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Major Adverse Cardiac Events (MACE) and the Thrombolysis in Myocardial Infarction (TIMI) Risk Score For STEMI

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Abstract

Introduction: The incidence of acute ST segment elevation myocardial infarction (STEMI) has decreased over the last decades, mostly in developed higher-income countries. However, in developing lower-income countries the incidence of acute myocardial infarction (both STEMI and Non-STEMI) has increased, as has the incidence of ischaemic heart failure globally.

Objective: To assess the major adverse cardiac events (MACE) and the thrombolysis in myocardial infarction (TIMI) risk score for STEMI.

Methodology: This cross-sectional prospective study was conducted in the Department of Cardiology, Sylhet MAG Osmani Medical College Hospital, Sylhet during the period from July 2017 to June 2018. Fifty patients with definite diagnosis of acute STEMI, received streptokinase, aged above 18 years and both sex were included. Prior myocardial infarction, coronary revascularization procedures either CABG or angioplasty or coronary stenting; co-morbidities such as renal failure, heart failure, cardiomyopathy, valvular heart disease and congenital heart disease were excluded. On admission TIMI was recorded. In hospital MACE were also recorded.

Results: The mean age of patients was 52.64 (SD 11.88) years and majority of the patients were male (84%) with male to female ratio was 5.25:1. The mean TIMI risk score for STEMI 4.50 (SD 2.38). In hospital major adverse cardiac events (MACE) occurred in 19 (38.0%) cases. TIMI risk score for STEMI was significantly higher in patients with MACE compared to without MACE (16.95, SD 1.78 versus 3.00, SD 1.10; $p<0.001$) respectively. Conclusion: In hospital major adverse cardiac events (MACE) occurred in 19 (38.0%) cases. TIMI risk score for STEMI was significantly higher in patients with MACE compared to patients without MACE (16.95, SD 1.78 versus 3.00, SD 1.10; $p<0.001$) respectively. From the study we conclude that TIMI risk score (5 or above) is a reliable tool in predicting in- hospital major adverse cardiac events in ST-segment elevation myocardial infarction.

Keywords: MACE; Thrombolysis; Myocardial infarction; STEMI

Introduction

The incidence of acute ST segment elevation myocardial infarction (STEMI) has decreased over the last decades, mostly in developed higher-income countries. However, in developing

lower-income countries the incidence of acute myocardial infarction (both STEMI and Non-STEMI) has increased, as has the incidence of ischaemic heart failure globally [1]. The overall prevalence of MI in the US is around 2.8% in adults' ages 20 years or over. The estimated incidence is 550,000 new and 200,000 recurrent MIs annually. According to American Heart Association estimates, every 42 seconds an American will have an MI. In 2013, 116,793 deaths in the US were due to MI, and of these around 57% were in males and 43% were in females. The average age of a person having a first MI is 65.1 years for men and 72 years for women [2]. About 90% of patients with coronary heart disease report at least one of the major risk factors, including cigarette smoking, dyslipidemia, hypertension, diabetes, and abdominal obesity [3]. In the developing nations like Bangladesh, medical facilities are very limited and various investigations procedures are not widely available, very often costly and time consuming. In these situations, the Thrombolysis in Myocardial Infarction (TIMI) risk score is likely to be clinically useful to predict the short term prognosis. The TIM) risk score for ST-Elevated Myocardial Infarction (STEMI) is a simple integer score for bed side risk assessment of developing and adverse cardiac outcome (death, re-infarction or recurrent severe ischaemia) of patients with STEMI [4]. It also helps to provide a more accurate assessment of a patient's prognosis [5]. The main advantage of TIMI score are its simplicity and ease of use. The TIMI risk score is of potential interest even beyond simple prognostication of outcomes because it also appears to be predictive of increasing benefit from specific therapies as risk increases [6]. This information would be helpful for patients, their families and would also allow for more effective triaging and clinical allocation. Several studies validate the TIMI risk score for STEMI patients as a predictor of in-hospital mortality, 30 days mortality and even one year mortality in abroad [7-11]. However, in-hospital mortality is still in the range of 5–8% [12] and approximately 12% of patient's dead within 6 months and with higher mortality rates noted in high-risk patients [13]. Survival after an acute STEMI is influenced by characteristics such as age, comorbidities (diabetes mellitus [DM], hypertension, previous myocardial infarction [MI] and renal failure), multivessel disease (MVD), left ventricular (LV) ejection fraction (EF) and timely revascularization (thrombolysis and/or PCI) [14]. There are several different tools used globally, in combination with history taking and physical examination, to assess ischemic risk when a patient presents at a facility with chest pain. These risk assessment tools are: global registry of acute coronary events (GRACE) and thrombolysis in myocardial infarction (TIMI); platelet glycoprotein IIb/IIIa in unstable angina; receptor suppression using integrilin (PURSUIT); the history, electrocardiogram, age, risk factors, troponin (HEART); and added sex, serial 2-hour ECG, serial 2-hour delta troponin (HEARTS3). The GRACE and TIMI risk assessment tools are most commonly used internationally [15]. The reason for this is that both tools have been validated in multiple clinical environments [16].

Methodology

Study Design: This was a cross-sectional observational study.

Study period: This study was conducted during the period from 1st July 2017 to 30th June 2018.

Place of Study: This study was conducted in the Department of Cardiology, Sylhet MAG Osmani Medical College Hospital and Sylhet.

Target Population: The patients got admitted in the Coronary Care Unit of Department of Cardiology, Sylhet MAG Osmani Medical College Hospital, Sylhet with the diagnosis of ST elevation myocardial infarction (STEMI) were the target population.

Study Population: The patients got admitted in the Coronary Care Unit of Department of Cardiology, Sylhet MAG Osmani Medical College Hospital and Sylhet with the diagnosis of ST elevation myocardial infarction (STEMI) and those fulfilling the inclusion criteria were the study population.

Inclusion criteria

- Patients with STEMI.
- Age above 18 years.
- Those who received streptokinase

Exclusion Criteria:

- Prior myocardial infarction, coronary revascularization procedures either CABG or angioplasty or coronary stenting.
- Serious co-morbidities like renal failure, heart failure, cardiomyopathy, valvular heart disease, congenital heart disease and severe anaemia.

Sample Size: Sample was calculated by using Guilford and Frucher's formula, considering 5% level of significance, 5% precision level (marginal error) and the prevalence rate of coronary artery disease in Bangladesh of 3.4% [17]. The sample size is calculated by using under mentioned formula which comes to 50.

The formula is: $n = \frac{Z^2 pq}{d^2}$

Sampling Technique: Non-probability, convenient sampling method was applied.

Methods of Data Collection

Data were collected by both qualitative and quantitative
Methods using a pre-designed questionnaire devised for the study.

1. After admission a detailed history, general and physical examination were performed. Informed written consent was taken from the patients after detailed explanation of the purpose of study.
2. A 12 lead ECG was taken on admission by placing the leads in proper position.
3. Acute ST elevation myocardial infarction was diagnosed if a patient has acute chest pain (anginal pain) persisting more than 20 minutes at rest with ECG changes such as

a. New ST elevation at J point in at least 2 contiguous leads of 2mm or more in men or
b. 1.5mm or more in women in leads v2-v3 and/or
c. 1mm or more in other contiguous chest leads or the limb leads in absence of LVH or LBBB [18].

Fifty patients with acute STEMI were selected purposively.
Following risk scores were noted at the time of admission- (a) Age (b) The presence of previous infarction or left bundle branch block, (c) Hypertension, (d) diabetes, (e) prior angina, (f) weight (g) reperfusion time (h) Killip class, (i) heart rate and (j) systolic pressure.
Total TIMI risk score was calculated. The final score was between 0 and 14. Risk categorization was based on the admission TIMI risks score from 0-14 possible points: (1) Low risk, 0 to 4; (2) Moderate risk 5 to 8; and (3) High risk 9 to 14 [19]. Baseline laboratory investigations such as Random Plasma Glucose, serum creatinine, fasting lipid profile, serum electrolytes and Troponin-I were measured. Echocardiography was performed in all patients (Tables 1-3).

Table 1: *Distribution of Patients According to Component of TIMI risk score for STEMI (n=50).*

Component of TIMI risk score	Frequency	Percentage (%)
Age		
Below 65 Years	38	76.0
65-74 years	7	14.0
≥ 75 years	5	10.0
Pulse		
<100 b/min	39	78.0
≥100 b/min	11	22.0
Systolic blood pressure		
<100 mm of Hg	11	22.0
≥100 mm of Hg	39	78.0
DM or HTN or angina		
Yes	23	46.0
No	27	54.0
Killip class		
I	31	62.0
II-IV	19	19.0
Weight		
<67 Kg	21	42.0
≥67 Kg	29	58.0
Anterior MI or LBBB		
Yes	24	48.0
No	26	52.0
Time to treatment		
> 4 hours	43	86.0
≤ 4 hours	7	14.0

Fifty patients with ST elevation myocardial infarction were studied. Distribution of Patients According to

Component of the Thrombolysis in Myocardial Infarction (TIMI) risk score for STEMI was shown in Table-I. The age between 65-75 years was in 7 (14.0%) cases and 75 years or above was in 5 (10.0%) cases; heart rate more than 100/min was found in 11 (22%) patients; systolic blood pressure below 100 mm of Hg was in 11 (22.0%) cases; Killip class II-IV was in 19 (38.0%) cases; DM or HTN or angina was in 23 (46.0%) cases, weight less than 67 kg was in 21 (42.0%) cases; anterior MI or LBBB was in 24 (48.0%) cases; and time to treatment more than 4 hours was in 43 (86.0%) cases.

Table 2: *Distribution of the Patients According to the Thrombolysis in Myocardial Infarction (TIMI) Risk Score for STEMI (N=50).*

TIMI risk score	Frequency	Percentage
1 to 4	29	68.0
5-14	21	32.0
Mean (SD)	4.50 (SD 2.38)	

***Table 3*:** *Distribution of Patients According to Major Adverse Cardiac Events (MACE) and the Thrombolysis in Myocardial Infarction (TIMI) Risk Score for STEMI (N=50).*

	N	%
MACE	19	38.0%
No MACE	31	62.0%
The Thrombolysis in Myocardial Infarction (TIMI) risk score in STEMI was 6.95 (SD 1.78) in patients with major adverse cardiac events (MACE) and was 3.00 (SD 1.10) in patients with no major adverse cardiac events (No MACE). TIMI risk score for STEMI was significantly higher in patients with major adverse cardiac events (MACE) compared to patients with no major adverse cardiac events (No MACE) (t=9.736; p<0.001).		

Data interpretation and analysis: Data were processed and analyzed both manually and by using SPSS (Statistical Package for Social Sciences) Version 22.0. Quantitative data were expressed as mean and standard deviation; comparison was dome using unpaired t test. Qualitative data were expressed as frequency and percentage. Analysis was done by T-test. Pearson's correlation coefficient was also determined. A probability value $p<0.05$ was considered as significant, $p<0.01$ was considered as highly significant and $p>0.05$ was considered as non-significant.

Discussion

In this study the age of the patients ranged from 35 to 75 years with the mean age of 52.64 (SD 11.88) years. This result correlated with the study of Masood, Naqvi, Jafar, et al [20]. that the mean age of their patients was 51.89 ± 12.01 years. Alam, Ullah, Ulabbi, et al [21]. found that the mean age of the patients with acute myocardial infarction was 53.6 ± 10.3 years. This study also revealed that 76.0% patients of STEMI were in the age group of below 65 years and 24.0% patients were in the age group of 65 or above years. This result correlated with the study of Ehsan, Mahmood, and Siddique, et al. that 72.8% patients of STEMI were in the age group of below 65 years and 27.2% patients were in the age group of 65 or above years. Silveira, Jaeger, Hatschbach, et al., reported 64.2% of patients with STEMI were aged under 65 years old and 35.6% of patients with STEMI were aged at or above 65 years. In the present study 84.0% patients with STEMI were male and 16.0% were female with a ratio of male to female was 5.25:1. This result was almost similar to the study of Ehsan, Mahmood, Siddique, et al., that 81% patients with STEMI were male and 19.0% were female. This result also correlated with Chen, Huang and Lin [22]. that 88.9% patients with STEMI were male and 11.1% were female. Correia, Garcia and Kalil, et al., reported that 72.0% patients with STEMI were male and 28.0% were female. Male preponderance was reported in several other studies. In this study 14.0% cases were the between 65-75 years and 10.0% cases were aged 75 years or above. This result correlated with the study of González-Pacheco, Arias-Mendoza, Álvarez-Sangabriel, et al [23]. which reported 19.6% cases were the between 65-75 years and 8.9% cases were aged 75 years or above. This study revealed that 22.0% of cases had the heart rate more than 100/min and 22.0% cases had systolic blood pressure below 100 mm of Hg. This result was consistent with the study of González-Pacheco, Arias-Mendoza, Álvarez-Sangabriel, et al., which reported 15.4% of cases had the

heart rate more than 100/min and 12.2% cases had systolic blood pressure below 100 mm of Hg. In the present study 38.0% cases had Killip class II-IV. This result was supported by Chen, Huang and Lin which reported 43.3% cases had Killip class II-IV. In this regards Ehsan, Mahmood, Siddique, et al., found 19.7% cases had Killip class II-IV and González-Pacheco, Arias-Mendoza, Álvarez-Sangabriel, et al., found 19.7% cases had Killip class II-III but no class IV. This study revealed that diabetes or hypertension or prior angina was in 46.0% cases. In this regards Ehsan, Mahmood, Siddique, et al., [5] found diabetes in 15.6%, hypertension in 36.1% and prior angina was in 8.2% cases. González-Pacheco, Arias-Mendoza, Álvarez-Sangabriel, et al., found diabetes in 30.1%, hypertension in 50.3% and prior angina was in 19.8% cases. The Thrombolysis in Myocardial Infarction (TIMI) risk score for STEMI of the patients ranged from 1 to 11 with the mean TIMI risk score of 4.50 (SD 2.38) years. Correia, Garcia and Kalil, et al., reported that TIMI score for STEMI was 3.7 ± 2.3. Chen, Huang and Lin reported that the median value of the TIMI risk score was 5 in the patients with STEM. Betancourt-Plaza and Martos-Benítez found the average TIMI score was 5.04 (SD 2.7 points). This study also showed that 36.0% of patients had TIMI risk score 5 or above and 64.0% had up to 5. González-Pacheco, Arias-Mendoza, Álvarez-Sangabriel, et al., [23] found that patients were classified as low risk with a TIMI score of 04 (68%) and high risk with a TIMI score ≥5 (32%). Masood, Naqvi, Jafar, et al., found that patients with TIMI score of up to 4 in 68% cases and with a TIMI score ≥5 in 32% of cases. This study revealed that 38.0% cases had major adverse cardiac events (MACE). In this regards Ehsan, Mahmood, Siddique, et al. [5] reported MACE in 11.6% of cases with STEMI. The Thrombolysis in Myocardial Infarction (TIMI) risk score for STEMI was 6.95 (SD 1.78) in patients with major adverse cardiac events (MACE) and was 3.00 (SD 1.10) in patients with no major adverse cardiac events (No MACE). TIMI risk score for STEMI was significantly higher in patients with major adverse cardiac events (MACE) compared to patients with no major adverse cardiac events (No MACE) ($p<0.001$). Betancourt-Plaza and Martos-Benítez found mean TIMI score in those with dead was 7.8 points [SD 3.4 points] and with living was 4.7 points [SD 2.4 points]; $p = 0.001$). TIMI risk score was significantly higher in patients with dead compared to living. Thrombolysis in Myocardial Infarction (TIMI) risk score may be an applicable bedside tool in predicting in-hospital major adverse cardiac events and provide important prognostic information in ST-segment elevation myocardial infarction. However, further multicenter study involving large sample in hospital with long follow-up is needed.

Conclusion

In hospital major adverse cardiac events (MACE) occurred in 19 (38.0%) cases. TIMI risk score for STEMI was significantly higher in patients with MACE compared to patients without MACE (16.95, SD 1.78 versus 3.00, SD 1.10; $p<0.001$) respectively. From the study we conclude that TIMI risk score (5 or above) is a reliable tool in predicting in- hospital major adverse cardiac events in ST-segment elevation myocardial infarction.

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