Not significant
Diabetes mellitus (21)	18.2 (12)	26.5 (9)	Not significant
Family history of premature IHD(15)	18.2 (12)	8.8 (3)	Not significant
Hyperlipidemia (22)	19.7 (13)	26.5 (9)	Not significant
*Total number = 66 **Total number = 34 IHD: Ischemic heart diseas; RVMI: Right ventricular myocardial infarction			

In our study, smoking, diabetes and hypertension were on the same footing with an average incidence of 60%, the other risk factors were rarely found.

The presentation of concurrent RVMI and inferior MI does not significantly differ from isolated inferior MI. All patients presented to the emergency department with typical infarct-like chest pain, consistent with acute coronary syndrome, with or without ST-segment elevation. In some cases, patients arrived at a late stage when the early reperfusion phase had already passed, with post-MI findings observed in 52% of cases. Furthermore, three patients presented in cardiogenic shock, requiring specific management [11].

The electrocardiographic diagnosis of RVMI relies primarily on detecting ST-segment elevation in right precordial leads (V3R and V4R) [12]. In our study, we encountered incomplete ECG recordings, with only 9 patients (52%) presenting with inferior MI undergoing right-sided lead recordings, revealing ST-segment elevation of at least 1 mm.

On a standard 12-lead ECG, less frequent and non-specific electrical signs may be observed. However, these findings can suggest right ventricular involvement, as previously described in the theoretical section and illustrated in the ECG of one of our patients [13].

Transthoracic echocardiography (TTE) is now a key bedside tool for the positive diagnosis of biventricular infarction, differential diagnosis, and the detection of complications. In two-dimensional echocardiography, the following findings are indicative of RVMI [14-22]:

- **Right ventricular dilation**, with an increased RV/LV diameter ratio.
- **Segmental wall motion abnormalities**, typically akinesia of one or more RV walls (the infarcted area also appears thinned and echogenic in later stages).
- **Paradoxical motion of the inter ventricular septum.**
- **Interatrial septal shift toward the left atrium** due to elevated right atrial pressure.
- **Inferior vena cava dilation** (>18 mm) with loss of inspiratory collapse.
- **Reduced right ventricular fractional area change** (<50%) in the apical four-chamber view.

Echocardiography also facilitates the detection of complications and the exclusion of differential diagnoses.

In our study, echocardiographic findings suggestive of RVMI were predominantly right ventricular systolic dysfunction, observed in 9 patients, and segmental wall motion abnormalities in 3 patients.

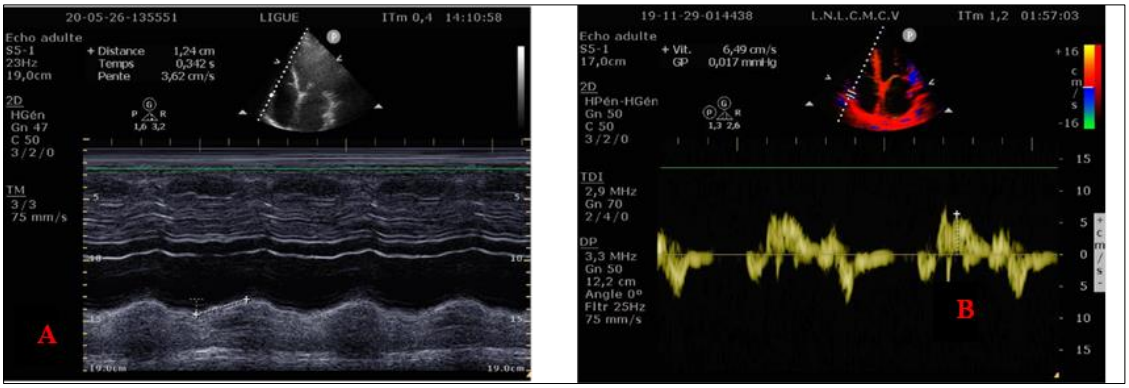

Figure 7 Echocardiographic images demonstrating a reduced TAPSE (Image A) and impaired tricuspid S-wave on tissue Doppler imaging (Image B)

On angiographic evaluation, the right coronary artery is the culprit in 94% of cases, with 53% of lesions located in the proximal RCA, which is consistent with the literature [7]. We also report a case of an extensive anterior myocardial infarction extending to the right ventricle due to a proximal left anterior descending artery occlusion, considered a rare association in the literature [7].

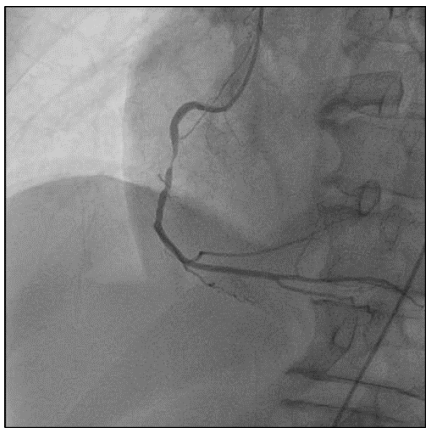

Figure 8 Coronary angiographic images showing a severe lesion in the right coronary artery in one of our patients

4.1. Therapeutic Management

Right Ventricular Myocardial Infarction is a cause of hypotension due to the sudden decrease in right ventricular systolic function. Immediate mortality is high in the absence of appropriate treatment (such as volume expansion and revascularization).

In our study, 3 patients received vascular filling, which corrected hypotension in these cases. The best treatment for RVMI, in addition to volume expansion, remains the earliest possible revascularization of the thrombotic artery using pharmacological (though the re-occlusion rate may be higher) or instrumental methods (primary angioplasty). This can quickly resolve the clinical symptoms and significantly improve the prognosis. In our series, 3 patients underwent thrombolysis, and 7 patients successfully underwent primary angioplasty

5. Conclusion

Between one-third and one-half of patients with inferior myocardial infarction experience complications due to RVMI, ranging from asymptomatic right ventricular dysfunction to severe hypotension, cardiogenic shock, and even sudden cardiac death. Diagnosing RVMI can be challenging; a 12-lead ECG, supplemented with right precordial leads, remains the primary diagnostic tool in the acute setting, although the findings may be transient. The physiology of the right ventricle makes it resistant to infarction, but acute ischemia can lead to significant hemodynamic consequences. Resuscitation with vascular filling to maintain adequate right ventricular preload remains the first-line treatment. Revascularization, preferably through primary percutaneous intervention, is the cornerstone in managing RVMI. Patients who survive the acute phase of RVMI generally have a favorable long-term prognosis.

Compliance with ethical standards

Disclosure of conflict of interest

The authors confirm that written consent for the submission and publication of this case, including images, has been obtained from the patients in line with the Committee on Publication Ethics (COPE) guidance.

Availability of Data and Materials

Data sharing is not applicable to this article as no datasets were generated or analyzed during the current study.

Author contribution

- MB: Study concept, Data collection, Data analysis, writing the paper.
- RL: Study concept, Data collection, Data analysis.
- RF: Study concept, Data analysis, writing the paper.
- NM: Supervision and data validation
- IA: Supervision and data validation
- AB: Supervision and data validation
- All authors reviewed the final manuscript.

Funding Sources

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Statement of informed consent

Written informed consent was obtained from the patients for publication of this cases report.

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