Al Ameen J Med Sci 2014; 7(3):213-216 ● US National Library of Medicine enlisted journal ● ISSN 0974-1143

ORIGINAL ARTICLE CODEN: AAJMBG

Prognostic significance of initial electrocardiogram in patients with ST elevation acute myocardial infarction (STEMI) - A study of 52 cases

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Abstract: *Background:* In Acute myocardial infarction patient's surface electrocardiogram allows risk management in individual patients by estimating the size of area at risk. This can be assessed from different waveforms of ECG. *Settings and Design:* In this prospective observational study we studied 52 consecutive patients of ST elevation acute myocardial infarction admitted into a teaching hospital. *Methods and Material:* The electrocardiogram of acute myocardial infarction patients which showed ST segment elevation of 1mm in two or more limb leads or 2mm in two or more chest leads with positive T waves in leads with ST segment elevation was analyzed in relation to ECG heart rate, number of leads showing ST segment deviation, ST segment deviation score, grades of ischemia as assessed by terminal portion of QRS complex. Out of 52 patients studied, mortality occurred in eight patients within seven days of hospital stay. Thus we had two groups of patients, one who survived seven days of hospital stay(n=44) and other who did not survive seven days of hospital stay(n=8).These ECG parameters between these two groups were compared to determine value of ECG in predicting short term mortality. Mean values with standard deviation were calculated for continuous variables. Chi square tests were used to determine the significance of difference between proportions for discrete variables and p value of less than 0.05 was considered statistically significant. *Results:* Mean heart rate on admission was 84 beats per minute ranging from 32 to 136 beats per min. Tachycardia on admission was present in 17 patients who had high mortality than that in patients with normal heart rate(17.3 and 14.2%respectively.) The mean ST segment deviation score was 22.69 ranging from 6 to 45.The high ST segment deviation score was associated with increased mortality at 7 days.(p=0.0209).Similarly in patients with ECG showing more number of leads showing ST segment deviation mortality was high(p=0.009).Mortality in patients (n=27) with grade III ischemia (terminal QRS distortion) was significantly more than that in patients (n=25) with grade II ischemia(without distortion of terminal QRS complex)(p=0.0385). *Conclusions:* Tachycardia, high ST segment deviation score, more number of leads with ST segment deviation, distortion of terminal portion of QRS complexes on admission ECG denoted poor short term prognosis.

Keywords: Electrocardiogram; Acute Myocardial Infarction; Reperfusion.

Introduction

The Electrocardiogram (ECG) remains the most accessible and inexpensive tool in the diagnosis and management of Acute Myocardial infarction. It plays crucial role in decision making about the aggressiveness of therapy especially in relation to reperfusion therapy because such therapy has resulted in a considerable reduction in mortality from acute myocardial infarction (AMI) [1]. Several variables affect the immediate short term prognosis in AMI patients such as size of ischemic myocardium at risk, the percentage of ischemic myocardium at risk that has already undergone necrosis, the severity of ischemia (expected rate of progression of myocardial necrosis.), presence of old myocardial infarction or fibrosis. (myocardial reserves) and presence of ischemia at distance. This information are obtained using different waveforms in standard 12 lead electrocardiogram [2].

ECG heart rate is simple index very useful in early risk stratification of patients of acute myocardial infarction with extremes of heart rate (bradycardia & tachycardia) related with increased mortality. The extent of ST segment abnormalities has been used in various ways to calculate myocardial area at risk and predict short term mortality such as number of leads

showing deviation and ST segment deviation score [3-7]. Another qualitative approach for predicting final infarct size by using ECG, based on grades of ischemia has been reported by Birnbaum. He divided the AMI patients into three grades with increasing severity of ischemia depending on the morphology of terminal portion of QRS complexes [8-10]. Thus ECG on admission in patients with acute myocardial infarction has great diagnostic and prognostic value. This work is undertaken with a view of analyzing the on admission ECG in AMI patients and correlating its various findings with short term outcome.

Material and Methods

This is prospective study of consecutive patients of acute myocardial infarction. Patients of ST elevation acute myocardial infarction whose admission ECG showed ST elevation of >0.1mv (1mm) in two or more limb leads OR >0.2mv (2mm) in two or more chest leads with positive T waves in leads with ST segment elevation were included. Following patients were excluded from study-chest pain duration more than 12 hours, admission ECG showing T wave inversion in leads with ST segment elevation, AV conduction disturbances, ventricular arrhythmias or paced rhythms.

Electrocardiographic analysis: A 12 lead ECG was recorded immediately after admission.

Heart rate was recorded from ECG. Number of leads showing ST segment deviation: Patients were divided into two groups. Group I patients with ECG showing ST segment deviation in leads 1-6.Group II patients with ECG showing ST segment deviation in leads 7-12.

ST segment deviation score: The intensity of initial epicardial injury was quantified by measuring ST segment deviation (elevation as well as reciprocal depression in opposite leads). ST segment deviation was measured 0.08 sec after J point in all 12 leads. Reference point was Tp segment immediately preceding the QRS-T complex. Patients were divided in two groups. GrI Pts with high score (above mean value) GrII pts with low score (below mean value) [7].

Terminal QRS distortion: Pts were grouped in depending on morphology of terminal QRS portion. Grade-III Pts whose admission ECG showed ST segment elevation and distortion of terminal QRS portion i.e. disapparance of S wave from leads with Rs pattern or emergence of J point above 50% of height of R wave in leads with Rs configuration. Grade-II Pts whose admission ECG showed ST segment elevation but without distortion of terminal QRS portion. Grade-I Pts whose on admission ECG showed no ST segment elevation & were excluded from study [8-9].

End point: The end point was mortality within 7 days follow up period since admission. The data on hospital course was available for all patients.

Statistical analysis: Mean values with standard deviation were calculated for continuous variables (age, time of onset of chest pain, ST segment deviation score, heart rate). Chi square tests were used to determine the significance of difference between proportions for discrete variables and p value of less than 0.05 was considered statistically significant.

Results

52 patients of ST elevation acute myocardial infarction who fulfilled the entry criteria were studied. Out of which 8 pts died within 7 days of hospital stay. Their in detail ECG analysis in relation to ECG heart rate, number of leads showing ST segment deviation, ST segment deviation score, grades of ischemia as assessed by distortion of terminal QRS portion is shown below.

Table-1: Heart rate analysis in 52 pts

Heart Rate per min	No of patients	Mortality
>100	17	03
<100	35	05
Total	52	08

Out of 52 patients, 17 patients had heart rate above 100 beats/min and 35 had rate below 100 beats/min. Out of 17 patients with heart rate above 100/min mortality occurred in 3 patients(17.6%) and out of 35 patients with rate below 100/min, mortality was seen in 5 patients (14.2%).

Table-2: Total number of patients with ECG showing leads with ST segment deviation and mortality		
Number of leads with ST segment deviation	**No of patients**	**Mortality**
GrI (1-6 leads with ST segment deviation)	34	02
GrII (7-12 leads with ST segment deviation)	18	06
Total	52	08

Out of 34 patients in Group I (1-6 leads with ST segment deviation) mortality was seen in 2 pts and out of 18 patients in Group II (7-12 leads with ST segment deviation) mortality occured in 6 pts (5.9 and 33% resp). Mortality was significantly higher in Gr. II than in Gr. I (p=0.009).

Table-3: Total number of patients with ECG showing high ST segment deviation score and mortality		
ST segment deviation score	**No of patients**	**Mortality**
GrI(High score)	20	06
GrII(Low score)	32	02
Total	52	08

Out of 32 patients in high score group, 6 pts died within 7 days of hospital stay and out of 20 patients in low score group mortality was seen in 2 patients (30&6.25%). Thus mortality was significantly higher in patients with high ST segment deviation score (p=0.02)

Table-4: Total number of patients with ECG showing Grades of ischemia and mortality		
Grade of ischemia	**Number of patients**	**Mortality**
GrII	25	01
GrIII	27	07
Total	52	08

In hospital mortality was significantly higher in grade III pts (with distortion of terminal QRS) than in grade II pts (without distortion of terminal QRS). Out of 27 pts in grade III, mortality was seen in 7 patients while 1 pt out of 25 died in grade II group.(25.9%&4% resp) (p=0.028).

Discussion

Previous studies on magnitude of ST segment deviation and number of leads showing ST segment deviation are based on the hypothesis that each lead represents the same amount of myocardium and similar size of ischemic area in different locations of left ventricle will result in similar magnitude of ST segment deviation in similar number of leads. Many variables such as width of chest wall, the distance of electrode from ischemic zone, the myocardial mass and presence of ischemic preconditioning and collateral circulation have major influence on magnitude of ST segment deviation [3].

Therefore although in general patients with ST segment deviations in many leads or high ST segment deviation score have a large infarction than in patients with ST segment deviation in small number of leads or low ST segment deviation score, there are many exceptions [7].

In present study mortality percentage was higher in patients with tachycardia indicating that heart rate on presentation independently predict short term mortality in patients with acute myocardial infarction. Moreover more the number of leads involved on admission ECG, higher the ST segment deviation score poorer the short term prognosis indicating direct correlation between magnitude of ST-T changes and short term mortality.

During regional myocardial ischemia the conduction velocity of the activation wave in the purkinje fibres is prolonged. Delayed conduction decreases the degree of cancellation increasing the R wave and decreasing the S wave amplitude in surface ECG. The purkinje system is less sensitive than the contracting myocytes to ischemia. Hence only a severe and prolonged ischemia that affects the purkinje fibres would alter the terminal portion of QRS complexes [8-10].

In present study mortality percentage was significantly higher in patients with higher grades of ischemia. Thus grade of ischemia as assessed by distortion of terminal QRS is useful marker to predict in hospital mortality and final infarct size.

Conclusion

Tachycardia, high ST segment deviation score, more number of leads with ST segment deviation and distortion of terminal QRS portion on admission ECG portends poor short term prognosis. Thus this simple, cheap, universally available investigation should be employed routenely.

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