Further ST Segment Elevation during the First Hour of Thrombolytic Therapy in Patients with Acute Myocardial Infarction as a Marker of Reperfusion

*Amir Farhang Zand Parsa, MD and Maryam Nouri, MD

Abstract

Background- Normalization of ST segment elevation after thrombolytic therapy for acute myocardial infarction (AMI) is accepted as an indirect method for reperfusion. In this study, we found that further ST elevation during the first hour of thrombolytic therapy is accompanied with better left ventricular (LV) function and patency of infarct-related artery (IRA) than cases without further ST elevation.

Methods- From Sept. 2000 to Aug. 2002, one hundred patients who had AMI (60% anterior, 37% inferior and/posterior, 3% combined anterior and inferior) and received streptokinase (SK) were evaluated for ST segment changes, LV function and IRA residual stenosis. 76% of them were male, and their mean age was 56.59±11.84 years.

Results- Further ST elevation occurred in 46 patients (Group 1), and 54 patients exhibited no additional ST segment elevation (Group 2). LV ejection fraction (LVEF) was higher in Group 1 than in Group 2 (48.58±6.72% vs. 41.75±8.91%, p<0.001). It was more significant in patients with anterior MI (48.21±6.83% vs. 39.68±8.12%, p<0.001) than in patients with inferior MI (50±5.86% vs. 46±8.52%, p=NS). Group 2 had more severe IRA residual stenosis than Group 1 (83.33±18.21% vs. 67.08±25.44%, p=0.034).

Conclusions- This study indicates that further ST elevation during the first hour of thrombolytic therapy in patients with AMI is in favor of reperfusion and a better outcome ***(Iranian Heart Journal 2004; 5(3):6-10).***

Key words: ST segment elevation■ thrombolytic therapy■ left ventricular ejection fraction■ myocardial infarction■ coronary angiography

Occlusion of the infarct related artery is the result of thrombosis that superimposes on an atherosclerotic ruptured plaque. The easiest way to open the occluded vessel is to dissolve the thrombotic component of occlusion by thrombolytic agents (TPA or streptokinase…).[1,2] Coronary angiography is the only direct way to show the patency rate (reperfusion) of IRA, but it is impossible in all the patients who receive thrombolytic agents.

Indirect assessment of reperfusion usually is done by echocardiographic ST segment changes. The early normalization of ST segment elevation is accepted as the most sensitive marker for reperfusion,[1,2] but frequently further transient ST segment elevation is seen during thrombolytic therapy. Recent reports[3,4] indicate that this finding is strongly in favor of reperfusion. However, there is no report that could support this finding by coronary angiography.

In this study we tried to assess the relationship between further ST segment elevation with improvement of LV function, as an end point of reperfusion and IRA residual stenosis.

From the Department of Cardiology, Imam Khomeini Medical Center, Tehran University of Medical Sciences, Tehran, Iran.
Correspondence to: A. Zand Parsa, Assistant Professor of Cardiology, Department of Cardiology, Imam Khomeini Medical Center, Tehran University of Medical Sciences, Tehran, Iran. Tel: 8029202 Fax: 6939537

Methods

This is a prospective study that includes 100 patients with acute myocardial infarction who received thrombolytic agents (streptokinase). The inclusion criteria were ischemic chest pain >30 min but ≤12 h, and ST segment elevation ≥1 mm in limb leads and ≥2mm in precordial leads. The exclusion criteria were contraindications for thrombolytic therapy.
All the patients received 1.5 million units of streptokinase intravenously for 1h. They also received ASA, heparin and corticosteroids (one bolus) as well. Other adjunctive medications include nitrates, β-blockers, ACE inhibitors, statins and Ca-blockers as indicated. There was no significant difference regarding adjunctive medications between the two groups.
12-lead electrocardiography (ECG) was obtained just before and every 15 mins. during SK infusion. ST segment elevation was measured from J point to isoelectric line (preceding TP segment and in case of tachycardia to preceding P-R line). Further ST segment elevation ≥ 1 mm and vice-versa were recorded. Echocardiographic evaluation of left ventricular function (LVEF) was done for all the patients after 48-72 h of thrombolytic therapy. Coronary angiography was performed for those patients who had indications. The degree of residual stenosis was quantified in all the patients who underwent coronary angiography.

Statistical analysis

In this report, all variables and their contractions were considered. Analysis of data was done with SPSS 9 program. Our findings were compared using Chi-square, Fisher-exact and ANOVA tests in accordance with our purpose and discrete variables. Data are expressed as mean value ± SD. P-Value ≤ 0.05 was considered significant.

Results

The baseline characteristics of the patients with AMI, eligible for thrombolytic therapy are shown in Table I. One hundred patients (76% male, mean age 56.59±11.84 years) were included in the study. Of these patients, 60% had anterior, 37% had inferior and 3% had both anterior and inferior MI (Table I).

Table I. Baseline characteristics of patients (100 patients).

Characteristics	Percent
Mean age (year±SD)	56.59±11.84
Male	76
History of MI	15
History of angina pectoris	55
Hypertension	30
Diabetes mellitus	25
Hyperlipidemia	43
Smoking	51
Family history of CHD*	25
Location of MI	
Anterior	60
Inferior/posterior	37
Extensive anterior & inferior	3

*: Coronary Heart Disease

Patients were classified into two groups. Group 1 consisted of 46 patients (28 with anterior, 17 with inferior and 1 with combined infarction) who had further ST segment elevation. Group 2 comprised 54 patients (32 with anterior, 20 with inferior and 2 with combined infarction) without further ST segment elevation (Table II).
The two groups had no significant differences in terms of age, gender, adjunctive therapy, risk factors (hypertension, diabetes mellitus, cigarette smoking, hyperlipidemia, family history of CHD), history of angina pectoris, myocardial infarction or the time of onset of chest pain to the beginning of thrombolytic therapy (Table II).
Echocardiographic evaluation of LV function (LVEF) revealed better LV function (higher LVEF) in Group 1 than in Group 2 (48.58±6.72% vs. 41.75±8.91%, $p<0.001$) (Table II).

Table II. Demographic and clinical characteristics of patients in Groups 1 and 2.

Characteristics	Group 1 N=46(%)	Group 2 N=54(%)
Mean age (year±SD)	54.58±12	58.29±11.52
Male	36(78.2)	40(74)
History of MI	6(13)	8(14.8)
History of angina pectoris	24(52.1)	31(57.4)
Diabetes mellitus	10(21.7)	15(27.7)
Hyperlipidemia	20(43.4)	23(42.5)
Smoking	27(58.6)	24(44.4)
Family history of CHD	9(19.5)	16(29.6)
Anterior MI	28(60.8)	32(59.2)
Inferior/posterior MI	17(36.9)	20(37)
Onset of pain to SK<6h	38(82.6)	45(82)
LVEF	48.58±6.72	41.75±8.91

*: By ANOVA test **: By Chi square test

This difference was more significant in the subgroup with anterior infarction (48.21±6.83% vs. 39.68±8.12%, p<0.001), but the subgroup with inferior infarction revealed no significant difference (50±5.86% vs. 46±8.52%, p=NS, Table III).

Table III. Characteristics of patients with anterior and inferoposterior MI in Groups 1 and 2.

Characteristics	Anterior MI n=60 (100%)		P Value	Inferior/ posterior MI, n=37 (100%)	pValue
	Group1 (%)	Group 2 (%)		Group1 (%) Group2 (%)	
Patients, no. (%)	28(46.7)	32(53.3)		17(45.9) 20(54.1)	
Mean age ± SD	51±10.6	55.93±8.9	NS*	60±12.6 61.9±14.57	NS*
Male	24(40)	22(36.7)	NS**	11(29.7) 17(45.9)	NS***
LVEF (%)	48.21±6.83	39.68±8.12	<0.001*	50±5.86 46±8.52	NS*

*: By ANOVA test **: By Fisher-exact test
***: By Chi-square test

Cardiogenic shock occurred more in Group 2 than in Group 1 (6% vs. 0%, p=0.03). Likewise, in- hospital mortality was higher in Group 2 than in Group 1 (4% vs. 0%, p=NS, Table IV).

Coronary angiographic assessment of residual stenosis of infarct related artery showed more severe stenosis in Group 2 than in Group 1 (83.31±18.21% vs. 67.08±25.44%, p=0.034).

Table IV. Incidence of occurrence of cardiogenic shock and mortality in the two groups.

Variable	Group 1 N=46(100%)	Group 2 N=54(100%)	P Value
Cardiogenic shock	0 (0%)	6 (11.1%)	0.03*
Mortality	0 (0%)	4 (7.4%)	NS*

*: By Fisher-exact test

Table V. Severity of residual stenosis of infarct related artery (IRA) in Groups 1 and 2 who had coronary angiography.

Variable	Group 1 N=11	Group 2 N=25	P Value
IRA residual stenosis Mean±SD (%)	67.08±24.44	83.33±18.21	0.034*

*: By ANOVA test

Discussion

At the beginning of the thrombolytic era, coronary angiography was the only way for assessing the effectiveness of thrombolytic agents and induction of reperfusion.[1,6,7,8,9] Usually it was done within 90 minutes following the infusion of thrombolytic agents.[7,8] Reestablishment of coronary blood flow was accepted as the end point for reperfusion,[5,6] and patients' survival was based on it.[6,8]

Since classification and acceptance of effectiveness of intravenous utilization of thrombolytic agents by randomized placebo-control trials such as ISAM, GISSI, ISIS-2, ASSET, ECSGS, AIMS, EMRAS and LATE,[10,11] the intravenous route for thrombolytic therapy has become popular. Since then, the assessment of reperfusion has been done by indirect methods such as normalization of ST segment elevation, etc. and LV function (LVEF) has been accepted as an end point for reperfusion.[12,13]

A few reports have clarified the prognostic value of LV function as an end point for

reperfusion after thrombolytic therapy.[9,11,14,15,16]

A few other reports have also revealed that early transient ST segment elevation during thrombolytic therapy is a more sensitive marker for reperfusion than ST segment resolution,[3,4] a finding that is compatible with that in our study. In our study, patients with early further ST elevation had better LV function and lower morbidity and mortality, especially in patients with anterior myocardial infarction. Furthermore, this group of patients had less severe residual stenosis of IRA in comparison with that group of patients who had early resolution of ST segment.

The pathophysiologic mechanism of early transient ST segment elevation during thrombolytic therapy is embedded in the reperfusion *per se*. The release of potassium and changes in cell membrane integrity and potentials could be the reason for the reactivation of current of injury during the beginning of reperfusion. Re-establishment of blood flow and wash out of accumulated ions as a result of cell injury could be another explanation for transient further ST segment elevation.

Conclusion

Our study and other reports[3,4] indicate that the occurrence of further ST segment elevation during the first hour of thrombolytic therapy in patients with AMI is accompanied with higher LVEF, lower in- hospital mortality and morbidity and less severe IRA residual stenosis in comparison with patients without additional ST segment elevation.

Acknowledgements

We would like to acknowledge the contribution of our colleagues in the department of cardiology at Imam Khomeini Hospital and the staff of coronary care unit, catheterization laboratory and echocardiography unit.

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