Original Article

Right Ventricular Myocardial Infarction as an Independent Predictor of Prognosis in Acute Inferior Myocardial Infarction

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Abstract

Background: Acute inferior myocardial Infarction frequently involves the right ventricle and associated with significant morbidity and mortality. We hypothesized that right ventricular involvement may affect the prognosis of patients with inferior myocardial infarctions.

Methodology: In 100 consecutive patients admitted to the hospital with acute inferior myocardial infarction, we assessed the incidence and prognostic factors for in-hospital outcome. RVMI (Right ventricular myocardial infarction) was diagnosed by ≥1mm ST elevation in lead V_{4R} in right sided electrocardiogram.

Result: RVMI was found in 31(31%) of patients of acute inferior myocardial infarctions. Major complications as hypotension and cardiogenic shock occurred in 96.7% and 64.5% patients respectively and in-hospital mortality was 41.9%. Whereas major complications as hypotension and cardiogenic shock occurred in 10.1% and 2.8% patients respectively and in hospital mortality was 2.8% of patients without right ventricular infarction among the inferior myocardial infarction. Multiple logistic regression analysis showed right ventricular infarction to be independent of and superior to all other clinical variables available on admission for the prediction of in hospital mortality (relative risk 88.37 percent, 95% confidence interval 7.33 to 1064.80; p=0.000) and major complications as hypotension (relative risk 394.22, 95% confidence interval 32.04 to 4849.07; p=0.000) and cardiogenic shock (relative risk 272.36, 95% confidence interval, 16.38 to 4526.35; p=0.000).

Conclusion: RVMI commonly occurs in inferior myocardial infarction. It is a strong and independent predictor of major complications and in-hospital mortality. Early detection and appropriate monitoring can reduce its high mortality rate.

Keywords: Acute inferior myocardial infarction, RVMI, Prognostic outcome.

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Introduction

The description of right ventricular infarction appeared more than 70 years ago,[1] yet for decades it was not considered an important clinical entity. In 1974, Cohn and coworkers[2] published their classic report on right ventricular infarction as a distinct clinical entity.

Clinical studies demonstrated that right ventricular involvement occurs almost exclusively in patients with inferior wall infarction and postmortem studies revealed that it was 19 to 51 percent of patients with acute inferior myocardial infarctions.[3]

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Clinically, RVMI may be missed; for the classical triad of hypotension, clear lung fields and elevated jugular venous pressure does not always occur.[4] Although quite specific, this triad has a sensitivity of less than 25 percent, but distended neck veins alone have been shown to be 88 percent sensitive and 69 percent specific.[4] Kussmaul's sign is highly sensitive and specific for right ventricular infarction.[5]

The diagnosis of right ventricular infarction can be made from the physical examination, echocardiography, first-pass, or equilibrium radionuclide, ventriculography, technetium-pyrophosphate myocardial scanning, and hemodynamic measurements. But right precordial electrocardiography,[6] at the time of presentation is the most readily available, simplest, inexpensive and currently gold standard of these techniques. ST-segment elevation ≥1mm in right chest lead V_{4R} is 70% sensitive and nearly 100% specific for RVMI.[7]

We looked at the frequency and in-hospital prognostic factors of outcomes of RVMI complicating IMI in the setting of a tertiary medical college hospital.

Methodology

This descriptive observational study was carried out on 100 consecutive patients of acute inferior myocardial infarction admitted in coronary care unit of Rajshahi medical college hospital. Patients were treated according to AHA guidelines. Informed consent was obtained from all patients and ethical review was done by institutional review board. Right sided ECG was routinely done in all patients presenting with acute IMI within 10 hrs of symptoms of onset at the time of admission. RVMI was diagnosed based on ≥1-mm ST-segment elevation in V_{4R} lead.[7]

Patients with RVMI constituted group A (n=31) and patients without RVI constituted group B (n=69) and served as controls.

Prognostic assessment was studied for all patients during in hospital course. Prognostic effect of RVI was evaluated in relation to other clinical variables available at the time of admission including age,

sex, smoking, hypertension, diabetes mellitus, hypercholesteromia and thombolytic therapy.

Data were analyzed by SPSS V-15 software. Significant test were done by Chi-square test. The independent prognostic effect of selected clinical variables of in-hospital mortality as well as short term complications were assessed with multiple logistic regression analysis. All tests of significance were two tailed and a p value of ≤0.05 was considered to indicate statistical significance.

Results

Right ventricular infarction occurred among thirty one patients (31%) presenting with acute inferior myocardial infarction. Table 1 shows the patient characteristics of both groups. Mean (±SD) age of group A was 55.26 ± 10.61 yrs and group B was 51.25 ± 9.95 and it revealed no significant difference (p=0.08). Male and female ratio in group A was 5.2:1and in group B was 6.6:1.

Total thirty seven (37%) patients were found to be hypotensive in which thirty (96.7%) patients belong to group A and only seven (10.1%) in group B (p=.00).

High degree AV block (second degree and complete heart block) were more in group B (11.6% vs 6.4%). Three patients (4.3%) of group B had required temporary pacing for complete heart block.

Twenty patients (64.5%) of group A had developed cardiogenic shock and it became irreversible in thirteen (65%) of them and ultimately death ensued. Incidence of cardiogenic shock was highly significant in group A (group A: 64.5% vs group B 2.8%; p=0.00).

Independent prognostic value of RVI with other clinical criteria for the incidence of death (Table 2):

Table 2 showed the logistic regression analysis of independent prognostic value of RVI with other clinical variables available at the time of hospitalization. The logistic regression relative risks for the age groups 28-40, 41- 50, 51-60 and >60yrs. were shown in table 2. Considering the first age group 28-40 as reference category, the relative risk of patients of other age groups did not

show any statistically significant association. Similarly, male patients, smoker, hypertensive, diabetic, patients of hypercholesteromia and patients who did not receive thombolytic therapy did not show statistically significant prognostic influence for the incidence of death.

But patients with right ventricular infarction were 88.37 times higher risk (95% confidence interval, 7.334- 1064.8) of poor prognosis than patients without right ventricular infarction which was statistically highly significant (p=0.000).

Independent prognostic value of RVI with other clinical criteria for the incidence of major complications (Table 3):
Table 3 showed the logistic regression analysis of independent prognostic value of RVI with other clinical variables available at the time of hospitalization for the incidence of major complications (Hypotension, high degree AV block and cardiogenic shock).

Hypotension
Age, male patients, smoker, hypertensive, diabetic, patients of hypercholesteromia and patients who did not receive thombolytic therapy did not show statistically significant influence for the incidence of hypotension. But patients with right ventricular infarction were 394.2 times higher risk (95% confidence interval, 32.04- 4849.07) of developing hypotension than patients without right

ventricular infarction which was statistically highly significant (p=0.000).

High degree AV block:
Considering the first age group 28-40 as reference category, the relative risk of patients aged 41-50 yrs, 51-60 yrs and >60 yrs were 1.2E+008, 0.907 and 4.7E+008 respectively which were statistically insignificant (p=0.99; p=0.99; p=0.99 respectively). Male patients, smoker, hypertensive, diabetic, patients of hypercholesteromia and patients who did not receive thombolytic therapy did not show statistically significant influence for the incidence of high degree AV block. But surprisingly, patients with right ventricular infarction were 0.049 times higher risk (95% confidence interval, 0.058- 2.879) of developing high degree AV block than patients without right ventricular infarction which was also statistically insignificant (p=0.36).

Cardiogenic shock:
Age, male patients, smoker, hypertensive, diabetic, patients of hypercholesteromia and patients who did not receive thombolytic therapy did not show any statistically significant influence for the incidence of cardiogenic shock. But patients with right ventricular infarction were 272.3 times higher risk (95% confidence interval, 16.38- 4526.35) of developing cardiogenic shock than patients without right ventricular infarction which was statistically highly significant (p=0.000).

Table 1: Patients characteristics, major complications and mortality during hospitalization.

Age (years)	IMI + RVI (Group-A) (n=31)	IMI (Group-B) (n=69)	p value
Total patients, N	31	69	-
Male:female	5.2:1	6.6:1	-
Age (mean±SD) yrs	55.26±10.61	51.25±9.95	0.08
Smoking, n (%)	26 (83.8)	45 (65.2)	0.04
Hypertension, n (%)	15 (48.3)	17 (24.6)	0.02
Diabetes, n (%)	05 (16.1)	18 (26.1)	0.07
Hypercholesteroemia, n (%)	03 (9.6)	17 (24.6)	0.07
Thombolytic therapy, n (%)	11 (35.4)	40 (58)	0.03
Hypotension, n (%)	30 (96.7)	07 (10.1)	0.00
High degree AV block, n (%)	02 (6.4)	08 (11.6)	0.07
Cardiogenic shock, n (%)	20 (64.5)	02 (2.8)	0.00
Death, n (%)	13(41.9)	02 (2.8)	0.00

Table 2: Multivariate analysis of the independent prognostic value of RVI with other clinical criteria for the incidence of death:

Clinical	Relative risk of Death	95% CI	P value
Age group (yrs) 28- 40 (R)			
41- 50	6.424	0.351- 117.6	P= 0.21
51- 60	5.356	0.335- 85.53	P= 0.23
> 60	3.959	0.257- 61.02	P=0.32
Sex (male- R)	0.91	0.003- 2.509	P= 0.15
Smoker	0.18	0.015- 2.140	P= 0.17
Hypertension	0.21	0.033- 1.454	P= 0.11
Diabetes	0.85	0.095- 7.757	P= 0.89
Hypercholesteroemia	0.51	0.038- 7.077	P= 0.62
Thombolytic	0.59	0.119- 2.962	P= 0.52
RV infarction	88.37	7.334- 1064.803	P= 0.00

* R= Reference Category; Sex (female- R); Smoker (No-R); Hypertension (No-R);
Diabetes (No-R); Dyslipidaemia (No-R); Thombolytic (Yes-R); RV infarction (No-R).

Table 3: Multivariate analysis of the independent value of RVI with other clinical criteria for the incidence of major complications:

Clinical	Major Complications		
Age group (yrs) 28- 40 (R)	Hypotension	High degree AV block	Cardiogenic shock
41- 50	2.83(0.146-5493) P= 0.49	1.2E+008 (0.00-) P= 0.99	0.825(0.06-10.38) P= 0.88
51-60	1.84 (0.081- 42.05) P= 0.70	90702785 (0.00-) P= 0.99	2.533 (0.248-25.86) P= 0.43
> 60	10.04(0.397-254.5) P= 0.16	4.7E+ 008 (0.00-) P= 0.99	4.074 (.348- 47.717) P= 0.26
Sex	1.501(0.119-18.87) P= 0.75	0.367 (.026- 5.100) P= 0.45	0.643(0.03- 11.223) P= 0.76
Smoker	0.62(0.105- 3.787) P= 0.61	0.221(0.041-1.193) P= 0.07	0.09 (0.006-1.51) P= 0.09
Hypertension	1.142(.182-7.155) P= 0.88	1.23 (0.183- 8.306) P= 0.82	.529 (.091- 3.067) P= 0.47
Diabetes	0.497(0.062- 3.946) P= 0.50	0.00(0.00-) P= 0.99	.996 (.146 – 6.808) P= 0.99
Hypercholesteroemia	0.602(0.067- 5.381) P= 0.65	0.00 (0.00-) P= 0.99	2.838(.258- 31.254) P= 0.39
Thombolytic	1.867 (0.35- 9.966) P= 0.46	1.131 (0.215- 5.954) P= 0.88	1.197 (.235- 6.081) P= 0.82
RV infarction	394.22 (32.04-4849.07) P= 0.00	0.409 (0.058- 2.879) P= 0.36	272.36 (16.389-4526.35) P= 0.00

* Values shown are relative risks followed in parentheses by 95 percent confidence interval.
* R= Reference Category; Sex (female- R); Smoker (No-R); Hypertension (No-R);
Diabetes (No-R); Dyslipidaemia (No-R); Thombolytic (Yes-R); RV infarction (No-R).

Discussion

The classic report of Cohn and coworkers[2] in 1974 for the first time established right ventricular infarction as a separate entity. Sharpe et al,[8] Garty et al,[9] Croft et al[10] and Rodigues[11] EA observed the incidence of right ventricular infarction 40%, 52.7%, 47.6 and 50% respectively. Recently, Chockalingram A[12] had showed 37% in India, Akbar MA et al[13] showed 30% in Pakistan and Hossain M[14] documented 40% incidence RV infarction among inferior MI patients in Bangladesh. Electrocardiographic criterion used by this study documented 31% RVI with acute inferior myocardial infarction. This finding is consistent with the previous studies.

In this study we documented a low incidence (6.4%) of high grade AV block in group A and a relatively high incidence (11.6%) in group B patients. Similar result was also found by Mehta SR[15]. But this finding is contrary to some of the previous studies reported as many as 48% AV block in RVI patients[16]. Chockalingram A.[12] Hossain[14] also reported a higher incidence. An explanation could therefore, be that dual or collateral blood supply to the AV node is functionally common.

Cardiogenic shock is relatively infrequent but leading cause of mortality in RVMI patients.[17] Zehender et al[18] found 11% cardiogenic shock in his observation. We had a higher incidence (64.5%) of cardiogenic shock in group B patients in comparison to group A patients without RVI and mortality was higher in group B than group A (64.5% vs 2.8%; p=0.00). Akbar et al[13] also observed a similar significant difference of cardiogenic shock between two groups of patients (p<.004).

The most striking finding was that while RVI has been described as a reversible cause of cardiogenic shock,[2,19] study patients who developed cardiogenic shock due to RVI died as a consequence. Although most patients (96.7%) received volume expansion and ionotopic supports (41.9%), most (80%) of them were non-responding to therapy and thirteen patients (41.9%) had died from irreversible cardiogenic shock.

This study confirms the prognostic effect of RV infarction in a good number of patients. Patients with RV infarction had a 14 percent risk of death and a 22 percent risk of major complications during hospitalization. In the absence of RV infarction, no patients died during the first 24hrs of hospital stay, on the other hand four patients (13%) of RV infarction died within this period. As compared with all clinical variables at the time of admission, RV infarction was associated with a relative risk of in-hospital mortality of 88.37 (95% confidence interval, 27.33 to 1064.80; p=0.000) and a risk of major complications of hypotension 394.2 (95% confidence interval, 32.04 to 4849.07;

p=0.000) and cardiogenic shock 272.36 (95% confidence interval, 16.38 to 4526.35; p=0.000). Ultimately, 97 percent of patients without evidence of RV infarction at the time of admission were discharged from the hospital, as compared with only 58 percent of those in whom RV infarction complicated the acute inferior myocardial infarction.

The independent prognostic value of RV infarction was assessed by a multiple logistic regression analysis in which we included all the other significant prognostic factors available at the time of admission (age, sex, smoking, hypertension, diabetes, thombolytic therapy). After this adjustment RV infarction (Table 2) was observed as one of the most powerful independent predictors of in-hospital death and major complications (Table 3) during hospitalization in patients with acute inferior myocardial infarction.

Conclusion

Right ventricular infarction is frequent in acute inferior myocardial infarction. It carries a high risk of mortality and major complications during hospitalization. Independent prognostic weight of RV infarction remains supreme when it compares with all other prognostic determinants.

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