Electrocardiographic Resolution of ST-Segment Elevation after Thrombolytic Therapy in Acute Myocardial Infarction

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Abstract
This study is done to evaluate the effect of thrombolytic therapy in acute M.I utilizing a non-invasive method (i.e. ECG).
Forty-five patients with acute Q-wave M.I whose ECG shows ST-segment elevation were given thrombolytic therapy. The sum of S-T segment elevation in 12-leads ECG were estimated prior to thrombolytic therapy, 2 hours later, and 24 hours after thrombolytic treatment. Resolution of S-T elevation after thrombolytic therapy is taken as a parameter of efficacy of thrombolysis in these patients.
Time of presentation (i.e. the time interval from the onset of chest pain until giving thrombolytic therapy) appeared as the most important factor in the response to thrombolysis.

Introduction
Acute M.I is a focus of necrosis of the myocardium resulting from inadequate tissue perfusion. It is accompanied by consequent hypoxia, accumulation of deleterious metabolites and signs and symptoms reflective of myocardial cell death.[1]
The diagnosis of acute myocardial infarction can be made when the history is typical with sequential ECG changes. Elevation of S-T segment with appearance of Q-wave can establish the diagnosis with certainty. Other markers are elevated serum level of cardiac-specific macromolecules such as troponin I, troponin T & CK enzyme. S-T segment elevation represents the current of injury initiated due to myocardial necrosis.
Either intravenous thrombolytic therapy or catheter-based approach or both can achieve coronary artery recanalisation.
There are many types of thrombolytic agents such as urokinase, streptokinase, tissue plasminogen activator (tPA), anisoylated plasminogen-streptokinase activator complex (APSAC), and reteplase.[1]
Actylase is a recombinant t-PA i.e. a genetically engineered thrombolytic agent. It is not antigenic & seldom causes hypotension, therefore better than streptokinase, but it is ten times more expensive than streptokinase.[2]

Thrombolytic agents help to restore coronary patency, preserve left ventricular function and improve survival. Successful thrombolysis leads to myocardial reperfusion with relief of pain, resolution of acute ECG changes & sometimes associated with transient arrhythmias.[3]

Patients and Methods

This open (i.e. non-controlled) study was conducted in Al-Najaf teaching hospital over a period of ten months extending from January 2003. It was conducted on patients who have been admitted to the coronary care unit (CCU) with acute myocardial infarction. Forty-five patients were included in this study. Their age ranged between 37 and 65 years. Forty-one of them were male, while four were female.

Patients included in the study were those with acute Q- wave myocardial infarction presenting within 12 hrs. from the onset of chest pain.

Excluded from the study were patients with factors that may influence the accuracy of assessment of ST- segment elevation in the ECG. These are:
1- Left bundle branch block.
2- Paced rhythm.
3- Ventricular rhythm.
4- Missing base-line ECG.

Base-line ECG record has been done prior to giving thrombolytic therapy. Other ECG records were done 2hrs. and 24hrs. after giving thrombolytic therapy, because the maximum response is seen within 2 hours, and we check after 24 hours to see that the response is sustained. The amount of ST-segment elevation was measured manually, 20 milliseconds after the “J” point with the use of a hand-held caliper. The sum of ST- segment elevation in the 12-lead ECG was measured for each patient ($\sum ST$).

After admission to the coronary care unit every patient was given actylase (thrombolytic agent). It is given intravenously over a ninety minutes period. A bolus dose of 15 milligram was given first. Then intravenous infusion of 0.75 milligram per kilogram body weight (not exceeding 50 milligram) was given over 30 minutes, followed by 0.5 milligram per kilogram body weight (not exceeding 35 milligram) over 60 minutes. Intravenous heparin is also given after that and continued as long as the patient is in the CCU.

The degree of resolution of ST-segment elevation i.e. the net differences between the sum ST-segment elevation in ECG taken before & after thrombolytic therapy is measured for every case ($\sum ST$ before versus $\sum ST$ after thrombolysis).

Statistical analysis used was according to pair-t test, LSD ANOVA test & pairwise-t test at a level of significance of $\alpha=0.05$ (P value $< 0.05$ regarded significant).

Results

Table (1) shows the number & percentage of patients in the study divided according to the time of presentation of chest pain. It shows that most of the patients with acute myocardial infarction fall in the early presentation group i.e. present within less than three hours from the onset of chest pain.

Table (2) includes the number & percentage of patients according to the age groups. It shows that most of the patients fall in the age group 51-60 years (44%). While the younger age group is less frequent and those older than 60 years are the least frequent (40% & 16% respectively).

Table (3) shows the effect of thrombolytic therapy given to the patients with acute myocardial infarction according to changes in the ECG, i.e. $\sum ST$ segment elevation, taken before and 2 hours after giving thrombolytic therapy.
They are divided according to the time of presentation of chest pain. It shows that in patients presenting early (<3 hours) the benefit is much greater than the others who presented later. The benefit of thrombolytic therapy becomes less significant as the time passes i.e. late presentation.

Table (4) shows the effect of thrombolytic therapy (as a change in ST-segment elevation) twenty-four hrs. after thrombolysis compared to that before thrombolysis. It also shows a significant effect for the time of presentation as that seen in table (3).

Table (5) shows the net ECG changes in Σ ST-segment elevation before and 2 hrs after thrombolysis according to age groups. It shows no significant difference between different age groups (P value>0.05).

**Table 1** Acute MI patients divided according to the time of presentation

<table>
<thead>
<tr>
<th>Time of presentation (hr.)</th>
<th>No. of patients</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-3</td>
<td>23</td>
<td>51</td>
</tr>
<tr>
<td>&gt;3-6</td>
<td>10</td>
<td>22</td>
</tr>
<tr>
<td>&gt;6-12</td>
<td>12</td>
<td>27</td>
</tr>
</tbody>
</table>

**Table 2** Acute MI patients divided into age groups

<table>
<thead>
<tr>
<th>Age groups (years)</th>
<th>No. of patients</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group1: 30-50</td>
<td>18</td>
<td>40</td>
</tr>
<tr>
<td>Group2: &gt;50-60</td>
<td>20</td>
<td>44</td>
</tr>
<tr>
<td>Group3: &gt;60</td>
<td>7</td>
<td>16</td>
</tr>
</tbody>
</table>

**Table 3** This table shows the sum ST-segment elevation in ECG taken before & 2hrs. after giving thrombolytic therapy. The patients are divided according to the time of presentation.

<table>
<thead>
<tr>
<th>Time of presentation (hr.)</th>
<th>No. of patients</th>
<th>ST elevation before therapy (mm.)¶</th>
<th>ST elevation 2hr after therapy (mm.)¶</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-3</td>
<td>23</td>
<td>8.22±1.09</td>
<td>3.00±0.79</td>
<td>&lt;0.001 *</td>
</tr>
<tr>
<td>&gt;3-6</td>
<td>10</td>
<td>13.30±3.28</td>
<td>8.60±2.55</td>
<td>&lt;0.05 **</td>
</tr>
<tr>
<td>&gt;6-12</td>
<td>12</td>
<td>11.83±1.85</td>
<td>5.42±0.94</td>
<td>&lt;0.05 **</td>
</tr>
</tbody>
</table>

¶ The values are expressed as: Mean ± Standard Error

*P<0.001 is highly significant

**P<0.05 is significant
Table 4 This table shows the sum ST-segment elevation in ECG taken before & 24 hrs. after giving thrombolytic therapy. The patients are divided according to the time of presentation.

<table>
<thead>
<tr>
<th>Time of presentation (hr.)</th>
<th>No. of patients</th>
<th>ST elevation before therapy (mm.)¶</th>
<th>ST elevation 24hr after therapy (mm.)¶</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-3</td>
<td>23</td>
<td>8.22±1.09</td>
<td>3.52±2.15</td>
<td>&lt;0.001 *</td>
</tr>
<tr>
<td>&gt;3-6</td>
<td>10</td>
<td>13.30±3.28</td>
<td>6.60±2.15</td>
<td>&lt;0.05 **</td>
</tr>
<tr>
<td>&gt;6</td>
<td>12</td>
<td>11.83±1.85</td>
<td>5.17±0.87</td>
<td>&lt;0.05 **</td>
</tr>
</tbody>
</table>

¶ The values are expressed as: Mean ± Standard Error

*P<0.001 is highly significant

**P<0.05 is significant

Table 5 This table shows the significance of ST-segment resolution in ECG taken 2 hrs. after thrombolytic in different age groups.

<table>
<thead>
<tr>
<th>Age groups* (years)</th>
<th>Mean difference ± S.E‡</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 1x group 2</td>
<td>1.959±1.221</td>
<td>&gt;0.05†</td>
</tr>
<tr>
<td>Group 1x Group 3</td>
<td>2.343±1.684</td>
<td>&gt;0.05†</td>
</tr>
<tr>
<td>Group 2x Group 3</td>
<td>0.385±1.674</td>
<td>&gt;0.05†</td>
</tr>
</tbody>
</table>

† P >0.05 is not significant

‡ S.E = Standard Error

* Age groups as mentioned in Table 2.

Discussion

This study is comparable to several studies that have evaluated the value of ST resolution within 24 hours after fibrinolysis as a bedside marker of prompt recanalization of the infarct-related artery.[4-7]

The time of presentation (i.e. the time from the onset of chest pain until the patient reaches the coronary care unit) is an important factor in the response to thrombolytic therapy.[10,11] The patients are divided according to the time of presentation into 3 groups. The first group (group 1) includes those who present within ≤3 hours. They are 23 patients (51%) who show a highly significant response in terms of ST resolution (p value<0.001).

The second group (group 2) includes those who presented later than 3 hours, but within ≤6 hours. These include 10 patients (22%) who show a less significant response than group 1, yet statistically significant (p value<0.05).

The third group (group 3) includes those patients who presented after >6 hours. They are 12 patients (27%) who show also a less significant response than group 1 (p value<0.05).

These results are comparable to the results achieved in the studies that had been conducted by Bossaert L. et al[8] and Pasceri V. et al.[9] which conclude that the predictability of patency of the infarct-related artery could be assessed with a high degree of accuracy by non-invasive markers including ST-segment resolution.
by ECG. Other markers used are: 1- early peak CK (creatine kinase) enzyme activity ≤12 hours after the start of thrombolysis. 2- occurrence of reperfusion arrhythmias within 90 minutes of thrombolytic therapy. These are not tested in our study. Also we notice from this study that there is no significant difference between different age groups (p value > 0.05).

**Conclusion**

I conclude that thrombolytic therapy is more effective in coronary reperfusion if given early in acute myocardial infarction. Any delay in giving thrombolytic therapy leads to a less pronounced effect. The response to thrombolytic therapy is not affected by age. Therefore I recommend that thrombolytic agents should be supplied to the emergency units and casualty teams whose ambulances reach the patient early.

**References**

8- Bossaert L; Conraads V; Pintens H, Eur Heart J., 1991, March, 12, 3, 357.
9- Pasceri V; Andreotti F; Maseri A, Eur Heart J., 1996, Sep, 17, suppl E, 35.