THE ELECTROCARDIOGRAPHIC PREVALENCE OF RIGHT VENTRICULAR INFARCTION IN PATIENTS WITH ACUTE INFERIOR ST-ELEVATION MYOCARDIAL INFARCTION

Hadi M.Abdullah [a], Hussain T.Fatah [b], and Kamaran Amin Omar [c]

Submitted: 4/12/2022; Accepted: 20/4/2023; Published: 21/12/2023

ABSTRACT

Background

Right ventricular myocardial infarction (RVMI) is associated with acute inferior STEMI in 30 to 50 % of cases and poor outcome of RVMI is usually related to profound hemodynamic and electrical complications, which occur in approximately 50 % of cases . In contrast, RVMI associated with anterior wall myocardial infarction in less than 10% of cases and isolated RV infarction is rare. It is the posterior RV wall that is most frequently involved in RV infarction and nearly always in association with left ventricular posterior and posteroseptal infarction .So right precordial leads (V4R & V5R) are recommended in patients with acute inferior STEMI, especially in the presence of hypotension and bradycardia.

Objective

To identify the prevalence of right ventricular infarction (RVI) in patients with acute inferior myocardial infarction (AIMI) within 24 hours of starting manifestations of infarction who got suitable precordial ECG and to detect associated risk factors that increase the risk of RVI in the setting of inferior MI in Sulaimani city/ Kurdistan region/Iraq.

Methods

One hundred patients with acute Inferior STEMI were included in the study. A simplified cardiovascular questionnaire was used, and a detailed physical examination and a standard 12-lead ECG, RPLs, and cardiac enzyme assay were carried out.

Results

Right Ventricular Infarction RVI was present in 39% of cases with acute inferior STEMI. The age group 50-59 years was most commonly affected (57.9%). Females more commonly have RVI than males. There was no significant difference between patients with RVI and non-RVI regarding residence and occupation. Both hypertension HT) and diabetes mellitus (DM) were the most dominant chronic diseases (55 % and 45 %, respectively).

Conclusion

Right ventricular infarction was found in 39% of patients with acute inferior STEMI. Right precordial leads (V4R & V5R) are recommended in patients with acute inferior STEMI, especially in the presence of hypotnsion and bradycardia.

Keywords: *Right Ventricular Infarction (RVI); Inferior STEMI; ECG.*

[a] Shar hospital,Slemani, Kurdistan Region, Iraq.
[b] Slemnai, Kuridstan, Kurdistan Region, Iraq.
[c] College of Science, University of Sulaimani, Kurdistan Region, Iraq.
Correspondence: kamaran.omer@univsul.edu.iq

https://doi.org/10.17656/jsmc.10433

INTRODUCTION

Blood supply to the inferior wall of the left ventricle may come from either the left circumflex artery, in about 8% of population, or the right coronary artery (RCA) in about 85% of population, termed "right dominant," meaning that the RCA provides a posterior descending artery branch to supply the inferior wall of the left ventricle, the remaining population is "Codominant": the blood supply is shared that is why ischemic changes in that region may be associated with left ventricular(LV), lateral wall ischemia or right ventricle RV ischemia [1-3].

Right ventricular myocardial infarction (RVMI) is associated with acute inferior STEMI in 30 to 50 % of cases [1-5], and Poor outcome of RVMI is usually related to profound hemodynamic and electrical complications, which occur in approximately 50 % of cases [6]. In contrast, RVMI is associated with anterior wall myocardial infarction in less than 10% of cases, and isolated RV infarction is rare [7].

The posterior RV wall is most frequently involved in RV infarction and nearly always in association with left ventricular posterior and posteroseptal infarction [8].

Several factors make the right ventricle less susceptible to infarction:

Lower oxygen requirements of the RV due to its smaller muscle mass and lower afterload. A greater total amount of blood flow is available due to greater coronary blood flow during both systole and diastole. More extensive collateralization of the RV, primarily from the left coronary system, and diffusion of oxygen from intracavitary blood through the thin wall of the RV.

Patients with RVMI may present with chest pain and sweating but less dyspnea in comparison to inferior MI without RV involvement (36% vs 68%) and are more likely to present with syncope (20% vs 6.7%) [9]. The clinical presentations of RVI vary widely. Therefore, patients with hemodynamic compromise will often have an elevated jugular venous pressure, usually 10 mm or more, with a positive Kussmaul's venous sign and clear lung fields, and in severe cases, systemic hypotension is present, and this may be a sign of tricuspid regurgitation[10].

The diagnosis of RVMI is strongly suspected when hypotension, raised jugular venous pressure and clear lung fields are present in patients whose 12 leads ECG showed an acute inferior wall infarction as well as ST-elevation in right precordial leads (RPL), (V3R-V6R) especially leads V4R and V5R [10], and there is greater ST elevation in lead III than in lead II has been suggested as a predictor of RVI. Approximately 80% of cases have echocardiographic evidence of RV dysfunction, and Echocardiography should be performed in patients with an inferior MI and evidence of hemodynamic compromise [11]. In the treatment of RVMI, the following steps should be taken into consideration: Using vasopressors, coronary intervention, Fibrinolysis therapy, and Morphine and because nitroglycerin is a vasodilator, it is contraindicated as a standard treatment or must be given with extreme care, so it is not a part of standard treatment [11].

MATERIAL AND METHODS

Hundreds of patients with inferior wall MI within 24 hours of starting symptoms were included in the study. All patients admitted to the coronary care unit (CCU) of Suleimani Centre for Cardiac Disease (CCU-SCCD) from May 2014 to January 2015 were enrolled in this cross-sectional descriptive study. Adapted localized questionnaires were used, a detailed physical examination was done in terms of the criteria for both inferior STEMI and RV infarction, and ECG was taken by ECG machine- MAC1600, GE,2014, and cardiac enzymes rapid strip Test- KIT (TnT, MYOGLOBIN, CKMB), estimation had been used. They were also evaluated for risk stratifications for ischemic heart diseases like smoking, gender, hypertension, diabetes mellitus, obesity, and alcohol, history of previous ischemic heart disease, and family history of cardiac disease. A standard 12-lead ECG, RPLs, and cardiac enzyme assay were carried out at the time of admission. The 12-lead ECG recordings were made at the standard calibration of 25 mm//second and amplitude of 1.0 mV),

(V4R and V5R) were applied on the right side of the chest on the areas where the leads corresponded on the left.

Statistical analysis

A statistical Package for Social Sciences (SPSS) software for Windows, version 18, US, was used. Descriptive statistics were presented as mean ± standard deviation (SD) for continuous variables and as frequencies (number) and percentages for categorical variables. Chi-square was used to compare frequencies

and percentages between any two groups, and the Fisher Exact Test was used if more than 20% of expected variables were less than five and a significance level of ≤ 0.05 was considered significant.

RESULTS

A total of one hundred Patients with inferior STEMI within 24 hours of onset of symptoms were included in this study with a mean age of 63±13 years; among patients with RVI, the age group between 50-59 years was the prevalent age group. Males 66 (66%) were more than 34 (34%) females, urban resident patients (53%) and rural residents (47%). Approximately two-thirds (71%) of studied patients were employed, and 29% were unemployed. (Table 1).

Medical and social history of IMI patients:

Both hypertension and diabetes mellitus were dominant chronic diseases (55% and 45%, respectively). Among smoking habits, 41 % of patients were smokers, 25 % of patients were positive for a family history of MI, and only 6 (6%) patients drank alcohol.

Among all patients included in this study, 20 patients (20%) had bradycardia (19 patients with RVI and one patient with non-RVI). Nineteen patients had hypotension (BP< 90/60 mmHg); of them, 18 patients with RVI, and one patient with non-RVI. All studied patients had standard respiratory rates.

ECG findings of inferior MI patients:

All patients had ST-elevation of at least 1 mm in inferior leads. Thirty-nine patients had 1 mm ST-elevation in V4R and V5R.

Signs of inferior MI

JVP elevation and Kassmual signs were present only in one patient and absent in 99 patients. Bilateral basal crackle was present in 7 patients, and Systolic murmur was detected in 4%.

Cardiac enzymes (Troponin, CKMB, and Myoglobin), onset of pain, and treatment options:

The 1st Cardiac enzymes were harmful among 36% of inferior MI; we did not perform the second and third tests because of economic difficulties, and they were positive in 64 patients (64%). The onset of pain to the therapy time was < 12 hours in 83 patients and ≥12 hours in 17 patients. No significant differences were observed between RVI patients and those with non-RVI regarding cardiac enzymes, onset of pain to therapy, and mode of revascularization (p>0.05).

The mode of revascularization is as follows

Twenty (20%) of the patients had just received conventional medical therapy; they had neither thrombolytic nor PCI, and the rest of the patients were treated with thrombolytic therapy (34%) and PCI therapy. (46%).

No significant difference in age was observed between patients with RVI and non-RVI (p=0.1), although RVI patients were prevalent among the age group 50-59 years (57.9%); on the other hand, MI with no RVI was prevalent among the age group 60-69 years. Females were significantly more prevalent to RVI than males (p=0.01). There was no significant difference between patients with RVI and non-RVI regarding residence and occupation (p>0.05)

RVI patients had significantly lower pulse rates ((<60) than those with non-RVI (p=0.001), and bradycardia was significantly more common (75%) in patients with IMI had RVI.(Table 2)

Blood pressure (BP) was significantly lower (<90/60) among RVI patients than those with no RVI (p<0.001), and the study showed 94.7% of patients with hypotension had RVI.

There were no significant differences between patients with RVI and those without RVI regarding SpO2, JVP elevation, Kussmaul's sign, bilateral basal Bi-basal crackles, and cardiac added sounds. (p>0.05)

Table 1. Demographic characteristics of inferior MI patients and distribution of demographic characteristics according to RVI.

Variable Age, mean±SD (63±13 years)	NO	%	RVI		No RVI		X^2	P
			No.	%	No.	%		
Age							8.3	0.1
< 40 years	4	4.0	1	25.0	3	75.0		
40-49 years	13	13.0	5	38.5	8	61.5		
50-59 years	19	19.0	11	57.9	8	42.1		
60-69 years	27	27.0	6	22.2	21	77.8		
70-79 years	21	21.0	11	52.4	10	47.6		
≥ 80 years	16	16.0	5	31.3	11	68.8		
Gender								
Male	66	66.0	20	30.3	46	69.7	6.1	0.01
Female	34	34.0	19	55.9	15	44.1		
Residence								
Urban	53	53.0	22	41.5	31	58.5	0.2	0.5
Rural	47	47.0	17	36.2	30	63.8		
Occupation								
Employed	71	71.0	28	39.4	43	60.6	0.02	0.8
Unemployed	29	29.0	11	37.9	18	62.1		

Table 2. Distribution of physical findings according to RVI.

Variable	RVI		No RVI		X^2	P
	No.	%	No.	%		
PR						
< 60	15	75.0	5	25.0	13.9	0.001
60-100	21	31.3	46	68.7		
>100	3	23.1	10	76.9		
BP						
< 90/60	18	94.7	1	5.3	30.6	<0.001
≥ 90/60	21	25.9	60	74.1		
SPO2						
< 92%	4	66.7	2	33.3	2.05	0.1
> 92%	35	37.2	59	62.8		
JVP elevation						
Yes	1	100.0	0	-	1.5*	0.2
No	38	38.4	61	61.6		
Kussmaul`s sign						
Yes	1	100.0	0	-	1.5*	0.2
No	38	38.4	61	61.6		
Bibasal crackles						
Yes	4	57.1	3	42.9	1.04	0.3
No	35	37.6	58	62.4		
Precordium						
Normal	38	39.6	58	60.4	0.3*	0.5
Murmur	1	25.0	3	75.0		

***Fisher's exact test.**

DISCUSSION

In this study, RVI was present in 39% of cases with inferior STEMI. Internationally similar results of RVI, 30% [12], 37% [13], and 32% of patients with IMI [10]. Necrobiopsy evaluation revealed evidence of RVMI in 14% to 60% of deaths from IMI [14]. Bangladeshi and his colleagues have shown that RVI was 30%-40% [15]

Age incidence

Our study showed that 11/39{28.2%} cases with RVI in the age group of 50 - 59 years, and 21/61 [34.4%} cases with non-RVI in the age group of 60-69 years, in another study {46.7%} of RVI occurred in age group 51-60 years which is comparable to our study, while non-RVI was found in 84.6% in the age group of 41-50 years [10]. There are studies indicating that age over 70 is the predictor factor for RV involvement for those who undergo inferior MI [16]. There were non-significant differences between patients with RVI and non-RVI in a study from Iran [17]; they found that there were no significant differences between these groups regarding age.

Gender

From 66 male cases, only 20 (30.3 %) and 19 of the 34 Females (55.9%) had evidence of RVI; this difference is a statistical significance (P=0.01), so in our study, female gender was a risk factor for RVI, as in the other studies females are the predictor factors for RV involvement for those who have inferior MI and RV infarction. [16], while a study by Khosoosi et al. from Iran [17] showed no significant differences regarding gender.

Hemodynamic and vital signs

In this study, there was no significant difference between patients with RVI and those with non-RVI regarding the history of HT, DM, and smoking (p>0.05). In other studies, hypertension and smoking were the predictor factors for RV involvement in IMI [16]. We have observed significantly low blood pressure (<90/60 mm Hg) associated with RVI, which is found in 46.2% of patients, corresponding to P value (p<0.001). On the other hand, 94.7% of the cases with IMI complicated with hypotension had RVI and bradycardia (<60 bpm) and P value (p<0.001). Bradycardia is more frequent and occurs in about 50% of RVI- IMI patients than in Non-RVI-IMI; 38.5% of IMI with RVI had bradyarrhythmia, and 75% of IMI patients with bradycardia had RVI. There are studies in other countries with comparable results [18,15].

In conclusion, right ventricular infarction was found in 39% of patients with acute inferior STEMI. Right precordial leads (V4R & V5R) are recommended in patients with acute inferior STEMI, especially in the presence of hypotension and bradycardia.

Acknowledgments

The authors would like to thank the Suleimani Cardiac Hospital and the cardiac center respiratory center staff for their support.

Competing Interests

The authors confirm no competing interests in this work. The authors have no conflict of interest related to the submitted m

Funding Statement

This research received no specific grant from any funding agency in the public, commercial or not-for-profit sectors.

The consent of presentation and publications

This has been taken verbally from all patients.

REFERENCES

1. Andersen HR, Falk E, Nielsen D. Right ventricular infarction: frequency, size, and topography in coronary heart disease: a prospective study comprising 107 consecutive autopsies from a coronary care unit. J Am Coll Cardiol. 1987; 10(6):1223-32.

2. Isner JM, Roberts WC. Right ventricular infarction complicates left ventricular infarction secondary to coronary heart disease. Frequency, location, associated findings, and significance from analysis of 236 necropsy patients with acute or healed myocardial infarction. Am J Cardiol. 1978; 42(6):885-94.

3. Cabin HS, Clubb KS, Wackers FJ, Zaret BL. Right ventricular myocardial infarction with anterior wall left ventricular infarction: an autopsy study. Am Heart J. 1987; 113(1):16-23.

4. Isner JM. Right ventricular myocardial infarction. JAMA. 1988;259(5):712-8.

5. Kinch JW, Ryan TJ. Right ventricular infarction. N Engl J Med. 1994;330(17):1211-7.

6. Sakata K, Yoshino H, Kurihara H. Prognostic significance of persistent right ventricular dysfunction as assessed by radionuclide angiocardiography in patients with inferior wall acute myocardial infarction. Am J Cardiol 2000; 85:939.

7. Cabin HS, Clubb KS, Wackers FJ, Zaret BL. Right ventricular myocardial infarction with anterior wall left ventricular infarction: an autopsy study. Am Heart J. 1987;113(1):16-23.

8. Isner JM, Roberts WC. Right ventricular infarction complicates left ventricular infarction secondary to coronary heart disease.

Frequency, location, associated findings, and significance from analysis of 236 necropsy patients with acute or healed myocardial infarction. Am J Cardiol. 1978;42(6):885-94.

9. Chockalingam A, Gnanavelu G, Subramaniam T. Right ventricular myocardial infarction: presentation and acute outcomes. *Angiology*. 2005; 56:371-376.

10. Iqbal A, Muddarangappa R, Shah SKD, Vidyasagar S. A study of right ventricular infarction in inferior wall myocardial infarction. J Clin Sci Res. 2013; 2(2):66-71.

11. Antman EM, Anbe DT, Armstrong PW. ACC/AHA guidelines for the management of patients with ST-elevation myocardial infarction. www.acc.org/qualityandscience/clinical/statements.htm (Accessed on August 24, 2006).

12. Malla RR, Sayami A. In-hospital complications and mortality of patients of inferior wall myocardial infarction with right ventricular infarction. JNMA J Nepal Med Assoc. 2007; 46(167):99-102.

13. Chockalingam A, Gnanavelu G, Subramaniam T, Dorairajan S, Chockalingam V. Right ventricular myocardial infarction: presentation and acute outcomes. Angiology. 2005; 56(4):371-6.

14. Zehender M, Kasper W, Kauder E, Geibel A, Schonthaler M, Olschewski M, et al. Eligibility for and benefit of thrombolytic therapy in inferior myocardial infarction: focus on the prognostic importance of right ventricular infarction. J Am Coll Cardiol. 1994;24(2):362-9.

15- McInnes D, Bollen J. Learning on the job: metaphors of choreography and the practice of sex in sex-on-premises venues. Venereology. 2000; 13(1):27-36.

16. Mehta SH, Eikelboom JW, Natarajan MK,. Impact of Right Ventricular Involvement on Mortality and Morbidity in Patients With Inferior Myocardial Infarction. J Am Coll Cardiol. 2001;37:37–43.

17. Khosoosi Niaki M, Abbaszade Marzbali N, Salehiomran M. Clinical manifestations of right ventricle involvement in inferior myocardial infarction. Caspian J Intern Med. 2014 Winter;5(1):13-6

18. Shiraki H, Yokosuka H, Negishi K. Acute impact of right ventricular infarction on early hemodynamic course after inferior myocardial infarction. Circ J. 2010;74:148–55.