ST segment resolution post MI-a predictor of better outcomes

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Abstract

Objective: To compare, the post Myocardial Infarction in-patient outcome of patients with early ST resolution to those without ST resolution on ECG, in a South Asian population.

Methods: This was a prospective study done at the Punjab Institute of Cardiology, Lahore. Consecutive patients of ST elevation myocardial infarction, who were not treated with primary angioplasty but were thrombolysed were recruited at the time of arrival in the emergency department. Streptokinase was administered to all patients as the agent of thrombolysis. ECG was acquired at baseline and at 60 minutes post streptokinase administration. Patients were subsequently divided into two groups

(A) Patients with ST segment resolution, after 60 minutes of administration of streptokinase

(B). Patients without ST segment resolution, after 60 minutes of administration of streptokinase.

This cohort was followed up through the in hospital stay for major complications which were recurrent ischaemic chest pain ,heart failure, arrhythmias and death, during the follow up period (Mean stay 3.01± 0.77 days).

Results: A total of 148 patients were included in this prospective study. There were 122 males and 26 females. In group A complications developed in 33 (35%) out of 95 patients and 43 (81%) out of 53 patients in group B ($p< 0.001$). Recurrent chest pain was present in 19 (20%) patients of group A and 31 (59%) patients of group B ($p<0.001$).Heart failure was the most common complication observed in both groups, 26 (27%) patients in group A and 33 (62%) patients in group B ($p<0.001$).Arrhythmias were more common in group B, with 17 (32%) patients from group B and 9 (10%) from group A developing this complication ($p<0.001$).

Conclusions: The extent of ST segment resolution provides useful information about early clinical outcome in post-myocardial infarction patients (JPMA 58:283;2008).

Introduction

Analysis of ST-segment resolution on ECG, after fibrinolytic therapy, in cases of ST elevation Myocardial Infarction offers 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 of microvascular reperfusion. Although successful thrombolysis of the epicardial vessel is necessary for good prognosis, but the micro-vascular flow more strongly correlates with the outcome. ST segment is therefore a better indicator of prognosis, and provides information, which cannot be assessed on basis of cardio angiogram alone.[1-3] In fact Schroeder et al[4] reported that absence of ST segment resolution was the most powerful independent predictor of early mortality ($p = 0.0001$). ST resolution can also be used as a tool to identify candidates for early invasive procedures such as PTCA, who are at risk of developing complications because of non resolution of ST segment after initial thrombolytic therapy[5] Since ECG is widely available even in developing nations, it is important to establish its effectiveness as a tool for assessing reperfusion as it will offer the cheapest alternative for assessing recovery and myocardial salvage. The aim of our study was to correlate the incidence of complications with ST-segment resolution, thereby re-enforcing the role of ST-resolution as a marker of improved clinical outcome in cases of ST-elevated myocardial Infarction in our population.

Patients and Methods

The duration of the prospective study conducted at Punjab Institute of Cardiology, was 6 months starting from July 2006 to January 2007. The study included data of 148 diagnosed cases of acute Myocardial Infarction. The diagnosis was based on WHO criteria for acute myocardial infarction i.e. presence of any two of the following: 1) Chest pain consistent with acute myocardial infarction of less than 24hrs duration, 2) Electrocardiography changes i.e. ST-segment elevation >0.2mv in at least two contiguous chest leads or >0.1mv in at least two contiguous limb leads, 3) New or presumably New left bundle branch block on Electrocardiogram and 4) raised levels of cardiac enzymes CPK-MB more than double of the reference value or positive Troponin I test done with commercially available kits of Trop I.

Inclusion criterion: only patients with ST elevated MI who received Streptokinase upon presentation, in

emergency were included in the study.

The study population was divided into two groups

1. Patients with ST segment resolution on Electrocardiogram. (done after 60 minutes of administration of streptokinase) and 2. Patients without ST segment resolution on Electrocardiogram (done after 60 minutes of administration of streptokinase)

A detailed history was taken, particularly of age, sex, occupation, address, history of smoking, Diabetes Mellitus, hypertension and family history of ischaemic heart disease. Complete physical examination of patients was done upon presentation in Emergency and important parameters such as pulse and blood pressure were noted. Patients were followed up daily. Pulse, ECG changes and complications if any, were monitored till death or discharge of the patient. The end point was a composite of recurrent ischaemic chest pain, Heart failure, arrhythmia or death.

Time from onset of chest pain to presentation of patient in emergency was noted through history of patient. ECG recordings of patients were taken upon presentation in Emergency. ST elevation was recorded in millimeters from the lead in which maximum elevation was observed

Repeat ECG was performed after 60 minutes of administration of Streptokinase(SK). ST resolution was observed in the lead with the maximum ST elevation. ST resolution was defined as a reduction of $\geq$ 50% ST segment elevation after thrombolysis. Follow up was conducted for each patient throughout his or her hospital stay. The major complications noted were recurrent ischemic chest pain, heart failure, arrhythmia and death.

Recurrent ischaemic chest pain was documented from the history and ECG, Heart failure was assessed on the basis of clinical examination, chest X-ray, echocardiography and coronary angiography reports. Arrhythmia was assessed seen from the continuous bed side monitoring of ECG. Tachycardia was defined as pulse rate >100 and bradycardia as<60 per minute.

All data was analyzed by SPSS (statistical package for Social Sciences) version 12.0 for windows. Chi- Square test was used to compare the demographic characteristics and complications in both groups 0.05% level of significance were used.

Results

A total of 148 patients were enrolled in the study, of these 82% were male and 18% were female. The overall mean age of the study participants was 54.4 ± 12.7 years. Table1 shows the demographic characteristics of the study population at presentation. Mean age in Group A was 53.34 ± 13.38 years while in group B was 56.30 ± 11.26 years.

Table 1. Demographic Data at time of presentation.

Demographic Characteristics		ST-resolution present (gp. A) n=95	ST-resolution absent (gp. B) n=53
Mean Age (st deviation)		53.34 ± 13.38	56.30 ± 11.26
Gender	M	76	46
	F	19	7
Diabetes Mellitus		34 (35%)	22 (42%)
Hypertension		38 (40%)	14 (26%)
Hypercholesterolemia		18 (19%)	12 (23%)
Family History		22 (23%)	9 (17%)
Smoking		48 (51%)	29 (54%)

There was no significant difference between the co-morbidities of the two groups, with Hypertension showing the most significant trend ($p< 0.097$). The history of hypertension and family history of cardiac disease was more common in group A, while history of Diabetes Mellitus and hypercholesterolemia was more common in group B. Smoking was almost equally prevalent in both the groups.

Of the 148 consecutive patients included in this prospective study, there were 95 (64%) patients who showed ST resolution in their post SK ECG taken after 60 minutes (group A) while 53 (36%) patients showed no ST resolution (group B). In group A, 33 (35%) patients developed complications during their follow up in the hospital. While in group B, 43 (81%) patients developed complications during their hospital stay.

Figure shows the time from onset of symptoms to the administration of streptokinase for thrombolysis(x-axis) linked to percentage of patients (y-axis) who showed ST resolution or did not show ST resolution. (Note: categories in which there were less than 10 patients presenting were excluded from the graph) 6 patients were thrombolysed 0.5 hr after onset of symptoms. Among these 3 (50%) showed

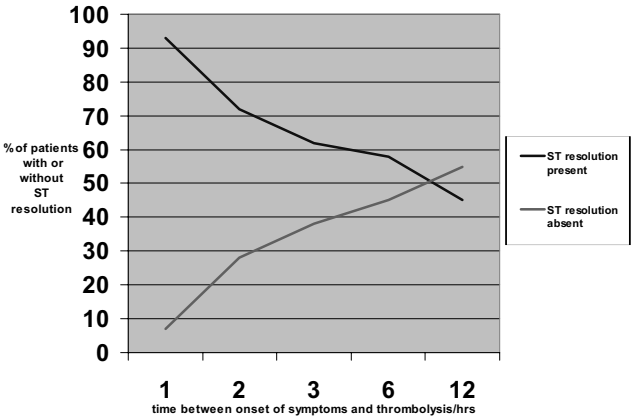

Figure. Time between onset of symptoms and thrombolysis linked to st resolution.

Table 2. Complications in the two groups.

Complication	ST resolution present (n=95)	ST resolution absent (n=53)	P value
Recurrent ischemic chest pain	19 (20%)	31 (59%)	<0.001
Heart failure	26 (27%)	33 (62%)	<0.001
Arrhythmia	9 (10%)	17 (32%)	<0.001
Death	0 (0%)	3 (6%)	<0.001

ST resolution while 3 (50%) showed no ST resolution. Fifteen patients were administered streptokinase within 1 hour after onset of symptoms, 14 (93%) of them showed ST resolution while 1 (7%) did not show ST resolution. Among the 43 patients who were thrombolysed 2 hours after onset of symptoms, 31 (72%) showed ST resolution and 12 (28%) did not show ST resolution. Twenty six patients were thrombolysed 3 hrs after onset of symptoms and among them 16 (62%) showed ST resolution and 10 (38%)did not show ST resolution. Two patients received thrombolysis after 4 hrs of onset of symptoms and in both (100%) cases ST resolution was absent. Of the 45 patients who were given streptokinase 6 hrs after onset of symptoms, 26 (58%) of them showed ST resolution while 19 (42%) did not show ST resolution. Thrombolysis 12 hours after onset of symptoms was given to 11 patients. Of these 5 (45%) had ST resolution while 6 (55%) had no ST resolution in their post SK ECG.

The most common complications were recurrent ischaemic chest pain, Heart failure and arrhythmias. Table 2 shows the relationship between these complications and presence or absence of ST resolution. There was a statistically significant difference in the incidence of all the complications between the two groups as shown by the p-values in Table2. Out of 148 patients, 3 died and their ECG did not show ST resolution in the post SK ECG.

Mean hospital stay was 3.21± 0.97 days for patients who showed no ST resolution and 2.89 ± 0.61 days for patients who showed ST resolution ($p<0.001$).

Discussion

ST- segment elevated Myocardial infarction (STEMI) is a serious condition with a bad outcome and historically ST resolution has been one of the markers used to assess reperfusion in STEMI. Its importance cannot be denied as a prognostic indicator and the results of our study also reinforce this fact. However its use as a cost effective marker has been underutilized. Our results showed the incidence of complications, in patients who showed ST resolution one hour after administration of streptokinase, to be 35% while the incidence of complications in patients without ST resolution in their post SK ECG was 81% ($p<0.001$), the rate in the latter being substantially higher. This finding therefore establishes a direct correlation between ST resolution and the frequency of complications.

These results are supported by the study carried out by Bhatia et al.[6] Their results showed that the patients who did not show ST resolution developed complications during their stay at the hospital more frequently than those who showed ST resolution. Of the patients who showed ST resolution, 38% developed complications compared to 83% of the patients from the non - ST resolution group ($P<0.001$). Another study carried out by Aderson RD et al[7] showed that presence or absence of ST resolution after thromobolysis therapy is a useful predictor of mortality in post myocardial infarction patients. Thus the above-mentioned references explain that ST-segment resolution is a useful prognostic indicator and should be used to assess the efficacy of thrombolysis.

In our study we noted that only 19 (20%) patients from ST resolution group developed recurrent chest pain while 31 (59%) from non-ST resolution group developed recurrent chest pain in their early clinical outcome ($p<0.001$). Study conducted by Ioannis vogiatzis et al[8] supports our results. Their results showed that recurrent ischemic angina was observed in 4.21% of the patients who showed no ST resolution while 3.08 % of the patients who showed ST resolution experienced recurrent ischemic chest pain.

In our results we observed that the incidence of Heart failure was 27% in patients with ST resolution and 62% in patients without ST resolution ($p<0.001$), during follow up. Heart failure is the major determinant for prognosis after myocardial infarction and the most common complication observed in this study. Our results are supported by the findings of a study done by the Shlomi Matetzky et al.[9] They report 28% left ventricular dysfunction rate in patients without ST resolution vs. 19% in with ST resolution. Another study conducted by Tomaszuk-Kazberuk A et al[10] also supports our results. Their results showed that frequency of Left Ventricular dysfunction was greater in post MI patients who did not show any ST resolution. They concluded that return of normal LV systolic function is linked to ST resolution. Lee SG et al[11], carried out a study to emphasize the relation between ST resolution and left ventricular recovery. Their results showed that in patients with ST segment resolution left ventricular ejection fraction and muscle contractility improved significantly. While in patients who did not show any ST resolution, changes relating to LV function were insignificant thus there was no improvement in LV function. They concluded that ST segment resolution is linked to return of normal LV systolic function and prognosis.

However we assessed clinical heart failure due to the fact that not every patient was subjected to echocardiography during hospital stay, but Bainey KR et al[12] found that 70% or higher ST-segment resolution was associated with a significantly lower incidence of in hospital congestive heart failure (CHF) and CHF/death.

We observed arrhythmias in 32% of the patients who had no ST resolution whereas 10% experienced arrhythmias in the ST resolution group. The results clearly show that arrhythmias are less frequent in patients who show ST resolution in their post SK ECG. A study was carried out by Ioannis vogiatzis et al[8] which supports these results. Their result indicated that arrhythmia was detected in 2.1 % patients who showed persistent ST elevation in their post SK ECG while only 1.54% of the patients who showed ST resolution developed arrhythmia.

The prognosis after ST elevation acute Myocardial Infarction is affected by various factors such as age, gender, number of coronary risk factors presented by the patient, use of aspirin within 7 days, and number of angina attacks the patients' suffered.[13] We could not assess these factors, which could correlate strongly with mortality in our study. This was an important limitation. A multi-variant analysis is required to exclude the importance of these confounding factors. Another limiting factor was the non-randomized nature of the research and small size of patients included in the study. In addition to this it was also limited by the fact that it was a single centre study and the researchers lacked experience. .

Conclusion

The findings of our study support the evidence that ST resolution is a useful and dependable marker for evaluating micro-vascular perfusion, which in turn establishes the role of ST resolution as a tool for predicting prognosis and mortality.

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