A comparison of in-Hospital complications with ST segment elevation resolution after thrombolytic therapy in acute myocardial infarction

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Abstract

Background and objective: The primary goal of thrombolytic therapy in ST-segment elevation myocardial infarction is to restore the complete coronary reperfusion. The aim of the study was to assess the association of in- Hospital complications with ST-segment resolution after thrombolytic therapy in acute myocardial infarction.

Methods: The ECG s of 100 patients with first ST-segment elevation myocardial infarction were recorded on admission, 90 and 180 minutes after Alteplase at Hawler Teaching Hospital (Coronary Care Unit) from January 2011 to October 2011. The mean age (±SD) was 59.8±8.4years,ranging from 37-80 years, 63% were males and 37% were females, male to female ratio equal 1.7:1. Patients were divided into three groups: Group (A): complete resolution of ST segment, group (B) : partial resolution and group (C) no resolution of ST-segment, those patients were followed for the detection of in-Hospital complications.

Results: Heart failure cardiogenic shock,left ventricular systolic dysfunction and ischemic mitral regurgitation were higher in group (B) and (C) than (A) when ECGs were recorded at 90 and 180 minutes after thrombolysis ($P < 0.001$).

Conclusion: Failure or partial resolution of ST segment can predict the early development of heart failure, shock, left ventricular systolic dysfunction and ischemic mitral regurgitation.

Keywords: ST-segment elevation resolution,thrombolytic therapy.

Introduction

Analyses of ST-segments resolution on ECGs after fibrinolytic therapy in cases of ST-Segment elevation myocardial infarction (STEMI) offer an attractive and cost effective solution to assess coronary reperfusion. Whereas coronary angiogram is a marker for epicardial reperfusion, ST segment resolution offers a better reflection for micro vascular reperfusion. Although successful thrombolysis of the epicardial vessel is necessary for good prognosis, the micro-vascular flow is more strongly correlates with the outcome. Therefore ST segment resolution is a better indicator for prognosis, provides information which cannot be assessed on basis of coronary angiogram alone[1,2]. The primary goal of reperfusion therapy has shifted from opening of the infarct related artery to establishment of myocardial tissue reperfusion[3]. ST-segment resolution can also be used as a tool to identify candidates for early invasive procedures such as Percutaneous Coronary Angioplasty, who are at risk of developing complications because of non resolution of ST-segment after initial thrombolytic therapy[4]. Several studies have shown that persistent ST-segment elevation is predictive of poor recovery of left ventricular function and of increased mortality[5, 6]. The aim of the study was to assess the association of in-hospital clinical events and echocardiographic complications with ST-segment resolution after thrombolytic therapy in patients with acute STEMI.

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Methods

The study population consisted of 110 patients with STEMI who had been admitted to Coronary Care Unit (CCU) of Erbil Teaching Hospital for the period from January 2011 to October 2011. The diagnosis of acute STEMI was based on the following criteria [7]: Typical rise and/or fall of troponin with at least one of the following: a- Chest pain of ischemic character of >30 minutes duration. b- Electrocardiographic changes indicative of ischemia (ST-segment elevation). History of hypertension, diabetes mellitus, smoking, alcohol and family history of ischemic heart disease were recorded. Obesity was defined as BMI ≥30[8]. Duration of chest pain till administration of thrombolytic therapy has been recorded for all patients. Ten out of these 110 patients died before full assessment and were excluded from the study. The remaining 100 patients enrolled in the study. Their mean age (±SD) was 59.8±8.4years,ranging from 37-80 years, 63% were males and 37% were females, male to female ratio equal 1.7:1. Only patients with STEMI who received Alteplase were included in the study. Left bundle branch block, previous history of heart failure and patients with previous history of valvular heart disease were excluded from the study. Twelve leads ECG were recorded on admission before thrombolytic therapy, at 90 minute and180 minute after thrombolytic therapy. The sum of ST-segment elevation was measured at 80 ms beyond the `J` point in leads I, aVL, V1-V6 for anterior leads, II, III, aVF for inferior leads and in V1-V4 for anteroseptal leads[9]. The ST-segment elevation resolution was calculated as the initial sum of ST-segment elevation on admission before thrombolytic therapy minus the sum of remaining ST segment elevation at 90 minutes & 180 minutes after thrombolytic therapy divided by the initial sum of ST-segment elevation expressed as percentage. The patients were subsequently divided into three groups depending upon the resolution of ST-segment which is stratified by Schroder et al[10]: Group A: complete resolution (≥70% reduction of ST-segment). Group B: partial resolution (<70% to 30% reduction of ST-segment). Group C: no resolution (<30% reduction of ST-segment). All patients were followed up daily in the CCU for the detection of tachy and brady arrhythmias, heart failure and cardiogenic shock. Heart failure diagnosed according to Framingham criteria[11] supported by echocardiographic study, cardiogenic shock defined as persistent systolic blood pressure <90mmHg [12] after exclusion of other types of shock. Transthoracic two-dimensional Echocardiography (TTE) had been performed for all patients 180 minute after thrombolytic therapy and in the range of 4-8 days for the assessment of left ventricular systolic function and the detection of ischemic mitral regurgitation. We couldn't perform TTE on admission (before thrombolytic therapy) and at any time because that facilities were available only from 8AM till 2 PM and we have no portable echocardiography in the Coronary Care Unit. The Ejection fraction was determined from apical four chamber view using the Simpson's biplane formula[13].Left ventricular systolic dysfunction defined as EF ≤50% in the absence of ischemic mitral regurgitation[14] and ≤60% in the presence of ischemic mitral regurgitation[15,]Ischemic mitral regurgitation was diagnosed by color Doppler and spectral Doppler study [16].

Statistical analysis: Data were analyzed using Statistical Package for Social Sciences (SPSS, version 18).Chi-square test was used to test the association between different variables. A "P" value of ≤ 0.05 was considered as statistically significant.

Results

From the total of 100 patients; 29% (group A), 42% (group B) & 29% (group C); when ECGs were recorded at 90 minutes. 28% (Group A), 40% (Group B) and 32% (group C); when ECGs were recorded at 180 minutes after thrombolytic therapy. The

Mean time from the onset of pain till thrombolytic therapy in all groups was 5.4 hours. Regarding baseline characteristic risk factors there was no difference between group A,B and C in relation to age, gender, hypertension, diabetes mellitus, obesity, smoking, alcohol and family history of Ischemic Heart Disease when ECGs recorded at 90 and 180 minutes after thrombolytic therapy, Table 1 and 2. There was no statistical difference between groups in relation to arrhythmias, heart block, when ECGs were recorded at 90 and 180 minutes after thrombolytic therapy, Table 3&4. Comparing the three groups of ST-segment resolution, heart failure was significantly higher in groups B (31%) and C (20.7%) than group A (0%), ($p<0.001$) when ECGs were recorded at 90 minutes, Table 3. A similar statistical significant value was recorded between groups B (32.5%), C (18.8%) & A (0%) ($p<0.001$) when ECGs recorded at 180 minutes after thrombolytic therapy, Table 4. Cardiogenic shock was significantly higher in groups B (9.5%) and C (58.6%) than group A (3,4%) ($p<0.001$) when ECGs were recorded at 90 minutes. Table 3. Groups B (10%), and C (56.3%) had higher incidence of cardiogenic shock versus group A (0%), ($p<0.001$) when ECGs were recorded at 180 minutes after thrombolytic therapy, Table 4. Left ventricular systolic dysfunction diagnosed by TTE was significantly higher in groups B (28.6%) and C (93.1%) than group A (3.4%), ($p<0.001$) when ECGs were recorded at 90 minutes, Table 5. Left ventricular systolic dysfunction was higher in group B (27.5%), C (90.6%) than group A (0%), ($p<0.001$) when ECGs were recorded at180 minutes after thrombolytic therapy. Table 6. Ischemic mitral regurgitation diagnosed by TTE was higher in groups B (14.3%) and C (44.8%) than A (6.9%), ($p=0.001$) when ECGs recorded at 90 minutes. Table 5 Similarly a significant difference occur between groups B(12.5%),C (43.85) and group A (7.1%),($P=0.001$) at 180 minutes after thrombolytic therapy. table 6.

Table 1: comparison of group A,B and C with patient characteristics at 90 minutes after thrombolysis.

Risk factors		n=100 n(%)	Group A n=29 n(%)	Group B n=42 n(%)	Group C n=29 N(%)	P
Age	≥55yr	71	18(62.1)	33(78.6)	20(69)	0.32
	<55yr	29	11(37.9)	9(21.4)	9(31)	
Gender	Male	63	18(62.1)	27(64.3)	18(62.1)	1
	Female	37	11(37.9)	15(35.7)	11(37.9)	
Hypertension		67	22(75.6)	26(62)	19(65.5)	0.46
Diabetes		51	15(51.7)	20(47.6)	16(55.1)	0.85
Obesity		47	15(51.7)	17(40.5)	15(51.7)	0.55
Smoking		65	19(65.5)	24(57.1)	22(75.9)	0.29
Family history of IHD		35	11(37.9)	14(33.3)	10(34.5)	0.96
Alcohol		4	1(3.4)	1(2.4)	2(6.9)	0.82

Group A: complete resolution, Group B: partial resolution and Group C: no resolution of ST segment

Table 2: Comparison of group A,B and C with patient characteristics at 180 minutes after thrombolysis.

Risk factors		n=100 n(%)	Group A n=28 n(%)	Group B n=40 n(%)	Group C n=32 n(%)	P
Age	≥55yr	71	18(64.3)	32(80)	21(65.6)	0.26
	<55yr	29	10(35.7)	11(27.5)	8(25)	
Gender	Male	63	17(60.7)	26(65)	20(62.5)	0.96
	female	37	11(39.3)	14(35)	12(37.5)	
Hypertension		67	21(75)	26(65)	20(62.5)	0.59
Diabetes		51	14(50)	19(47.5)	18(56.3)	0.77
Obesity		47	14(50)	16(40)	17(53.1)	0.53
Smoking		65	18(64.3)	23(57.5)	24(75)	0.29
Family history of IHD		35	10(35.7)	13(32.5)	12(37.5)	0.93
Alcohol		4	1(3.6)	1(2.5)	2(6.3)	0.82

Group A: complete resolution, Group B: partial resolution and Group C: no resolution of ST segment

Table 3: Comparison of group A,B and C with in-hospital clinical events at 90 minutes after thrombolysis.

Clinical Events	Group A n=29 n(%)	Group B n=42 n(%)	Group C n=29 n(%)	P
VT/VF**	1 (3.4)	1 (2.4)	3 (10.3)	0.389
Complete heart block	0 (0.0)	2 (4.8)	4 (13.8)	0.81
Heart failure	0 (0.0)	13 (31.0)	6 (20.7)	< 0.001*
Cardogenic shock	1 (3.4)	4 (9.5)	17 (58.6)	< 0.001*

*p<0.05considered as statistically significant
**VT/VF= ventricular tachycardia/ventricular fibrillation, Group A: complete resolution, Group B: partial resolution & Group C: no resolution of ST segment.

Table 4: Comparison of group A,B and C with clinical events at 180 minutes after thrombolysis.

Clinical Events	Group A n=28 n(%)	Group B n=40 n(%)	Group C n=32 n(%)	P
VT/VF**	0 (0.0)	1 (2.5)	4 (12.5)	0.065
Complete heart block	0 (0.0)	2 (5.0)	4 (12.5)	0.147
Heart failure	0 (0.0)	13(32.5)	6 (18.18)	< 0.001*
Cardiogenic shock	0 (0.0)	4 (10.0)	18 (56.3)	< 0.001*

*p<0.05 considered as statistically significant ** VT/VF= ventricular tachycardia / ventricular fibrillation, Group A: complete resolution, Group B: partial resolution and Group C: no resolution of ST segment

Table 5: Comparison of group A,B and C with in-hospital echocardiographic complications at 90 minutes after thrombolysis .

Echocardiographic complications	Group A n=29 n(%)	Group B n=42 n(%)	Group C n=29 n(%)	P
Left ventricular systolic dysfunction	1(3.4)	12 (28.6)	27 (93.1)	< 0.001*
Ischemic mitral regurgitation	2(6.9)	6 (14.3)	13 (44.8)	0.001*

*p<0.05considered as statistically significant. Group A: complete resolution, Group B: partial resolution and Group C: no resolution of ST segment.

Table 6: Comparison of group A,B and C with in-hospital echocardiographic complications at 180 minutes after thrombolysis.

Echocardiographic complications	Group A n=28 n(%)	Group B n=40 n(%)	Group C n=32 n(%)	P
Left ventricular systolic dysfunction	0 (0.0)	11 (27.5)	29 (90.6)	< 0.001*
Ischemic mitral regurgitation	2 (7.1)	5 (12.5)	14 (43.8)	0.001*

*p<0.05considered as statistically significant. Group A: complete resolution, Group B: partial resolution and Group C: no resolution of ST segment

Discussion

No significant differences regarding the characteristic risk factors have been recorded between group A, B and C. (table 1and 2), our results were supported by M. Sezer et al [17]. Ten out of these 110 patients died before full assessment and were excluded from the study, their mean age (±SD) was 60.2±6.4 years, ranging from 56 -80 years;6 were male and 4 were female, most of those 10 patients were died at 90 and 180 minutes after thrombolysis or during follow up period within the hospital before echocardiographic study. Most of these patients were with persistent ST-segment elevation or partial resolution, and the mortality rate in patients with acute coronary syndrome is directly proportional with ST-segment deviation according to Global Registry of Acute Coronary Events (GRACE score)[18] Comparing the three groups of ST-segment resolution, heart failure was significantly higher in group B and C than A, (p<0.001) when ECGs were recorded at 90 minutes. A statistically significant value was recorded between groups B and C than A, (p<0.001) at 180 minutes after thrombolytic therapy. Heart failure is a major determinant for prognosis after MI according to GRACE score[18] and it's the most common complication in our study. These results are supported by Tomaszuk-Kazberuk A et al[19] and International Joint Efficacy Comparison of Thrombolytics trial (INJECT) trial [20]. The left ventricular systolic dysfunction diagnosed by TTE was significantly higher in groups B and C than A , when ECGs were recorded at 90 and 180 minutes after thrombolytic therapy,P<0.001. Lee SG et al carried out a study to emphasize the relation between ST segment resolution and left ventricular recovery, their results showed that ST-segment resolution is linked to return of normal left ventricular systolic function[21]. The ischemic mitral regurgitation diagnosed by TTE was

detected significantly in groups B and C than group A, (p=0.001) when ECGs were recorded at 90 and 180 minutes after thrombolytic therapy. Otsuji Y et al demonstrated that the mechanism of ischemic mitral regurgitation with segmental left ventricular dysfunction was correlated with successful reperfusion therapy determined by three-dimensional echocardiography[22]. In-hospital clinical events (table 3&4) and echocardiographic complications (table 5&6) were generally higher in groups B and C than A, these results put both groups B and C as high risk patients but further studies are needed to find out the differences between them and if the differences were not obtained and the groups B and C were incomparable, probably re classification of ST-segment resolution will be a matter of discussion in the future.

Conclusion

Failure or partial resolution of ST-segment elevation in acute MI after thrombolytic therapy can be used to predict the risk of early in-hospital development of heart failure, cardiogenic shock, LVSD and ischemic mitral regurgitation.

Recommendations:

Failure or partial resolution of ST-segment elevation can be used as a prognostic indicator to assist clinicians in early identification of high risk patients eligible for immediate interventions such as rescue angioplasty or coronary artery bypass graft.

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