

## Study of Incidence and Complications of Right Ventricular Infarction in Patients with Inferior Wall Myocardial Infarction- A Prospective Study from Tertiary Care Hospital in Coastal City of South India

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### Original Research Article

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#### Article History

Received: 04.02.2018

Accepted: 15.02.2018

Published: 28.02.2018

#### DOI:

10.36347/sjams.2018.v06i02.025



**Abstract:** Right ventricular infarction is not uncommon. The presence of RVI is known to increase the incidence of cardiogenic shock, arrhythmias and conduction blocks in case of myocardial infarction. Hence the present study was taken up to find out the incidence, clinical profile and complications of RVI. A prospective study was conducted on 50 patients of IWMI out of 170 AMI proved by ECG standard readings and RPLs taken at the time of admission and repeated at 6 hours, 12 hours, 24 hours and 48 hours. Out of 50 cases of inferior wall MI of 170 AMI cases only 15 developed RVI. The incidence of RVI was 30% in inferior wall MI. Syncope was present in 46.6% of RVI and 5.7% of IWMI without RVI. Bradycardia in 46.6% of RVI and 2.85% of IWMI without RVI. Hypotension was present in 66.6% of RVI and in 11.4% of IWMI without RVI. Ventricular fibrillation was seen in 26.6% of RVI and 2.8% of patients of IWMI without RVI. Complete Heart Block was in 6.6% of RVI and in 5.7% of patients IWMI without RVI. Mortality was 46.6% in RVI and 5.7% in patients IWMI without RVI.

**Keywords:** Right ventricular infarction; Right precordial leads; Inferior wall MI; Complete heart block; Syncope; Bradycardia; Hypotension.

### INTRODUCTION

Acute myocardial infarction is one of the leading causes of morbidity and mortality in developed countries. The incidence of acute MI is increasing in developing countries due to lifestyle changes, increase in risk factors and rapid urbanization.

Right ventricular infarction (RVI) was first recognized in a sub-group of patients with inferior Wall myocardial infarction (MI) who had right ventricle (RV) failure and elevated right Ventricular filling pressure despite of relatively normal left ventricular (LV) filling pressure. Post-mortem studies revealed that there is RV involvement in 19% to 51% of Patients with acute inferior wall MI.

RVI significantly causes haemodynamic instability, atrioventricular (AV) block, bradycardia, arrhythmias and cardiogenic shock. RVI usually accompanies IWMI and isolated RVI is very rare.

The incidence of complications and mortality is less in inferior wall myocardial infarction without RVI when compared to IWMI with right ventricular infarction. So it is necessary to recognize right ventricular infarction at earliest to prevent morbidity and mortality

The diagnosis of right ventricular infarction can be done by various methods like echocardiography, invasive hemodynamic techniques and nuclear imaging but electrocardiography still remains the most commonly done investigation since it is easily available, non-invasive and economical.

Early recognition is also important because the management of RVI differs substantially from other acute MI's, and has prognostic significance.

### METHODOLOGY

This study is based on analysis of 50 patients of inferior wall myocardial infarction admitted to ICCU of Kanachur institute of medical sciences, Mangalore

### Diagnostic Criteria

Patients with definite evidence of IWMI in 12 lead standards ECG were included in this study. For these patients additional Right Precordial leads were

taken at the time of admission and repeated at 12 hours, 24 hours and 48 hours.

For recording ECG 12 lead ECG (3 standard leads, 3 augmented limb leads, 6 precordial leads) machine was used. The recording were made at 25 mm/sec. Speed and 1 mv = 10 mm. Right precordial leads were applied on the areas of chest which the leads corresponded on the left.

A detailed case history was taken and complete physical examination was done at the time of admission.

**Criteria for diagnosing RVI**

ST elevation in leads II, III, avF, V1 and ST elevation in all or any one of the right precordial leads i.e. RV3, RV4, RV5, RV6 and associated mirror changes in the anterior leads.

**Inclusion Criteria**

All the patients with definite evidence of acute inferior wall myocardial infarction as proved by 12 lead ECG along with RPLs (Right Precordial leads) and the duration of the chest pain of less than 24 hours were considered in our study.

**Exclusion Criteria**

- ECG evidence of LBBB
- History of previous Myocardial infarction.
- Cor-pulmonale
- Suspected pulmonary embolism

- Associated pericardial disease.
- Patients with chest pain of more than 24 hour duration, as ST elevation in RPLs is transient

A detailed case history was taken and careful physical examination was done with special reference to raised jugular venous pulse (JVP), Kussmaul’s sign, hypotension, S3/S4 and cardiac murmur. Lead II ECG monitoring was done during the stay in ICCU for the identification of arrhythmias and conduction blocks.

Acute Myocardial infarction was treated with or without thrombolytic therapy. In cases with RV infarction that were haemodynamically compromised volume loading using normal saline (and inotropes in unresponsive cases) was done. Arrhythmias were treated accordingly.

**OBJECTIVES**

- To analyse the incidence of RVI in inferior wall MI.
- To study the clinical manifestations and complications of RVI.
- To study the ECG manifestations of RVI.
- To evaluate RVI echocardiographically.

**RESULTS**

Out of the total 170 cases of Acute Myocardial Infarction (AMI) admitted in Kanachur institute of medical sciences

**Table-1: Incidence in all groups**

	TOTAL No. of all AMI	No. of IWMI among AMI	PERCENTAGE
<b>INCIDENCE IN ALL GROUPS</b>	160	50	31.25%

The incidence of IWMI among all the cases is 31.25%

**Table-2: Incidence of RVI in IWMI**

	TOTAL NO. OF IWMI	NO. OF RVI IN IWMI	PERCENTAGE
<b>INCIDENCE OF RVI IN IWMI</b>	50	16	32%

In our study group of IWMI, RVI incidence was 32%. So the incidence of RVI in all cases of AMI was 10%.

**Table-3: Incidence among Age Groups**

AGE IN YEARS	IWMI WITHOUT RVI (N=34)	RVI (N=16)	TOTAL (N=50)
<b>21-30</b>	2 (5.8%)	--	2 (4%)
<b>31-40</b>	3 (8.8)	1 (6.2%)	4 (8%)
<b>41-50</b>	8 (23.5%)	4 (25%)	12 (24%)
<b>51-60</b>	10 (29.4%)	9(56.2%)	19 (38%)
<b>61 AND ABOVE</b>	11 (32.3%)	2 (12.5%)	13 (26%)

Our study showed a peak incidence of RVI in the age group of 51 – 60 years, but the peak incidence of IWMI was in the age group of 61 years above.

**Table-4: Sex Incidence**

SEX	TOTAL INCIDENCE IN IWMI (N=50)	INCIDENCE IN IWMI WITHOUT RVI (N=34)	RVI (N=16)
MALE	40(80%)	29 (82.8%)	12 (75%)
FEMALE	10(20%)	5(14.2%)	4(25%)

Our study showed a very high incidence of IWMI and as well as RVI in males compared to females. This may be due to association of many risk factors which is more common in males.

**Table-5: Incidence of Risk Factors**

RISK FACTORS	IWMI WITHOUT RVI (N=34)	RVI (N=16)	TOTAL (N=50)
DIABETES	9 (26.4%)	2 (12.5%)	11 (22%)
HYPERTENSION	19 (55.8%)	7 (43.7%)	26 (52%)
SMOKING	30 (88.2%)	12 (75%)	42 (84%)
FAMILY HISTORY	12(35.2%)	8(50%)	20 (40%)
ALCOHOL CONSUMPTION	8(23.5%)	5(31.2%)	13(26%)

**Table-6: Symptomatology at Presentation**

SYMPTOMS	IWMI WITHOUT RVI (N=34)	IWMI WITH RVI (N=16)	IWMI (N=50)
CHEST PAIN	32 (94.1%)	16 (100%)	48 (96%)
SYNCOPE	5 (14.7%)	9 (56.2%)	14 (28%)
PALPITATION	4(11.7%)	2 (12.5%)	6 (12%)
SWEATING	26 (76.4%)	11 (68.7%)	37 (74%)
ANGINA < 24 HRS	4(11.7%)	5(31.2%)	9 (18%)

**Table-7: Physical Findings At Presentation**

PHYSICAL FINDINGS	IWMI (N=50)	RVI (N=16)	IWMI WITHOUT RVI (N=34)
<b>a. Pulse (beats/min)</b>			
1. Normal (60-100)	40 (80%)	5(31.25%)	33 (97%)
2. Bradycardia (<60)	8 (16%)	7(43.75%)	1 (2.9%)
3. Tachycardia (>100)	2 (4%)	1 (6.25%)	1 (2.9%)
<b>b. Blood pressure(mmHg)</b>			
1. Normotensive (100-140/60-90)	23 (46%)	1 (6.25%)	22 (62.8%)
2. Hypotensive (<100/<60)	15 (30%)	12 (75%)	3 (8.8%)
3. Hypertensive (>140/>90)	12 (24%)	3 (18.75%)	9 (26.4%)
<b>c. JVP</b>			
1. Normal	36 (72%)	4 (25%)	32 (94.11%)
2. Elevated	14 (28%)	12 (75%)	2 (5.8%)
3. Kussmaul's sign	8 (16%)	7 (43.75%)	1 (2.9%)
<b>d. Heart sounds S3/S4</b>	6 (12%)	4 (25%)	2 (5.8%)
<b>e. Tricuspid regurgitation murmur</b>	8 (16%)	6 (37.5%)	2 (5.8%)
<b>e. Respiratory Crepitations</b>	18 (36%)	12 (75%)	6 (17.6%)

Hypotension, elevated JVP, Bradycardia and Kussmaul's sign were increasingly associated with RVI when compared to IWMI without RVI.

**Table-8: ECG Findings of RVI**

	CHANGES IN RPLs	NO. OF PATIENTS OF RVI (N=15)	PERCENTAGE
1.	IN ONLY 1 RPL	2	13.3
2.	IN ONLY 2 LEADS	8	53.3
3.	IN ALL 4 LEADS	9	60
4.	ST↑ IN RV4	15	100
5.	ST↑ IN V1	10	66.6

**Table-9: Echocardiographic Evaluation of RVI**

FEATURES	INCIDENCE (N=16)
RIGHT VENTRICULAR WALL MOTION ABNORMALITIES	16 (100%)
TRICUSPID REGURGITATION	9 (56.2%)
PARADOXICAL SEPTAL MOTION	8 (50%)
RIGHT VENTRICULAR ENLARGEMENT	12 (75%)

**Table-10: Showing Clinical Course In All Cases**

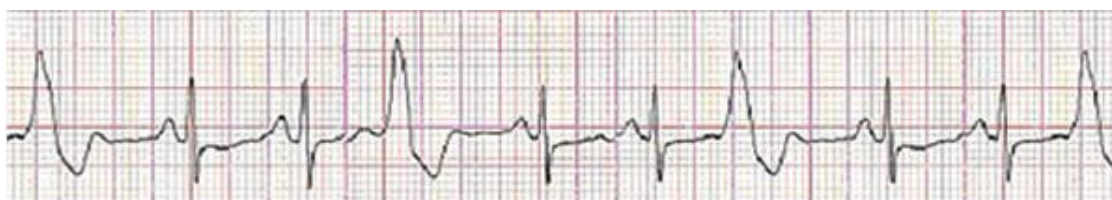
S.NO	CLINICAL COURSE	IWMI WITHOUT RVI(N=34)	IWMI WITH RVI (N=16)	TOTAL (N=50)
1.	COMPLICATED	18(52.9%)	12(75%)	30 (60%)
2.	UNCOMPLICATED	16 (47%)	4 (25%)	20(40%)

**Table-11: Incidence of Arrhythmias**

	TYPE OF ARRHYTHMIA	IWMI WITHOUT RVI(N=34)	IWMI WITH RVI (N=16)	TOTAL (N=50)
1.	SVT/AF	0	0	0
2.	VENTRICULAR ECTOPICS	5(14.7%)	4 (25%)	9(18%)
3.	VENTRICULAR TACHYCARDIA	1 (2.9%)	2 (12.5%)	3 (6%)
4.	VENTRICULAR FIBRILLATION( VF)	1 (2.9%)	4 (25%)	5 (10%)



**Fig-1: ECG Showing Ventricular Fibrillation**



**Fig-2: ECG Showing Ventricular Ectopics**

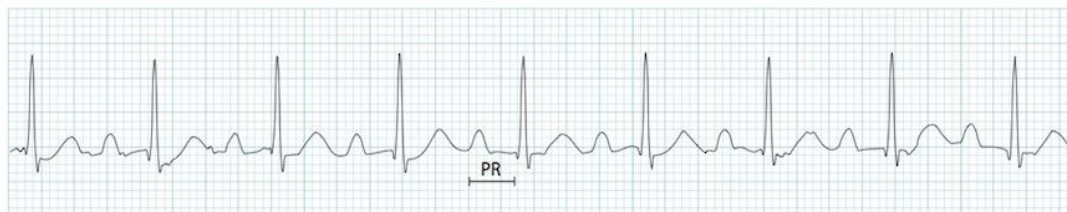
The incidence of VF was significantly higher in cases of RVI and it was a major cause for mortality. However, the incidence of it was very low in IWMI

without RVI. Ventricular Ectopics were seen at a similar incidence in both the groups. And most of them

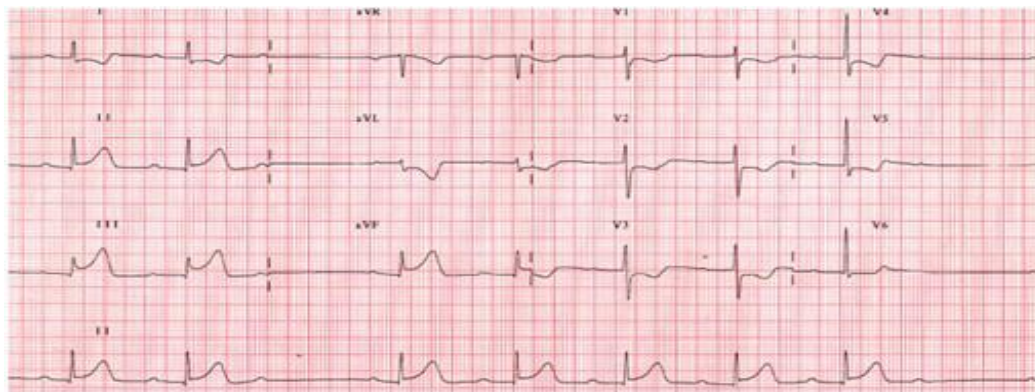
were transient which disappeared without any medication or causing any major problem.

**Table-12: Showing Incidence of Conduction Blocks**

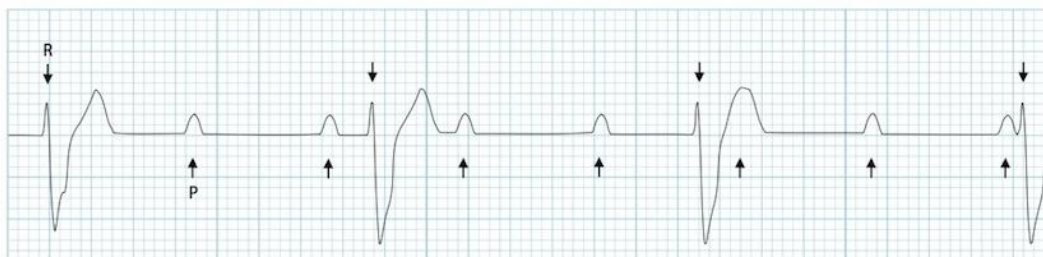
S.NO	CONDUCTION BLOCKS	IWMI WITHOUT RVI (N=34)	IWMI WITH RVI (N=16)	TOTAL (N=50)
1.	<b>FIRST DEGREE AV BLOCK</b>	4 (11.7%)	1 (6.2%)	5 (10%)
2.	<b>SECOND DEGREE AV BLOCK</b>	2(5.8%)	2(12.5%)	4 (8%)
3.	<b>THIRD DEGREE AV BLOCK</b>	1(2.9%)	8 (50%)	9 (18%)



**Fig3: ECG Showing 1<sup>st</sup> Degree Heart Block**



**Fig-4: ECG Showing 2<sup>nd</sup> Degree Heart Block Type 1**



**Fig-5: ECG Showing 3<sup>rd</sup> degree heart block**

Our study shows the incidence of conduction block to be significantly high in Cases of RVI.

Complete Heart Block was commonly seen in the RVI and few of them.

**Table-13: Showing Benefit of Thrombolysis**

	IWMI WITHOUT RVI (N=34)	MORTALITY (N=2)	RVI (N=16)	MORTALITY (N=6)
<b>THROMBOLYSED</b>	28 (82.3%)	1 (3.5%)	5 (33.3%)	1 (20%)
<b>NON-THROMBOLYSED</b>	6 (17.6%)	1 (16.6%)	10(66.66%)	5(50%)

This report clearly shows the benefit of thrombolysis as the mortality in the nonthrombolysed group is very high.

Total death in the group=8  
 Death in rvi group=6  
 Death in iwmi without rvi group=2

**Table-14: Showing Incidence of Mortality**

	RVI (N=16)	IWMI WITHOUT RVI (N=35)
<b>MORTALITY</b>	6 (75%)	2 (25%)

**DISCUSSION**

Our study consisted of 50 patients of acute inferior wall myocardial infarction who were admitted to Kanachur institute of medical sciences, Mangalore.

Cabin and Setaro J. reported an incidence of RVI in 13% of all cases of MI they studied in 1992. Our study shows 10% (only ECG proven) of RVI in all cases of MI. Our reported incidence of RVI is comparable to that of Cabin and Setaro study (Table 15) [1].

**Table 15: Comparison of incidence of RVI in all myocardial infarction**

Study	Percentage of RVI in all MI
Cabin and Setaro study [1]	13
Present Study	10

**Table 16: Comparison of RVI in IWMI**

STUDY	PERCENTAGE OF RVI IN IWMI
S.Khan <i>et al.</i> [13]	34%
SH Braat <i>et al.</i> [14]	43%
Klein HO <i>et al.</i> [15]	52%
Gertz <i>et al.</i> [2]	32%
Present study	32%

Our study based on ECG shows an incidence of 32% and Gertz *et al.* reported necropsy analysis of IWMI as a part of TIMI study to have had RVI in 32% of patients. So our report tallied with that of Gertz *et al.* study [2].

patients aged above 60 years. Here the study was done in 820 patients of MI. In Israeli Heart Study the peak age incidence was seen in age group of 45 – 54 years. Our study had a peak incidence of IWMI in 38% in the age group of 51 – 60 years and RVI of 56.2% in the same age group. So our report is similar and compared with these two groups with respect to age (Table-17) [3].

In Dittrich *et al.* study the maximum incidence of MI was below 60 years (75.26%) and 24.26% in the

**Table-17: Comparison of age of peak incidence**

STUDY	Age of peak incidence of Acute inferior wall MI
Dittrich H. Griffin <i>et al.</i> [3] study	75.26% in below 60 years
Israeli Heart study	34% in 45-54 years age group
S. Khan <i>et al.</i> [13]	Mean age 56.3 ±13 years (33-83 age group)
Present study	38% in 51-60 years age group

**Table 18: Comparison of sex incidence**

Study	Males	Females
Chinnaiah <i>et al.</i> [4]	72%	28%
Kannel W B., <i>et al.</i> [4,5]	66%	34%
S. Khan <i>et al.</i> [13]	86%	14%
Present study	80%	20%

Chinnaiah *et al.* reported an incidence of 72% in males and Kannel W.B *et al.* in 26 years follow up of a group of males and females aged between 35 – 84 years found the incidence to be 66%. Our study shows a

higher incidence i.e., 80% in males. This clearly indicates a male predominance and it might be due to higher associated risk factors like smoking stress factors and alcoholism. Kannel *et al.* study might be showing a

lower male predominance because of other associated risk factors in females of the west which is not present in the females of our study [4,5].

**Table-19: Comparison of risk of hypertension in MI**

RISK OF HYPERTENSION IN MI	PERCENTAGE
Framingham Study	40%
North Kareella Project	29%
Present Study	52%

There is little difference between our study and Framingham study with that of North Kareella Project and this difference is not very significant. The high

incidence of hypertension in our study may be because we had a very limited study group over a short period [6].

**Table-20: Lead sensitivity**

STUDY	LEAD SENSITIVITY IN V3R	LEAD SENSITIVITY IN V4R
M C Gupta <i>et al.</i> [16]	88.8%	100%
Lopez sendon <i>et al.</i> [12]	79%	100%
Braat <i>et al.</i> [4]	69%	93%
Present study	65%	100%

**Table-21: Comparison of incidence of hypotension**

Study	Incidence of hypotension
Shah <i>et al.</i> [17]	52%
Mohan <i>et al.</i> [7]	55%
Present study	75%

Shah *et al.* reported hypotension in 52% and Mohan *et al.* in 55% and our study shown 75% in cases of RVI. This is comparatively high when compared with 8.8% of hypotension in IMI without RVI. This proves that RVI causes significant hemodynamic derangements [7].

In our study ECG was the only (12 lead standard ECG + RPLs) investigative device used to prove RVI as other techniques were not affordable or available.

In our study in patients with RVI, ST elevation in only one RPL was seen in 13.3% of patients. But RV4 was elevated in all the 15 cases of RVI.

Croft *et al.* [20] in 1982 was the first to report that ST elevation of 1 mm or more in one or more of RV4 to RV6 was 90% sensitive and 91% specific for RVI. It is now generally agreed that 1 mm ST elevation in RV3 to RV6 or only in RV4 in highly specific and sensitive for diagnosing RVI [8-10].

Chou *et al.* [21] in 1981 had proposed that ST elevation in V1 might suggest RVI and our study of RVI in 15 patients showed that there was ST↑ elevation in V1 in 66.6% of cases. This is significant finding [9].

**Table-22: Incidence of cardiogenic shock**

Author	Year	Cardiogenic shock with RVI	Cardiogenic shock without RVI
Ramires <i>et al.</i> [18]	1993	57.1%	18.9%
Bueno <i>et al.</i> [19]	1997	32%	5%
Present study	2012-2014	25%	3%

Our study findings are lower than findings reported by Bueno *et al.* The early reorganization and the initiation of treatment of right ventricular failure with adequate intravenous fluids and

inotropic drugs prevent the existence of cardiogenic shock. This might be the responsible factor for reporting of low incidence of cardiogenic shock in our study.

**Table- 23: Comparison of incidence of CHB in RVI**

STUDY	Incidence of CHB in RVI
Lloyd <i>et al.</i> [11]	31%
Present study	50%

Lloyd *et al.* have reported completed Heart Block in 31% of the cases where as our study showed 50%. In our study, complete heart block in IWMI without RVI was seen in 2.9%. This shows a significant risk in patients of RVI to develop complete heart block than in patients of IWMI without RVI. This is because of the involvement of the AV node [11].

The incidence of VF in RVI was 25% where as in IWMI without RVI was 2.5% in our study. Cinca *et al.* [22] reported an incidence of 4% of patients developing VF during thrombolysis. His study included all cases of MI. Our study has only IWMI and RVI. So incidence of VF in our study is very high [12].

The incidence of VT in RVI was 12.5% and 2.9% in IWMI without RVI in our study. Lopez and Sendon *et al.* [12] have reported very high incidence of VT and VF in cases of RVI who were catheterized (Swan Ganz Catheter) or were applied pace makers. This might be due to the irritation by pacemaker or catheter of the injured RV [12].

Mortality rates, particularly, in RVI, is higher than compared to IWMI without RVI. In our study the mortality in RVI was 37.5%. Whereas it was only 5.8% in IWMI without RVI.

In thrombolysed patients the mortality was significantly low (6%) compared with non thrombolysed patients (37.5%). Most of the cases of RVI were not suited for thrombolysis because of the associated complications. In these patients the death rate was high. Zehender *et al.* [23] have reported a high incidence of complications and mortality in patients who were not candidates for thrombolytic therapy. Castaigne *et al.* [9] in their study of mortality after thrombolysis reported an incidence of 4% where as in our study it was 18%.

**Acknowledgement:** None

**Conflict of Interest:** None

## CONCLUSION

Right ventricular infarction is a serious entity seen in patients with IWMI. It increases the incidence of complications and mortality. So it is necessary to look for RVI in all cases of IWMI.

Right ventricular infarction is rarely isolated; it is usually part of an inferior wall infarction. The syndrome of right ventricular infarction is that of low output and hypotension. Right ventricular infarction is responsible for some cardiogenic shock cases and a

larger proportion of hypotensive inferior wall myocardial infarction cases. Incidence of arrhythmias and conduction defects is more in RVI. Bedside physical diagnosis and electrocardiographic findings are strongly suggestive in most cases.

So in all cases of IWMI, RVI should be looked for by using simple and specific investigation like RPLs of ECG. Clinically RVI can be suspected when there is bradycardia, irregular pulse, hypotension and elevated JVP with clear lungs in a setting of Acute MI. ECG is a very simple investigative tool. The Advantage of ECG is it is easily available, non-invasive, cost effective, specific and sensitive.

Early diagnosis means careful management for avoidance of complications like hypotension, Complete Heart Block etc, which are common in these patients and reducing mortality.

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