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Correlation of TIMI score with severity of coronary artery disease in acute coronary syndrome

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Abstract

Background: ACS presents as wide range of clinical ailments that requires prompt treatment to avoid unforeseen circumstances. As noninvasive strategy, TIMI risk assessment is a widely accepted tool for risk stratification of ACS patient to initiate timely management. Purpose of the present study is to determine the association of TIMI score in predicting the severity of coronary artery disease in ACS.

Methodology: A cross-sectional study was conducted in specialized tertiary care cardiac hospital on 255 patients from January 2021 to June 2021. For all patients, TIMI score calculated based on all the seven variables. Confidentiality of the participants was maintained. Ethical approval was obtained from review board of concerned hospital. Data was analyzed on SPSS version 23.0. One way ANOVA was used to compare categorical variables. Chi square test used to reveal difference in proportion to three TIMI groups.

Results: Finding show that ST segment deviation was evident in 51.5% patients. Out of 37 patients in group-III with ST segment changes, 91.8% were found of having significant CAD. Results show that in group-III, 54.1% had significant three vessel CAD compared to 17.6% group-II & 7.5% group-I patients. Also, p-value of <0.001 depict significant association between TIMI score and severity of CAD.

Conclusion: A significant association from this study gives a notion that TIMI score is valuable tool in clinical setting to make urgent decision regarding the management of CAD. Also, it was concluded from current study that patients with higher TIMI score had additional risk of three vessel CAD and left main vessel CAD in patients with ACS.

Keywords

TIMI Score, Coronary Artery Disease, Acute Coronary Syndrome, Risk Assessment.

Introduction

Cardiovascular diseases remained a challenging factor of global mortality accounting for approximately 17.9 million deaths yearly. Acute coronary syndrome comprising of multiple variables is a common cause of hospitalization in cardiac disorders[1]. ACS presents as wide range of clinical ailments that require prompt treatment to avoid unforeseen circumstances. As noninvasive strategy, risk assessment is a widely accepted tool for early diagnosis of ACS patients to initiate timely management[2]. Multiple scoring system have been established on the basis of risk assessment to aid physician for better outcomes in ACS. These scoring systems are the most valuable tool for prompt treatment of patients in ACS. Risk scores help physician in predicting casual factors to augment clinical judgment. American and European guidelines insist the use of risk scores as mainstay of treatment in ACS[3].

Acute coronary syndrome is considered as ischemic heart disease due to obstruction of coronary arteries leading to diminished or no blood supply to cardiac muscles. Decreased blood supply to heart muscles leads to decrease perfusion rate as balance between oxygen supply and demand is interrupted[4]. The spectrum of ACS involves three common types, ST segment elevation myocardial infarction (STEMI), non-ST segment elevation myocardial infarction (NSTEMI), and unstable angina[5]. All the three types of ACS reveal different clinical picture for cardiologist. Timely decision is required for starting treatment regime to reduce morbidity and mortality rate in ACS[6].

Globally, ACS is common cause of adult deaths accounting for 30% mortality rate. Risk stratification is a key component for initial assessment of ACS that differentiates low and high risk patients to avoid life threatening consequences via early medical management of high risk cases[7]. American cardiac association and European heart academy widely recommend the use of thrombolysis in myocardial infarction (TIMI) score for timely prognosis in ACS both STEMI & NSTEMI[8].

As a noninvasive and easy bedside strategy, TIMI is a valuable scoring tool that is widely accepted for prompt assessment of cardiac events in ACS patients. Risk score is based on multiple clinical parameters composed of clinical assessment of patient, ECG findings and laboratory evaluation[8]. TIMI score comprises different aspects to detect the extent of disease like age of patients, clinical manifestation and comorbidities associated with cardiac event, ECG report, raised level of troponin, continuous pain history with therapy[9].

In ACS, TIMI score helps to predict short term risk for death and other adverse cardiac events. So, timely detection of high-risk cases is another aspect of TIMI score system to initiate invasive treatment modalities in saving lives[10]. TIMI score is a simple numeric sum of clinical characteristics without the use of computers to identify the severity of disease in ACS. In this scoring system, seven independent variables are identified as significant key factors to evaluate the patient at initial and each variables carry one point, so score range is 1 to 7 at TIMI and 7 depicts the worsening condition[11].

1. AGE: Age is considered as first component. Age $\geq$ 65 presents as a risk for coronary artery disease and risk of ACS increases with increasing age but 65 is considered as cutoff value in TIMI score[12].
2. Severity of angina pain: $\geq$ 2 episodes of chest pain in 24 hours. Angina pain variable is approved from multiple studies as key factor in this scoring system. Recurrent pain episodes in last 24 hours, or chest pain at rest and post angina MI are considered as poor prognostic factors in ACS[13].
3. History of $\geq$ 3 risk factors responsible for coronary artery disease. These factors include hypertension, diabetes, hyperlipidemia, smoking and disease presence in family members. These factors are evidenced as contributors of ACS from multiple studies. Among multiple contributors, first four are modifiable while the other one in non-modifiable factor [12, 13] .

4. History of aspirin use: Data from numerous studies provide a clue regarding the previous usage of aspirin as it's prolong use is associated with increased resistance due to platelets rich thrombi that worsen the prognosis[12,13].
5. ST segment deviation on ECG: Another significant predictor of ACS is ST segment deviation. Any change in ST segment is hint for a complex lesion and needs revascularization. ST segment depression connotes more extensive CAD that results in poor outcomes and increase the risk of death[12, 13].
6. Raised levels of serum cardiac markers: Serum troponin level is a true marker of cardiac muscle necrosis in predicting the risk of mortality. Due to higher specificity and sensitivity, troponin concentration clearly detect the micro-infarcts in nearly 30% cases of unstable angina[14].
7. History of coronary artery disease: Presence of CAD is useful to elaborate further diagnosis of ACS[12, 13, 14].

TIMI score is a fruitful tool in assessing risk for CAD in ACS. Purpose of the present study is to determine the association of TIMI score in predicting the severity of coronary artery disease in ACS[15].

Table 1: TIMI risk Score

Characteristics	Points
Age ≥ 65 years	1
≥ 2 episodes of recurrent angina chest pain in 24 hours	1
History of ≥ 3 risk factors responsible for coronary artery disease	1
History of aspirin use	1
ST segment deviation on ECG	1
Raised levels of serum troponin	1
History of coronary artery disease	1
Total Risk Score	0-7

Methodology

A cross-sectional study was conducted in specialized tertiary care cardiac hospital on 255 patients from January 2021 to June 2021. Patients with history of ACS waiting for coronary angiography admitted in cardiac facility were selected. Comprehensive assessment of patients was done along with ECG finding and laboratory test to select the candidates.

Inclusion criteria of the study involved patients older than age 20, history of recurrent chest pain or pain at rest, ST segment deviation on ECG and raised levels of serum cardiac markers. Informed consent was taken from selected candidates and detailed past history was obtained. A questionnaire listing all the main risk factors and medical history was used to collect data from patients[15].

All the patients included in present study received standardized medical treatment and admitted in CCU. Chest pain was described as heaviness that last for >20 minutes, exacerbates with minimal exertion and can be of increased severity or new onset. A 12 lead ECG was performed on all the patients for risk stratification by detecting ST segment deviation (ST segment depression > 0.5, T- wave inversion > 3mm or ST segment elevation >0.5).

Blood samples were obtained to investigate the serum troponin levels as cardiac marker of ACS. Lipid profiles, fasting blood sugar levels and HbAIC were also done. Past history regarding smoking, previous aspirin usage and presence of CAD in family was also obtained.

For all patients, TIMI score calculated based on all the seven variables. After scoring patients were further categorized in three groups.

Group-I: TIMI score 0-2 categorized as low risk group
Group-II: TIMI score 3-4 categorized as intermediate risk group
Group-III: TIMI score 5-7 categorized as high-risk group

Coronary angiography was performed in all selected patients within 72 hours of hospitalization through radial or femoral approach. All the lesions were visualized and interpretation done by two experienced cardiologist. Lesions were differentiated on anatomical basis as ischemic related or a culprit lesion with visual stenosis diameter of >70%. Based on angiography, coronary artery disease was categorized into[16].

1. Normal (absence of any lesion)
2. Non-significant lesion accounting for < 70% stenosis in one or more coronary arteries or <50% stenosis in left main coronary artery.
3. Significant one vessel disease > 70% occlusion in one major artery.
4. Significant 2 vessel disease > 70% occlusion in 2 major arteries.
5. Significant 3 vessel disease > 70% occlusion in 3 major arteries.
6. Significant left main coronary artery > 50% occlusion in left main coronary artery.

Confidentiality of the participants was maintained. Ethical approval was obtained from review board of concerned hospital. Informed consent was taken from study participants and they were assured that their participation will be voluntary without any force or coercion.
Data was analyzed on SPSS version 23.0. One way ANOVA was used to compare categorical variables. Chi square test used to reveal difference in proportion in three TIMI groups. All the tests were performed at 95% confidence interval and p-value < 0.5 was used to reveal significant results.

Results

In this study, total 255 participants were included. TIMI risk score was calculated from all the study subjects. Table 2 reveal the TIMI risk score of participants.

Table 2 clearly illustrate the participants TIMI score according to all the seven variable. Total 67 participants belong to group-I (low risk group). In intermediate risk group 137 participants were included in this study whereas 36 participants were from high risk group. Age criteria depicts only 1 member having age> 65 was in group-I. 61 participants in group-II & 36 in group-III have age more than 65 years as illustrated in above table. > 2 episodes of angina pain were present in 61(27.1%) group-I, 130(57.8%) group-II and, 34 (15.1%) in group-III members. More cases of angina pain were present in group-II participants compared to other groups.

Also, history of >3 risk factor of CAD were prevalent in group-II members i.e. 71(65.1%) So, group –II members had strong implications for risk factors. In group-I only 17 (21.8%) had aspirin use in previous days while 48(61.5%) in group-II & 13 (16.7%) participants in group-III had history of aspirin use. ECG finding showed ST segment deviation in 21 (16.6%) group-I, 72(56.7%) group-II & 34(26.7%) in group-III participants out of 255. In group-II ST segment deviation was more pronounced. Table#2 also illustrate that troponin levels and history of coronary artery disease was distinct in intermediate risk group compared to others.

Table 2: Characteristics of Participants on base of TIMI risk score

TIMI Score Variables		Group-I n= 67	Group-II n= 137	Group-III n= 42	Total	p-value
Age ≥ 65 years	Frequency	1	61	36	98	<0.001
	% Within TIMI group	1.4%	42.2%	97.2%		
	% Within the variable	1.0%	62.2%	36.7%	100%	
	% of total	0.4%	24.4%	14.6%	39.4%	
≥ 2 episodes of recurrent angina	Frequency	61	130	34	225	0.1
	% Within TIMI group	91%	91%	91.8%		

chest pain in 24 hours	% Within the variable	27.1%	57.8%	15.1%	100%	
	% Of total	24.4%	52.8%	13.8%	91.2%	
History of ≥ 3 risk factors responsible for coronary artery disease	Frequency	2	71	36	109	<0.001
	% Within TIMI group	2.9%	50%	97.2		
	% Within the variable	1.8%	65.1%	33.0%	100%	
	% Of total	0.8%	28.8%	14.6%	44.2%	
History of aspirin use	Frequency	17	48	13	78	0.2
	% Within TIMI group	25.3%	33%	35%		
	% Within the variable	21.8%	61.5%	16.7%	100%	
	% Of total	6.9%	19.5%	5.2%	31.6%	
ST segment deviation on ECG	Frequency	21	72	34		<0.001
	% Within TIMI group	31.3%	50.7%	92%		
	% Within the variable	16.6%	56.7%	26.7%	100%	
	% Of total	8.5%	29.2%	13.8%	51.5%	
Raised levels of serum troponin	Frequency	14	73	30	117	<0.001
	% Within TIMI group	22%	51%	81%		
	% Within the variable	12.0%	62.4%	25.6%	100%	
	% Of total	5.6%	29.6%	12.1%	47.3%	
History of coronary artery disease	Frequency	5	28	16	49	<0.001
	% Within TIMI group	8%	19%	43%		
	% Within the variable	10.2%	57.1%	32.7%	100%	
	% Of total	2%	11.3%	6.5%	19.8%	

Risk factors of CAD showed in above table illustrate that family history of CAD was present in 13(19.4%) group-I, 31(21.8%) group-II & 31(21.8%) group-III participants. p-value of 0.01 also show a signification associate regarding family history of CAD in three group. The most prevalent risk factor responsible for CAD was hypertension 173(70.3%). Hyperlipidemia 117(47.4%) found the second important risk factor of CAD. Similarly, other factors of CAD like smoking 113(45.8%), DM 100(40.6%) & family history 54(21.9%) also showed significant association mentioned in Table 3.

Table 3: Risk factors of coronary artery disease in TIMI groups

Risk Factors	Group-I	Group-II	Group-III	Total	p-value
Family history of premature CAD	13(19.4)	31(21.8)	31(21.8)	54(21.9)	0.01
Hypertension	31(46.2)	109(76.7)	33(89)	173(70.3)	<0.001
Diabetes Mellitus	16(23.8)	59(41.5)	25(67.5)	100(40.6)	<0.001
Hyperlipidemia	21(31.3)	69(48.6)	27(73)	117(47.4)	<0.001
Smoking	25(37.3)	71(50)	17(45)	113(45.8)	0.03

*Variables represented in n(%)

Results in Table 4 showed that normal or non-significant CAD was dominant in group-I members 35(60.3%) compared to group-II & III participants. Also, a significant relationship was noticed as p-value was <0.05. In group-II participants significant one vessel CAD was more common 45(67.2%) then group-I and III. p-value of 0.03 revealed significant association. Furthermore, angiogram results also depicted prevalence of other categories of CAD more in group-II participants compared to other groups. Significant associations were evident from p-vale illustrating the prevalence of CAD.

Table 4: Coronary Angiographic Findings in TIMI Groups

Angiogram Results		Group-I	Group-II	Group-III	Total	p-value
Normal/ Non-significant CAD	Frequency	35	22	1	58	<0.01
	% With coronary angiogram results	60.3%	37.9%	1.7%		
	% Within TIMI risk score	52.2%	15.5%	2.7%		
Significant one vessel CAD	Frequency	18	45	4	67	0.03
	% With coronary angiogram results	26.9%	67.2%	6.0%		
	% Within TIMI risk score	26.9%	31.7%	10.8%		
Significant two vessel CAD	Frequency	7	39	5	51	<0.001
	% With coronary angiogram results	13.7%	76.5%	9.8%		
	% Within TIMI risk score	0.4%	27.5%	13.5%		
Significant three vessel CAD	Frequency	5	25	20	50	<0.001
	% With coronary angiogram results	10%	50%	40%		
	% Within TIMI risk score	7.5%	17.6%	54.1%		
Significant left main CAD	Frequency	2	11	7	20	0.03
	% With coronary angiogram results	10%	55%	35%		
	% Within TIMI risk score	3.0%	7.7%	18.9%		

Discussion

Present study was conducted to assess the role of TIMI score in predicting the severity of CAD in patients with ACS. 255 participants were included in this study. Finding reveal that ST segment deviance was obvious in 51.5% patients (table#2). Out of 37 patients in group-III with ST segment changes, 91.8% were found of having significant CAD. These results are also consistent with other studies revealing the significance of TIMI scoring in CAD[17].

Moreover, patients were categorized into 3 groups based on TIMI score i.e low risk, intermediate and high risk groups. Aim of the classification was to explore the association of TIMI risk score and severity of CAD. Results show that in group-III, 54.1% had significant three vessel CAD compared to 17.6% group-II & 7.5% group-I patients. Also, p-value of <0.001 depict significant association between TIMI score and CAD extension. Findings are similar to other studies undertaken to demonstrate the scoring system usefulness in CAD[18].

Likely, one vessel CAD was more prevalent in group-II (31.7%) then other groups, 26.9% in group-I & 10.8% group-III participants. Statistically significant association was also evident as p-value was <0.05 (table#4). These finding are well suited with others to reveal significant relationship between TIMI score and severity of CAD[19, 20].

In table #4 results show that high risk TIMI group suffered more with multiple vessel disease compared to low and intermediate risk group. Significant left main CAD was also dominant in high risk group (group-III) and show a significant relationship (p-value<0.05). Other research studies conducted on efficacy of TIMI score in predicting CAD also forecast consistent results and showed significant association between TIMI score and CAD[21, 22].

Because of its simplicity in calculation and easiness, TIMI risk score should be considered as the most important score in stratify the risk of patients presented with ACS to identify patients who will benefit from early coronary intervention.

Conclusion

In this study, TIMI scoring system proved beneficial to illustrate the severity of CAD. A significant association from this study give a notion that TIMI score is valuable tool in clinical setting to make urgent decision regarding the management of CAD. Also, it was concluded from current study that patients with higher TIMI score had additional risk of three vessel CAD and left main vessel CAD. TIMI score system could be used as routine investigation method to ease physicians in planning interventions. As an easy and simple bedside approach, efficacy of TIMI score can't be negated.

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