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ST Segment Score on Initial Electrocardiogram (ECG) as a Predictor of In-Hospital Outcome of ST-Elevated Myocardial Infarction (STEMI) Patients

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Abstract :

Introducation *: The process of myocardial infarction progresses over several hours and therefore most patients present when it is still possible to salvage myocardium. ECG is usually a sensitive and specific way of confirming diagnosis. ST segment score (STSS) in myocardial infarction is emphasized but not often quantified. HJ Wellens gave cutoff for STSS in anterior wall MI (AWMI)of 12 mm and inferior wall MI (IWMI)of 7 mm. In this study the predictive value of ST Segment Score (STSS) with patients of STEMI on admission ECG & after thrombolysis had been assessed.* ***Objectives:*** *Identify patients at higher risk early in the course of their hospital admission & correlation of initial ECG and post thrombolysis ECG regarding clinical outcome.* ***Materials and Methods:*** *Considering inclusion and exclusion criteria 112 patients admitted in CCU, DMCH during october 2007 to september 2008 were studied of which 64 were inferior STEMI and 48 were anterior STEMI. Like admission ECG, after 90 minutes of starting thrombolytic,another ECG was recorded and calculated. Echocardiography was done for each patient before discharge. Data was collected in a pre-designed form.* ***Results:*** *The mean age of Group-I was 55.2±12.2 years and that of Group-II 56.9±14.1 years, Group-III 59.2±11.7 years,Group-IV 55.0±12.6 years. Of the 30 patients studied in Group-I 76.7% was male and 23.3% female. Smoking was the most prevalent (60% in Group I, 58.8% in Group II) risk factor. In post thrombolytic ECG shows that in Group-I mean sum of ST elevation decreased to 3.9 ± 1.1 mm from 4.8 ± 1.2 mm. which was approximately (45+14)% of ST resolution, in Group-II(50+19%),in Group-III (55+19)%, in Group-IV(45+23)%.* ***Conclusion:*** *Significant differences were seen in chest pain, killip class,arrhythmia, echocardiographic LVEF, duration of hospital stay in patients with AWMI & STSS above 12 mm and IWMI & STSS above 7 mm in comparison with below these level even after use of thrombolytics.*

Keywards: *ST segment score, STEMI, LVEF.*

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Introducation:

Ischemic heart disease (IHD) is a major health problem throughout the world[1]. Myocardial infarction is one of the leading cause of death in Bangladesh mostly in the fourth decade of life main cause of death was pump failure (53%) and ventricular fibrillation (27%)[2,3]. Myocardial infarction (MI) is almost always due to the formation of occlusive thrombus at the site of rupture or erosion of an atheromatous plaque in a coronary artery[4] .The process of infarction progresses over several hours and therefore most patients present when it is still possible to salvage myocardium[5]. Diabetes Mellitus,hypertension,high cholesterol, smoking,male sex, family history,old age are major and homosysteiene, inactivity etc. are minor risk factors[6]. Clinical presentation of MI ranges from mild chest pain to sudden severe chest pain[7]. The ECG is usually a sensitive and specific way of confirming the diagnosis of MI[8]. Myocardial necrosis is associated with the release of diagnostic markers for AMI. An absolute level of CK-MB-2 isoform greater than 1.0 U/L or a ratio of CK-MB-2/CK-MB-1 greater than 2.5 has a sensitivity for diagnosing AMI of 46.4% at 4 hours & 91.5% at 6 hours[9]. Ideally, an early prognostic indicator in patients with acute myocardial infarction should be simple, quick, noninvasive and easy to use in all patients. An assessment by ECG criteria would fulfill all of these claims[10]. The ST segment score (STSS) in myocardial infarction is emphasized but not often quantified. HJ Wellens gave cutoff for STSS in anterior wall

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MI (AWMI) of 12 mm and inferior wall MI (IWMI) of 7 mm. The outcomes may be worsen in patients with STSS above this value[11]. Total ST- segment elevation on the initial ECG can also predict the final acute myocardial infarct size[8,12,13]. Reperfusion strategies in the early phase of treatment of acute myocardial infarction aim to rapidly normalise and maintain tissue perfusion. Primary angioplasty is probably the best current treatment but it can only be applied to a minority of patients. A number of methods are available to identify patients of failed thrombolysis and although they are imprecise, a convenient and easy- to- use method is to examine the ST segments on the standard 12 lead ECG. The amount of ST segment resolution within 90 minutes after the start of thrombolytic therapy conveys very useful information about the outcome[14]. In this study the predictive value of ST Segment Score (STSS) with patients of STEMI on admission ECG & after thrombolysis had been assessed and correlated with other variables like ejection fraction, in-hospital complication etc11. Actually STSS is a simple and useful index to risk stratify STEMI and to identify the patients at higher risk early in the course of their admission.

Objectives:

a) Risk stratification of STEMI patients on the basis of ST segment score on initial ECG.b) Identify patients at higher risk early in the course of their hospital admission.c) Correlation of initial ECG and post thrombolysis ECG regarding clinical outcome.

Materials and Methods:

This study was prospective non-randomize observational study.

All patients admitted in CCU, DMCH during october 2007 to september 2008, with the diagnosis of ST elevation myocardial infarction were included. Considering inclusion and exclusion criteria 112 consecutive patients were studied of which 64 were inferior wall acute STEMI and 48 were anterior wall acute STEMI. Among inferior wall AMI patients, 30 were ST segment score ≤ 7 mm (Group-1) & 34 were ST segment score > 7 mm. Again ,among anterior wall AMI 22 patients were ST segment score ≤ 12 mm (Group-3) & 26 were ST segment score > 12mm(Group-4)[11]. Like admission ECG, after 90 minutes of starting thrombolytic, another ECG was recorded and calculated in the same way. Echocardiography was done for each patient before discharge. Data was collected in a pre-designed form Data obtained was expressed in frequency, percentage, mean or standard deviation as applicable. Comparison between groups was done by Chi-square test, students t test, and Fisher's exact test as applicable. A discussion was made after results were obtained and P value of < 0.05 was considered statistically significant.

Results:

Inferior wall myocardial infarction patients were subdivided into Group-I & Group- II and anterior wall myocardial infarction patients into Group-III & Group-IV. The mean age of Group-I was 55.2±12.2 years and that of Group-II was 56.9±14.1 years. The mean age of Group-III was 59.2±11.7 years and that of Group-IV was 55.0±12.6 years. Analysis revealed no statistically significant age difference between the groups(P=0.239).

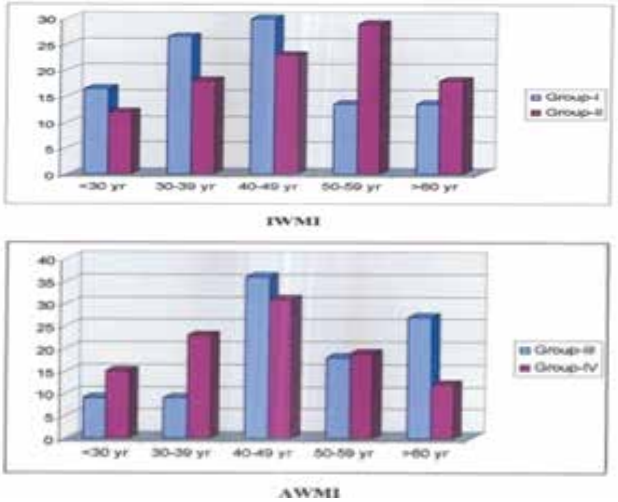

Figure 1: Distribution of study population by age

Of the 30 patients studied in Group-I 76.7% was male and 23.3% was female. In Group-II 76.5% was male and 23.5% was female. Among Group-III 72.7% was male and 27.3% was female. In Group-IV 73.1% was male and 26.9% was female. The difference in sex distribution between the groups were not statistically significant (P=0.985).

Table-I(a): Sex distribution among study population of IWML

Table I (a): Sex distribution among study population of IWMI.

Sex	Study subjects						P value
	Group I(n=30)		Group II(n=34)		Total(n=64)		
	No		No		No		
Male	23	76.7	26	76.5	49	76.6	
Female	7	23.3	8	23.5	15	23.4	0.985[NS]
Total	30	100	34	100	64	100	

Table-I(b): Sex distribution among study population of AWMI.

Table I (b): Sex distribution among study population of AWMI.

Sex	Study subjects						P value
	GroupIII(n=22)		Group IV(n=26)		Total(n=48)		
	No	%	No	%	No	%	
Male	16	72.7	19	73.1	35	72.9	
Female	6	27.3	7	26.9	13	27.1	0.978[NS]
Total	22	100	26	100	48	100	

According to the study smoking was the most prevalent risk factor in Group-I (60%) and in Group-II (58.8%). Out of 48 patients of anterior wall myocardial infarction,

63.6% were smoker in Group-III and 69.2% were in Group-IV.

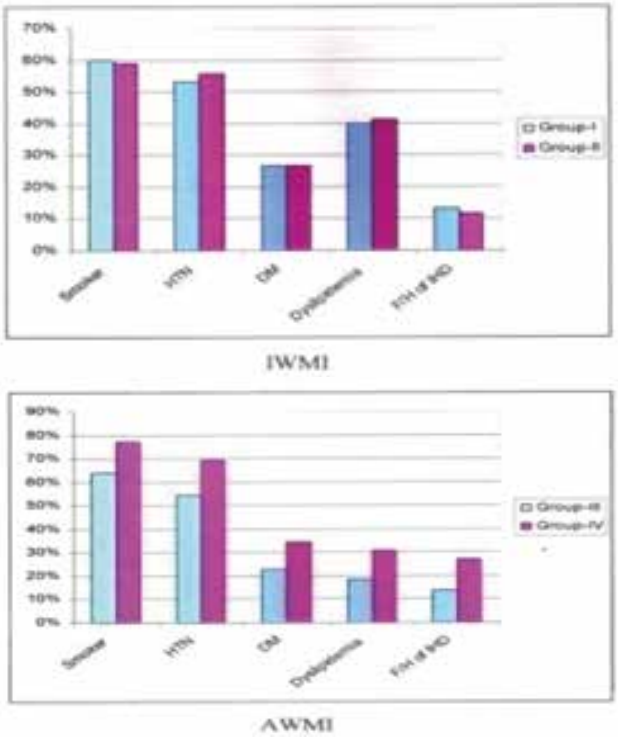

Figure 2: Distribution of study population by risk factor

In post thrombolytic electrocardiographic findings shows that in Group-I mean sum of ST elevation decreased to 3.9 ± 1.1 mm from 4.8 ± 1.2 mm. which was approximately (45+14)% of ST resolution and in Group-II. In Group-III mean sum of ST elevation decreased to 3.2 ± 2.2 mm from 9.3 ± 1.5 mm. which was approximately (55+19)% of ST resolution and in Group-IV ST elevation decreased to 12.0 4.0 mm from 22.8 ± 6.3 mm which was (45+23)% of ST resolution.

Table II(a): Post thrombolytic ECG findings of the study population of IWMI.

Table II(a) : Post thrombolytic ECG findings of the study population of IWMI.

Characteristics	Study Population		P value
	Group I (n=30) Mean ± SD (Range)	Group II (n=34) Mean ± SD (Range)	
Sum of ST elevation before thrombolysis(mm)	4.8 ± 1.2 (3 - 7)	15.4 ± 5.6 (7.5 -24)	0.001 *
Sum of ST elevation after thrombolysis(mm)	3.9 ± 1.1 (2 - 6)	9.6 ± 1.4 (3 - 12)	0.001 *
%of ST Resolution	45±14 (0 - 75)	30±19 (0 - 70)	0.226[NS]

Table II(b): Post thrombolytic ECG findings of the study population of IWMI.

Table II(b) : Post thrombolytic ECG findings of the study population of AWMI.

Characteristics	Study Population		P value
	Group III (n=22) Mean ± SD (Range)	Group IV (n=26) Mean ± SD (Range)	
Sum of ST elevation before thrombolysis(mm)	9.3 ± 1.5 (7 - 12)	22.8 ± 6.3 (13 - 35)	0.001 *
Sum of ST elevation after thrombolysis(mm)	3.2± 2.2 (3- 7	12.0 ± 4.0 (6- 20)	0.001 *
%of ST Resolution	55±19 (0-70)	45±23 (0-60)	0.058 [NS]

Discussion:

The present study was a prospective non-randomized observational study conducted in Dhaka Medical College, Dhaka. The aim of the study was identification of the high risk patients on the basis of electrocardiographic study by ST segment score on initial ECG and to see it as a predictor of the in-hospital outcomes of STEMI patients. A total of 112 patients were studied, among them 64 were inferior wall and 48 were anterior wall acute myocardial infarction. On the basis of ST segment score that is sum of ST elevation, inferior wall myocardial infarction patients were again subdivided into Group-I & Group-II with a cutoff point at 7mm and anterior wall myocardial infarction patients into Group-III & Group-IV with a cutoff point at 12mm[1,11]. Mean age of the patients in Group-I was 55.2±12.2 years and those with Group-II was 56.9±14.1 years. Among anterior wall mean age was 59.2±11.7 and 55.0±12.6 years respectively in Group-III & Group-IV. These findings are consistent with the findings of Haque et al (2001)[15]. Highest number of patients was in the age group 40-49 years in all groups except Group-II where it was 50-59 years[15,16,17]. In both the inferior and anterior wall myocardial infarction groups male patients were found to be higher .In Group-I & Group-II female patients were 23.3% & 23.5% respectively while it were 27.3% & 26.9% in Group-III & Group-IV respectively[18]. Study of common risk factors showed that smoking was the commonest one followed by hypertension, dyslipidemia, diabetes mellitus and family history. Data were almost similar to those of the study done in Bangladesh and abroad[17,19].

Analysis of presenting complaints showed highest percentage of the patients had chest pain (96.7%) followed by shortness of breath (33.3%), sweating (26.7%) & nausea or vomiting (16.7%)[3,7]. Regarding haemodynamics there were no difference in mean pulse rate and mean diastolic blood pressure in the groups .Lower mean systolic blood pressure in Group-II & Group-IV indicate more myocardial damage in these groups of higher ST elevation.

The Group-I and Group-II patients had same no. of leads with ST-elevation but Group-II patients had a greater sum of ST elevation. It was statistically significant ($p<0.05$). Again in Group-III & Group-IV the sum of ST elevation were 9.3 ± 1.5 mm & 22.8 ±6.3 mm respectively and also was statistically significant. These higher sum of ST elevation in Group-II and Group-IV patients indicate more myocardial damage. In general it is true that patients with ST deviation in many leads and greater magnitude of ST deviation have a larger final infarct size than patients with ST deviation in a small number of leads or low sum of ST deviation[18]. Regarding post-thrombolytic ECG findings,it

showed sum of ST elevation after thrombolysis in Group-I was 3.9±1.1 mm and it was (45±14)% resolution of ST elevation and in Group-II it was 9.6+1.4 mm which was (50+19)% resolution.

Again in Group-III & Group-IV the sum of ST elevation after thrombolysis were 3.2± 2.2 mm & 12.0±4.0 mm and those were (55±19)% & (45±23)% ST resolution respectively. This finding was also statistically significant[14].

Left ventricular ejection fraction (LVEF) was determined on every patient by 2D echo by Teichholz method before discharge from hospital. There were more patients with LV systolic dysfunction (24.1% vs 41.9%) in Group-II than Group-I of inferior wall myocardial infarction. The mean left ventricular ejection fraction in Group-III and Group-IV were 52.9±7.0 % and 47.2 ± 9.4% respectively which was also statistically significant[20]. Most frequent complications were chest pain,arrhythmia and conduction disturbances, heart failure and cardiac death. This study showed that 35.3% patients from Group-II complaints chest pain in comparison with only 6.7% from Group-I which was statistically significant ($p< 0.05$).But in cases of anterior wall myocardial infarction, more patients from Group-IV complaints chest pain (58.3%) than from Group-III (18.8%) which was also statistically significant[17,21].

Out of 30 patients from Group-I only 6 (20%) developed Killip class-II and 2 (6.7%) developed class-III heart failure. But in Group-II 12 (35.3%) patients developed class- II, 3 (8.8%) class-III heart failure out of 34 patients. Out of 22 patients from Group-III, 5 (22.7%) developed class-II, 2(9.1%) class—III & 1(4.6%) class-IV heart failure. But in Group-IV more patients developed heart failure like 12 (46.2%) developed class-11, 2 (7.7%) developed class-III, 3 (11.5%) developed class-IV[20,22]. Among the study population different arrhythmias and heart block were developed during hospital stay. In Group-I 40% developed arrhythmia of which PVC was the most frequent (16.7%). In 34 patients of acute inferior wall MI of Group-II showed that 67.6% developed arrhythmia and heart block. Again in Group-III, 54.5% developed arrhythmia and heart block. In Group-IV as much as 84.6% developed arrhythmia and heart block . In our current study there were eight death, three from Group-II of inferior wall, one from Group-III and four from Group-IV of anterior wall.

Hospital stay was 5.2 ± 0.6 days for Group-I and 6.9± 0.7 days for Group-II. The difference in hospital stay between groups was statistically significant ($p<0.05$). For Group-III and Group-IV mean duration of hospital stay were 7.0± 0.7 days and 9.9± 0.7 days respectively,the difference of which was also statistically significant ($p<0.05$). These represent hospital outcome worse in Group-II & Group-IV.

Conclusion:

Significant differences were seen in chest pain, killip class, arrhythmia, echocardiographic LVEF, duration of hospital stay in patients with AWMI & STSS above 12 mm and IWMI & STSS above 7 mm in comparison with below these level even after use of thrombolytics. This study may be the base of further clinical controlled studies with larger population to validate our finding.

Conflict of Interest: None.

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