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Original Research Paper

"A CROSS SECTIONAL STUDY OF ECG CHANGES IN ACUTE MYOCARDIAL INFARCTION PATIENTS TREATED WITH THROMBOLYTIC THERAPY AT A TERTIARY CARE CENTRE IN WESTERN INDIA."

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Abstract:
Background: When it comes to identifying an acute myocardial infarction, ECG is both sensitive and specific. For a prompt evaluation of the effectiveness of reperfusion treatment in acute ST- elevation myocardial infarction (STEMI), simple and quick assessments are required. Although successful recanalization of the epicardial vessel is a prerequisite, micro vascular flow is the factor that most closely predicts the outcome. ST segment changes, which reflect myocardial rather than epicardial flow, provide prognostic information beyond that offered by a coronary angiogram alone. It has been demonstrated that failure to resolve ST segment alterations after thrombolysis is a predictor of a worse long-term result in comparison to the cohort with resolution. There hasn't been a lot of research on using ECG to gauge the state of LV function or ST segment changes following thrombolytic therapy for AMI. We thus conducted this study to evaluate the ECG changes in AMI patients treated with thrombolytic therapy at a tertiary care centre in eastern Gujarat.
Methodology: This was a retrospective, descriptive, cross-sectional study at a tertiary care medical college and hospital in Eastern Gujarat. A baseline conventional 12 lead ECG was performed on admission and at 1 hr, 3 hr, 6 hr and 12 hr following thrombolysis and in between if the patient showed arrhythmias. Data was collected for each patient using hospital records. Demographic and clinical data was collected in a pre-structured proforma. All the data was tabulated in Microsoft Excel and Statistical analysis was done using SPSS program (version20).
Results: Majority were from the age group of 51 to 70 years with 38 cases (38%). There were 68% males. We observed that the most common cases were from inferior wall MI with 42 cases (42%), Inferoposterior wall M.I. with 26 cases (26%). Out of 42 patients with Inferior wall MI, we observed that 26 patients had >50% regression at 1 hour. Out of 26 patients with Infero-posterior wall MI 9 patients had >50% regression in 1 hours. Antereoseptal wall M.I. there were 16 cases with Antereoseptal wall M.I. 7 patients had >50% regression in 1 hour post SK ECG.
Conclusion: Premature recording of the ST segment and T wave after acute myocardial infarction is a sensitive, reasonably specific, and easily recognizable ECG manifestation. Also, reperfusion is associated with accelerated evolution and deepening of the T waves following acute myocardial infarction. So, efforts to improve the delivery of thrombolytic therapy in the emergency department should include a focus on electrocardiographic interpretation skills.
Keywords: ECG Changes, Myocardial Infarction (MI), Post Thrombolysis, reperfusion, Regression.

INTRODUCTION:

Herrick coined the phrase "Coronary Thrombosis" in 1912.[1] The prevalence and significance of thrombosis in acute myocardial infarction have been disputed since this initial description. Patients with symptomatic atherosclerotic heart disease had their future prognosis predicted by electrocardiographic abnormalities of which 6882 patients with symptomatic atherosclerotic heart disease were reported by Block et al in 1952.[2]

One of the most typical medical diagnoses for individuals admittedto hospitals is acute myocardial infarction (AMI). More than half of AMI-related deaths occur before the patient reaches the hospital, according to the early (30-day) mortality rate from the condition. Although the death rate for AMI has decreased by 30% since admittance, over the past 20 years, one in every 25 patients who survive the initial hospitalization still passes away in the first year after the AMI. Patients who are elderly (over 75) have much lower survival rates.[3]

Since it enables differentiation between patients who present with ST-segment elevation and those who present without ST-segment elevation, the 12-lead ECG is at the centre of the decision process for care. To differentiate between unstable angina and non-ST segment MI (NSTEMI) and to gauge the severity of an ST-segment elevation MI (STEMI), serum cardiac bio-markers are acquired.[4]

An apparent precipitating event, such as strenuous activity, emotional stress, or a medical or surgical condition, appears to have occurred in half of the patients prior to acute myocardial infarction. According to circadian variation, clusters might be noticed in the morning shortly after waking up. This could be as a result of an increase in sympathetic tone and a higher propensity for thrombosis between the hours of 6:00am and 12:00pm.[5] The most frequent presenting complaint is pain. It is frequently described as being weighty, squeezing, and crushing. It affects the epigastrium and/or the middle of the chest, and occasionally it extends to the arms. The abdomen, back, lower jaw, and neck are less often exposed radiation regions. Sudden dyspnea, unconsciousness, extreme weakness, arrhythmia, peripheral embolisation, etc. are examples of unusual presentations.[6]

ECG Changes

When it comes to identifying an acute myocardial infarction, ECG is both sensitive and specific. The ECG has a specificity of 91% and a sensitivity of 46% in patients with ischemic type pain and ST elevation.[7] According to electrocardiography, the progression of myocardial infarction can be classified into three main phases.

1) The initial period of hyper acute damage.
2) The acute phase at its peak.
3) The stage of chronic stabilization.

The early phase of hyper acute damage: Acute injury block, slope elevation of the ST segment, and an increase in T wave magnitude are its defining features.

Acute Injury Block is characterized by a delay in conduction and a delay in the depolarization process via the wounded area.

Characteristics of the acute phase myocardial infarction when it has fully developed:

1) Pathological Q waves or the QS complex
2) ST segment with elevation.
3) A T wave with a symmetrical inverted arrowhead.

The R wave may be somewhat low and not as tall as in the pre-infarction tracing, and the QRS complex may show a pathological Q wave as a component of a QR complex in the chronic stable phase of acute myocardial infarction. The t wave may become vertical as the ST section becoming isoelectric.[8]

For a prompt evaluation of the effectiveness of reperfusion treatment in acute ST- elevation myocardial infarction (STEMI), simple and quick assessments are required. Although successful recanalization of the epicardial vessel is a prerequisite, micro vascular flow is the factor that most closely predicts the outcome. ST segment changes, which reflect myocardial rather than epicardial flow, provide prognostic information beyond that offered by a coronary angiogram alone. The degree of ST resolution and subsequent mortality has been associated in a remarkable number of researches.[9, 10]

It has been demonstrated that failure to resolve ST segment alterations after thrombolysis is a predictor of a worse long-term result in comparison to the cohort with resolution. Successful perfusion is more accurately predicted by this study than unsuccessful reperfusion. Numerous ECG indices for successful or unsuccessful reperfusion have been shown in investigations.[11] These included the greatest pre to post thrombolysis ST segment elevation ratio, the post to pre thrombolysis ST segment elevation sums that are equal to or less than 0.5, and the 25% reduction in ST segment elevation observed in the "worst lead" on the 60 to 180 minute after-thrombolytic ECG. Regardless of the magnitude of the infarct, all of these measures have been regarded as having reasonable sensitivity and specificity.[12,13] Continuous ST segment monitoring, particularly when the initial ST segment elevation is greater than 4mms, has also been demonstrated to have a good prognostic value for non-reperfusion in the GUSTO-I research.[14]

R wave amplitude and the existence and depth of Q waves in infarct leads have received the most attention in analyses of the ECG progression of an infarction pattern following thrombolysis. Anderson also provided information on the nQ in the SK and control groups.[15]This figure grew from 1.8 at the time of hospital admission to 3.6 the day following myocardial infarction, and then just slightly more to 3.8 by day 10 in the control group. However, in the SK group, nQ rose only from 1.0 to 2.5 the day after therapy, and then fell to 2.0 on day 10. Analysis of a small number of patients treated within 4 hours of the onset of their symptoms revealed a trend towards decreased R wave loss and Q wave development in patients who had successful thrombolysis compared to those who had not.[16]

There hasn't been a lot of research on using ECG to gauge the state of LV function or ST segment changes following thrombolytic therapy for AMI. In the late stages following infarction, R and n Q both correlated with the ejection fraction and the duration of akinetic segments. A study conducted by Manfred Zehendei in 1991. [17] found that 95% of re-perfused patients experienced VT episodes in the first 24 hours following thrombolysis. We thus conducted this study to evaluate the ECG changes in AMI patients treated with thrombolytic therapy at a tertiary care centre in eastern Gujarat.

METHODOLOGY:

This was a retrospective, descriptive, cross-sectional study carried out from 2020 to 2022 at a tertiary care medical college hospital.

Simple convenience non-probability sampling technique was used for data collection.

The study included 167 patients of Acute Myocardial Infarction were admitted in this duration of which 45 were not thrombolysed because they were out of window period, 43 patients were included in the study were thrombolysed within 4 hours of onset of chest pain. Around 32 other patients were thrombolysed on time but were not included because ECG's were not done on time. Around 27 patients were thrombolysed but were out of window period (>4 hrs) of our study. 12 patients had non ST- segment elevation MI and 8 patients expired before all ECG in the first 12 hours could be done. The patient with onset of chest pain preceding 4 hours and ECG showing ST segment elevation were given Thrombolytic therapy. A baseline conventional 12 lead ECG was performed on admission and at 1 hr, 3 hr, 6 hr and 12 hr following thrombolysis and in between if the patient showed arrhythmias.

The study excluded patients with history of cerebral hemorrhage at any time, non hemorrhagic stroke or other cerebrovascular events in preceding 1 year, marked hypertension (i.e.: systolic BP >180 mmHg and Diastolic BP > 110mmHg during presentation),active internal bleeding except menses, known bleeding diathesis, pregnancy, history of peptic ulcer disease.

Data was collected for each patient using hospital records. Demographic and clinical data was collected in a pre-structured proforma.

Sample size was calculated using the formula $N=z^2 pq/d2$ where, p=prevalence, q=p-1, N=sample size, z=1.96 at 95% confidence interval (CI), d=maximum tolerable error. Estimated sample size was 167.

All the data was tabulated in Microsoft Excel and Statistical analysis was done using SPSS program (version20). Categorical data are expressed as frequency and percentage. Continuous data (if any) are expressed with mean and standard deviation. Chi-square test was used to compare two categorical data. A P-value of <0.05 was considered statistically significant.

Ethical clearance was obtained from the institutional ethics committee. A written informed consent was obtained from all the participants before the study.

RESULTS:

100 patients were included in the study were thrombolysed within 4 hours of onset of chest pain. 68 were males and 32 were females.

Table 1: Age and Gender distribution

Age group	No. of cases	Male	%	Female	%
≤ 30 yrs	6	4	5.88%	2	6.25%
31-50	30	24	35.29%	6	18.75%
51-70	38	30	44.12%	8	25.00%
>70 yrs	26	10	14.71%	16	50.00%
Total	100	68	100.00%	32	100%

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P = 0.002, Significant difference

We observed that 6 patients were in age group less than 30 years, majority were from the age group of 51 to 70 years with 38 cases (38%) followed by 30 cases in age group 31 to 50 years (30%).We observed a significant difference in the age presentation in males and females, with males presenting in average younger age as compared to females. (p = 0.002)

In males, majority were from age group of 51 to 70 years with 30patients (44.12%) followed by age group 31 to 50 years with 24 patients (35.29%). In females, majority were from age group more than 70 years with 16 patients (50%) followed by age group 51 to 70 years with 8 patients (25%).

Table 2: Distribution of area of heart affected in myocardial infarction

Heart wall affected	Number of Patients
Inferior wall M.I.	42
Inferoposterior wall M.I.	26
Antereoseptal wall M.I.	16
Anteriolateral wall M.I.	9
Extensive anterior wall M.I.	7

We observed that the most common cases were from inferior wall MI with 42 cases (42%), Inferoposterior wall M.I. with 26 cases (26%), Antereoseptal wall M.I. with 16 cases (16%),Anteriolateral wall M.I. with 9 cases (9%) and there were Extensive anterior wall M.I. in 7 cases (7%).

Inferior wall M.I.
Out of 42 patients, we observed that 26 patients had >50% regression at 1 hr post SK ECG. 11 patients had no change and 5 patients had increase in ST segment elevation in 1 hr following thrombolysis.31 patients had >70% regression in 3 hrs.6 patients had >30% but <70% regression in 3 hrs.3 patients showed further increase in ST segment elevation.2 patients showed no further increase or decrease in ST segment elevation.

Inferoposterior wall M.I.
Out of 26 patients 9 patients had >50% regression in 1 hr post SK ECG.17 patients had >70% regression in 3 hrs post SK ECG. 6 patients had >30% but <70% regression in 3 hrs post SK ECG.3 patients had <30% regression in 3 hrs post SK ECG.
8 patients had ST re-elevation of which 2 patients had re-elevation in post SK 6 hrs which increased in post SK 12 hrs ECG but was <75% of the ST segment elevation of on admission ECG and was not associated with the chest pain.

Antereoseptal wall M.I.
There were 16 cases with Antereoseptal wall M.I. 7 patients had >50% regression in 1 hr post SK ECG.9 patients had >70% regression in 3 hrs post SK ECG.
4 patients had >30% but <70% regression in 3 hrs post SK ECG.3 patient had <30% regression in 3 hrs post SK ECG.

Anterolateral wall M.I.
There were 9 patientsin this category out of which 4showed >50% regression in post SK 1 hr.4 patients had >70% regression in 3 hrs post SK ECG.3 patients had >30% but <70% regression in 3 hrs post SK ECG.2 patients had <30% regression in 3 hrs post SK ECG.
The patients showed T wave changes in infarcted leads and in I, aVl and inferior wall leads II, III, and aVF.

Extensive anterior wall M.I.
7 patients of which 3 patientseach showed >50% and >70% regression in post ST 1 hr and post K 3 hrs ECG respectively. And rest 4 patients showed increase in ST segment elevation in post SK 1 hr ECG and <30% regression in post SK 3 hrs ECG indicating failure of thrombolysis.

DISCUSSION:
Coronary angiography is not available every time due to the high cost, limited availability, and time commitment. So, an easy tool is necessary to assess the success of reperfusion therapy.

Regarding age and gender distribution of the study participants, our study observed a significant difference (p=0.002) between males and females in terms of age presentation. Males tended to present at a younger age compared to females. Notably, six patients were in the age group of less than 30 years, suggesting that AMI can also affect younger individuals. Majority were from the age group of 51 to 70 years with 38 cases (38%) followed by the age group of 31 to 50 years. There were 68% males. **Singh RB et al** [5] had reported similar findings with male majority (65%) and mean age of 55.62 years. **MM Karim et al** [18] also reported the mean age of 59.25 years similar to our study.

We observed that the most common cases were from inferior wall MI with 42 cases (42%), Inferoposterior wall M.I. with 26 cases (26%). **Kimura K et al** [14] reported that inferior wall MI was most common with 46% cases followed by Inferoposterior wall M.I. with 22% cases. These findings were similar to our study.

The extent of ST-segment regression was measured to assess the effectiveness of reperfusion treatment. It has the advantage of providing prognostic information as it can assess the myocardial flow rather than just the epicardial flow by coronary angiography.

Thrombolysis within 4 hours resulted in a decrease in R wave loss and Q wave development. ST segment regression, re-elevation after initial regression, further increase in already noted ST elevation, and no significant change were observed Post thrombolysis. **Singh RB et al** [5] alsoobserved similar findings**,** with no further ECG changes observed post thrombolysis.

Some patients showed significant regression of ST-segment elevation, indicating successful reperfusion, while others demonstrated minimal regression or even an increase in ST-segment elevation, suggesting a failure of thrombolysis. These findings emphasize the need for continuous monitoring and assessment of ECG changes to evaluate the effectiveness of reperfusion treatment in AMI.

MM Karim et al [18] observed that 58% cases showed successful reperfusion, similar to our study. Few cases showed increased ST elevation requiring coronary bypass surgery.

In all types of MI involving different walls of the heart >50% regression of ST segment changes was seen on a 1hr post-SK ECG and >70% regression on a 3hr post-SK ECG. Several outcomes such as successful reperfusion, failure, and re-occlusion can be detected from simple and fast electrocardiographic findings reducing the need for coronary angiography in emergent and small settings. Expertise should be obtained in interpreting the changes in the ST segment to act quickly and efficiently in poor resource settings. **Ketan D et al** [19] also observed that one hour post treatment, all cases showed >50% regression similar to our study.

CONCLUSION:

In the studies done earlier, angiography is the gold standard for diagnosing successful thrombolysis and re occlusion. It is not possible in small set ups and it is not feasible to do a coronary angiography in all thrombolysed patients. So, what we need is a noninvasive tool for identifying patients with failed thrombolysis and re-occlusion following successful thrombolysis so that we can diagnose them at the earlier and subject them to PTCA. The only noninvasive marker for this which has been proved in majority of studies is the ST segment elevation on ECG. Premature recording of the ST segment and T wave after acute myocardial infarction is a sensitive, reasonably specific, and easily recognizable ECG manifestation. Also, reperfusion is associated with accelerated evolution and deepening of the T waves following acute myocardial infarction. Efforts to improve the delivery of thrombolytic therapy in the emergency department should include a focus on electrocardiographic interpretation skills. We recommend the use of ECG screening in resource poor settings in post thrombolysis M.I. cases to check for effective reperfusion and to access need for prompt referral to a Cardiac Care unit in case of worsening signs.

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REFERENCES:

1. Herrick JB. Clinical features of sudden obstruction of the coronary arteries. Journal of the American Medical Association. 1912 Dec 7;59(23):2015-22.
2. Reeves TJ, Oberman A, Jones WB, Sheffield LT. Natural history of angina pectoris. The American journal of cardiology. 1974 Mar 1;33(3):423-30.
3. Disegni E, Goldbourt U, Reicher-Reiss H, Kaplinsky E, Zion M, Boyko V, Behar S, SPRINT Study Group. The predictive value of admission heart rate on mortality in patients with acute myocardial infarction. Journal of clinical epidemiology. 1995 Oct 1;48(10):1197-205.

4. JCS Joint Working Group. Guidelines for management of patients with ST-elevation myocardial infarction (JCS 2008). Circ J. 2008;72:1347-442.
5. Singh RB, Shastun S, Saboo B, Mahashwari A, Singh RK, De Meester F, Verma N, Bharadwaj K, Chibisov S, Abramova M, Singh V. Association of chronophysiological and psychological risk factors among patients with acute coronary syndromes. World Heart Journal. 2017 Apr 1;9(2):123-34.
6. Lu L, Liu M, Sun R, Zheng Y, Zhang P. Myocardial infarction: symptoms and treatments. Cell biochemistry and biophysics. 2015 Jul;72:865-7.
7. Kligfield P, Lauer MS. Exercise electrocardiogram testing: beyond the ST segment. Circulation. 2006 Nov 7;114(19):2070-82.
8. Keller T, Zeller T, Peetz D, Tzikas S, Roth A, Czyz E, Bickel C, Baldus S, Warnholtz A, Fröhlich M, Sinning CR. Sensitive troponin I assay in early diagnosis of acute myocardial infarction. New England Journal of Medicine. 2009 Aug 27;361(9):868-77.
9. Guha S, Sethi R, Ray S, Bahl VK, Shanmugasundaram S, Kerkar P, Ramakrishnan S, Yadav R, Chaudhary G, Kapoor A, Mahajan A. Cardiological Society of India: position statement for the management of ST elevation myocardial infarction in India. Indian heart journal. 2017 Apr;69(Suppl 1):S63.
10. Prasad A, Stone GW, Aymong E, Zimetbaum PJ, McLaughlin M, Mehran R, Garcia E, Tcheng JE, Cox DA, Grines CL, Gersh BJ. Impact of ST-segment resolution after primary angioplasty on outcomes after myocardial infarction in elderly patients: an analysis from the CADILLAC trial. American heart journal. 2004 Apr 1;147(4):669-75.
11. Ko DT, Atzema CL, Donovan LR, Graham MM, Huynh T, So DY, Wang J, Wijeysundera HC, Tu JV. Rescue percutaneous coronary interventions for failed fibrinolytic therapy in ST-segment elevation myocardial infarction: a population-based study. American heart journal. 2011 Apr 1;161(4):764-70.
12. Prasad A, Stone GW, Aymong E, Zimetbaum PJ, McLaughlin M, Mehran R, Garcia E, Tcheng JE, Cox DA, Grines CL, Gersh BJ. Impact of ST-segment resolution after primary angioplasty on outcomes after myocardial infarction in elderly patients: an analysis from the CADILLAC trial. American heart journal. 2004 Apr 1;147(4):669-75.
13. Hallén J. Cardiac troponin I and electrocardiogram for estimation of infarct size and for risk stratification in patients with STelevation myocardial infarction treated with primary percutaneous coronary intervention.
14. Kimura K, Kimura T, Ishihara M, Nakagawa Y, Nakao K, Miyauchi K, Sakamoto T, Tsujita K, Hagiwara N, Miyazaki S, Ako J. JCS 2018 guideline on diagnosis and treatment of acute coronary syndrome. Circulation Journal. 2019 Apr 25;83(5):1085-196.
15. Hemingway H, Crook AM, Feder G, Banerjee S, Dawson JR, Magee P, Philpott S, Sanders J, Wood A, Timmis AD. Underuse of coronary revascularization procedures in patients considered appropriate candidates for revascularization. New England Journal of Medicine. 2001 Mar 1;344(9):645-54.
16. Hou C, He Q, Li S. Imitative restenosis after percutaneous transluminal coronary angioplasty prevented by buyanghuanwu decoction in rabbits. CHINESE JOURNAL OF INTEGRATED TRADITIONAL AND WESTERN MEDICINE. 2001 May 1;21(5):359-63.
17. Takada T, Shishido K, Hayashi T, Yokota S, Miyashita H, Yokoyama H, Nishimoto T, Ochiai T, Moriyama N, Tobita K, Mizuno S. Impact of late ventricular arrhythmias on cardiac mortality in patients with acute myocardial infarction. Journal of Interventional Cardiology. 2019 Oct 31;2019.
18. Karim MM, Khan HL, Faruk M, Salam MA. ST Segment Score on Initial Electrocardiogram (ECG) as a Predictor of In-Hospital Outcome of ST-Elevated Myocardial Infarction (STEMI) Patients. Medicine Today. 2022 Oct 10;34(2):88-92.
19. Khetan D, Agrawal D, Anil KG. Comparative study of QT, QT Dispersion, and T-Wave Peak to End Time Changes After Thrombolysis and Primary Percutaneous Coronary Intervention in Patients Presenting with Acute ST-Elevation Myocardial Infarction. J Clinical Cardiology Interventions. 2021 Jun 23;2(3).