

Predictive Value of TIMI Risk Score Analysis for In-Hospital and Long-Term Survival of Patients with Right Ventricular Infarction

S. Ghaffari MD and J. Samadikhah MD.

Abstract

Objective- Right ventricular infarction (RVI) is a common complication of inferior wall infarction and usually leads to a greater mortality and in-hospital complications. This study aims to evaluate the value of TIMI risk score in the prediction of in-hospital and long-term mortality in RV infarction.

Methods- Five hundred patients with acute inferior infarction were surveyed in this study. In-hospital complications and mortality of these patients were collected, and they were followed on average for about 31 months.

Results- RVI was diagnosed in 24% of the patients. In-hospital morbidity (RVI: 56.7% vs. non-RVI: 34.4%; $P < 0.001$) and mortality (RVI: 28.3% vs. non-RVI: 8.9%; $P < 0.001$) were increased in patients with RVI. Any one-point increase in TIMI risk score led to a 3.5 ± 1.4 percent increase in in-hospital mortality ($P = 0.001$). Long-term mortality, however, did not reveal such a correlation with TIMI risk score ($P = 0.1$). Out-of-hospital mortality in a mean follow-up period of about 31 ± 8.7 months was 24.3% in the RVI and 12.1% in the non-RVI group ($p = 0.02$).

Conclusion- RV infarction significantly increases in-hospital complications and mortality of inferior infarction. Any one-point increase in TIMI risk score leads to a parallel increase of in-hospital mortality but there is no such a correlation between TIMI risk score and long-term mortality (*Iranian Heart Journal 2006; 7 (4):26-30*).

Key words: myocardial infarction n right ventricular infarction n TIMI risk score n prognosis

Inferior myocardial infarction (MI) complicated by right ventricular infarction (RVI) is associated with a greater risk of in-hospital mortality¹⁻⁵ and cardiovascular-related complications including heart failure and shock, A-V conduction disorders and tachyarrhythmias, and mechanical complications.^{1-3,6} Post-mortem studies have revealed that there is right ventricular involvement in 19 to 51 percent of patients with acute inferior myocardial infarctions.³

In one clinical study its presence was estimated to be about 17% in patients with acute inferior or lateral MI.¹ While previous work has established the prognostic role of RVI in patients with inferior MI,¹⁻⁵ only limited studies to date have attempted to stratify risk among patients with RVI. The development of the TIMI risk score has provided a useful tool to quickly and easily stratify patients with acute MI.⁶ The utility of the TIMI risk score has also been validated in a large acute MI registry.⁷

Received Jul 26, 2005; Accepted for publication Oct. 6, 2006.

From the Department of Cardiology, Shaheed Madani Heart Hospital, Tabriz University of Medical Sciences, Tabriz, Iran.

Address for correspondence and reprint request to: S. Ghaffari, MD, Assistant Professor in Cardiology, Department of Cardiology, Shaheed Madani Heart Hospital, Tabriz, Iran

Tel: 09143137973 Fax: +98 (411) 3344021

E-mail: ghafaris@gmail.com

The purpose of the current investigation was to determine if the TIMI risk score could provide a useful way to risk-stratify patients with RVI with regard to short and long-term mortality.

Materials and Methods

Acute MI was diagnosed according to World Health Organization criteria.⁸ Five hundred patients who were admitted with the diagnosis of acute inferior wall MI as their first MI between May 1998 and Dec. 2002 were enrolled in this study. We utilized the following criteria to diagnose RVI in our data set: the presence of a clinical suspicion of RVI and any of the following which were present within 24 h of presentation: (1) ST elevation ≥ 1 mm in V3R or V4R on right-sided precordial chest leads; (2) evidence of right ventricular infarction or dilatation with hypokinesis on echocardiography. TIMI (Thrombolysis in Myocardial Infarction) scores were calculated according to published criteria,⁶ which is depicted in Table I.

Table I. Thrombolysis in Myocardial Infarction (TIMI) risk score.

Clinical data	Points
Historical	
Age ≥ 75 years	3
Age 65–74 years	2
History of DM, hypertension or angina	1
Examination	
Systolic blood pressure < 100	3
Heart rate > 100	2
Killip class II–IV	2
Weight < 67 kg	1
Presentation	
Anterior ST elevation or LBBB	1
Time to therapy > 4 h	1
Total possible score	14

Demographic, clinical, paraclinical data and in-hospital complications were recorded for analysis. According to the above-mentioned criteria, 120 patients with RVI and 380 cases without RVI were detected. Excluding patients who died during the in-hospital period and considering some logistic problems for long-term follow-up, data for out-of-hospital study were available for 78 patients in the

RVI group, which were compared with 154 randomly-selected patients in the non-RVI group. Post-hospital survival was evaluated by telephone or periodic visit of patients. Analysis of data was done with SPSS 11.5 software package. Data were expressed as mean value \pm SD, and p-value ≤ 0.05 was considered significant.

Results

Baseline characteristics

Of the 500 consecutive patients with inferior wall myocardial infarction, 120 were found to have RVI. The diagnosis of RVI was made by ECG in 91% and echocardiographic criteria in 9%. The baseline characteristics are recorded in Table II. No significant difference was observed between the groups in terms of age, sex, diabetes mellitus, smoking, or familial history of coronary artery disease (Table II).

Table II. Characteristics of study patients

	RVI Group (n=120) (%)	Non-RVI Group (n=380) (%)	P value
Age (yr)	64.8 \pm 11.6	62.3 \pm 9.5	0.3
Male Sex	63.2	68	0.2
Hyperlipidemia	20.8	29.2	0.1
Familial Hx of CAD	10	13	0.4
Diabetes	17.5	17.5	0.9
Hypertension	50.8	42.9	0.2
Smoking	38.3	38.7	0.9
LVEF(Mean \pm SD)	48.1 \pm 11.2	49.2 \pm 12.5	0.9
Streptokinase	43.2	31.8	0.03
Angioplasty	5	3.7	> 0.05

RVI: right ventricular infarction; **SD:** standard deviation; **Hx of CAD:** history of coronary artery disease; **LVEF:** left ventricular ejection fraction

There was no significant difference in the prevalence of severe systolic LV dysfunction defined as EF $\leq 35\%$ between the two groups (RVI: 7.5% vs. non-RVI: 7.1%, $p > 0.3$).

Patients with RVI were less likely to be treated with beta-blocking agents ($p<0.001$) and nitrates ($p<0.001$); no difference was seen in the use of heparin or ACE inhibitors ($p=0.9$) or aspirin ($p=0.2$). Of the patients with RVI, 43.2% underwent thrombolytic therapy with streptokinase compared with 31.8% of the patients without RVI ($P=0.03$). Angioplasty was performed in 6 patients in the RVI group compared with 14 cases in the non-RVI group ($p>0.05$).

Clinical course

In-hospital mortality was higher in patients with RVI than in patients without RVI (RVI: 28.3% vs. non-RVI: 8.9%; $P<0.001$). Similarly, in-hospital AMI-related complications were significantly increased in patients with RVI compared to patients without RVI (RVI: 56.7% vs. non-RVI: 34.4%; $P<0.001$, Table III).

Table III. Comparison of end-points by right ventricular infarction status

End – points	RVI (n = 120) %	Non – RVI (n = 380) %	P - Value
In- hospital death	28.3	8.9	<0.001
In-hospital complications	56.7	34.4	<0.001
Ventricular arrhythmias	10	5.8	0.05
CHB	34.2	9.1	<0.001
Hemodynamic compromise	11.7	6.5	0.03
Mechanical complications	3.4	1.4	0.5

CHB: Complete Heart Block; **mechanical complications** (ventricular septal defect, acute mitral regurgitation); **Hemodynamic compromise** (cardiogenic shock, and CHF).

Considering a mean follow-up period of about 31 ± 8.7 months, out-of-hospital mortality was more common in the RVI group (24.3% vs. 12.1% in non-RVI; $P =0.02$) and was more common in females (53%) vs. males (29%, $P =0.02$).

TIMI risk score analysis

Application of TIMI scores revealed a strong association between the outcome and degree of TIMI score elevation (Fig. 1).

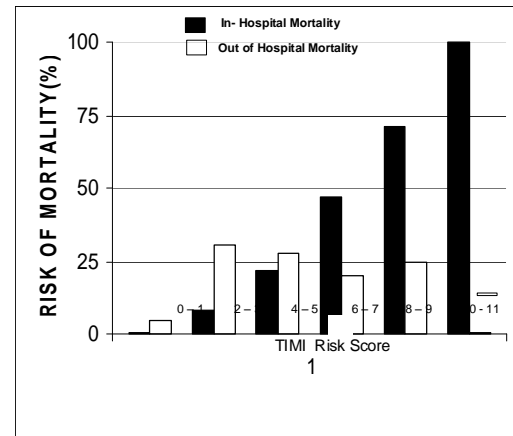


Fig.1. In-hospital and long-term mortality by TIMI risk score in patients with RVI.

Of the 120 patients with RVI, 45 (37.5%) had TIMI score < 4 and 75 (62.5%) had TIMI score ≥ 4 . In-hospital mortality was 4.4% in the first compared with 42.7% in the second group ($P<0.001$, $OR=15$). Also, in-hospital complications were found in 45.5% of the first group and 63.2% of the second group patients ($P=0.05$). There was no significant difference in out-of-hospital mortality between the two groups (TIMI score < 4 : 18.6% vs. TIMI score ≥ 4 : 25.5%; $P=0.35$). We observed a significant association between each one-point increase in the TIMI score and in-hospital mortality ($OR=3.56$, $P<0.001$), but such a correlation could not be found between TIMI score and long-term survival ($P=0.15$).

Discussion

Clinical data provide clear evidence that patients with inferior MI who have RV myocardial involvement are at substantially increased risk of major complications, including death, cardiogenic shock, and ventricular arrhythmias¹⁻⁵

In our study, in-hospital mortality was three times more common in the RVI group, similar to the findings of Mehta² and Gumina et al.¹ Meanwhile, the lack of any difference in the prevalence of significant LV dysfunction between these two groups, as demonstrated in our study (RVI: 7.5% vs. non-RVI: 7.1%, $p>0.3$), indicates that the adverse prognosis in patients with RV myocardial involvement is not simply due to more extensive infarction of the LV; rather, it appears to be due directly to the involvement of the RV.²

In our study, similar to some other reports,^{1,3} in-hospital complications were significantly more common in the RVI group (Table III). The worse prognosis in patients with RV myocardial involvement may be related to these increased complications, as increased risk of life-threatening ventricular arrhythmias, atrioventricular block, sustained VT and VF.

To our knowledge, only one study has established a prognostic measure within RVI patients alone.¹ The development of the TIMI risk score⁶ has created a useful tool with which to risk-stratify patients with acute MI. It has been validated in a large, non-selected registry of AMI patients.⁷ Our observations extend previous work by demonstrating the utility of the TIMI risk score to patients with RVI. The score accurately predicted incremental short-term mortality risks in patients with RVI.

With increasing TIMI risk score, in-hospital mortality increased step-wise from 0 in TIMI risk score 0-1 to 70.5% in those with TIMI risk score ≥ 6 . However, unlike our study, there was no further increase in mortality with risk scores beyond 4-5 in the Gumina study.¹ In this study, the number of patients within each score group was not reported, so we could not find a definite explanation for this finding. One possible cause may be related to a higher rate of reperfusion therapy in the Gumina study (61.8%) compared with our study (48.2%), which has led to decreased mortality of high score patients. In our study, every one-point increase in TIMI risk score was associated with $3.5\pm 1.4\%$ ($p<0.001$) increase in in-hospital mortality.

In our study, out-of-hospital mortality in a mean follow-up period of about 31 ± 8.7 months was 24.3% in RVI and 12.1% in the non-RVI group ($p=0.02$). The long-term prognosis of patients with right ventricular infarction has not been well defined.⁹

Berger et al. identified 58 patients with right ventricular dysfunction out of 1110 patients undergoing predischARGE radionuclide ventriculography in the TIMI-2 trial. Right ventricular function had returned to normal by 6 weeks in over 80% of patients, and the initial right ventricular dysfunction was not associated with increased mortality at 1 year.⁵ Also, using echocardiography, Keitkoglou et al. showed significant improvement in RV systolic and diastolic function 3 months after acute RVI.¹⁰ However, other studies have shown that right ventricular dysfunction may persist,^{5,11} and if it does, it predicts an adverse long-term outcome.⁹ The differences in these studies may depend upon whether the patients studied had true right ventricular infarction or ischemia with resultant right ventricular stunning that subsequently recovered completely. The prognosis may also be different if patients receive reperfusion therapies. Prompt and complete reperfusion of the right ventricle dramatically improves right ventricular function and hence the clinical outcome.^{12,13} Consequently, increased mortality of the RVI patients in our study may be related to the lower rate of reperfusion therapy (especially angioplasty) in our patients and higher rate of persistent RV dysfunction. For example, the rate of primary angioplasty in the RVI group was 61.8% in the Gumina et al. study versus 5% in our patients.¹

In our study, there was no significant correlation between TIMI risk score and long-term mortality (TIMI score <4 : 18.6% vs. TIMI score ≥ 4 : 25.5%; $p=0.35$). Considering the fact that only 78 patients underwent long-term follow-up, we are inclined to believe that this finding should be evaluated at a larger series. Nonetheless, at present, our explanation for this finding is related to the nature of parameters in TIMI risk score (Table I) since parameters like systolic blood

pressure, heart rate, and Killip class may indicate acute ischemia and acute left or right ventricular ischemia that resolves with routine treatments with no long-term sequelae. So, there is no place for increase in long-term mortality with increase in TIMI risk score.

Conclusion

RVI leads to a significant increase in in-hospital mortality and morbidity of acute inferior wall infarction, which can be predicted accurately with TIMI risk score system. Lack of early reperfusion therapy may lead to increased long-term mortality of these patients, which could not be predicted accurately using this system.

References

1. Gumina RJ, Wright RS, Kopecky SL et al. Strong predictive value of TIMI risk score analysis for in-hospital and long-term survival of patients with right ventricular infarction. *Eur Heart J* 2002; 23: 1678 – 1683.
2. Mehta S, Eikelboom J, Natarajan M et al. Impact of right ventricular involvement on mortality and morbidity in patients with inferior myocardial infarction. *J Am Coll Cardiol* 2001; 37: 37–43.
3. Zehender M, Kasper W, Kauder E, et al. Right ventricular infarction as an independent predictor of prognosis after acute inferior myocardial infarction. *N Engl J Med* 1993; 328: 981–8.
4. Bueno H, Lopez-Palop R, Bermejo J, Lopez-Sendon J, Delcan J. In-hospital outcome of elderly patients with acute inferior myocardial infarction and right ventricular involvement. *Circulation* 1997; 96: 436–41.
5. Berger P, Ruocco N, Ryan T, et al. Frequency and significance of right ventricular dysfunction during inferior wall left ventricular myocardial infarction treated with thrombolytic therapy (results from the thrombolysis in myocardial infarction [TIMI] II trial). *Am J Cardiol* 1993; 71: 1148–52.
6. Morrow D, Antman E, Charlesworth A, et al. TIMI risk scores for ST-elevation myocardial infarction: a convenient, bedside, clinical score for risk assessment at presentation. An intravenous NPA for treatment of infarcting myocardium early II trial substudy. *Circulation* 2000; 102: 2031–7.
7. Morrow D, Antman E, Parsons L, et al. Application of the TIMI risk score for ST-elevation MI in the National Registry of Myocardial Infarction 3. *JAMA* 2001; 286: 1356–9.
8. Braunwald E, Zipes D, Libby P. *Heart Disease: A Textbook of Cardiovascular Medicine*. 6th edition. Philadelphia, W. B. Saunders Co., 2001; 1131.
9. Wong CK, White HD. Risk stratification of patients with right ventricular infarction: is there a need for a specific risk score? *Eur Heart J* 2002; 23: 1642 – 1645.
10. Keitkoglu DG, Karvounis HL, Papadopoulos CE et al. Echocardiographic evaluation of spontaneous recovery of right ventricular systolic and diastolic function in patients with acute right ventricular infarction associated with posterior wall left ventricular infarction. *Am J Cardiol* 2004; 93: 911–913.
11. Marmor A, Geltman EM, Biello DR, Sobel BE, Siegel BA, Roberts R. Functional response of the right ventricle to myocardial infarction: dependence of the site of left ventricular infarction. *Circulation* 1981; 64: 1005–11.
12. Dellitalia LJ. Reperfusion for right ventricular infarction. *N Engl J Med* 1998; 338: 978–980.
13. Bowers TR, O'Neill WW, Grines C, Pica MC, Safi'an RD, Goldstein JA. Effect of reperfusion on biventricular function and survival after right ventricular infarction. *N Engl J Med* 1998; 338: 933–40.