Section: Cardiology

Original Research Article

A STUDY OF THE ADDED VALUE OF ST-ELEVATION IN LEAD AVR TO CLINICAL TIMI RISK SCORE IN PREDICTING THE ANGIOGRAPHIC SEVERITY AND EXTENT OF CAD IN PATIENTS WITH NSTE-ACS

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ABSTRACT

Background: The spectrum of ACS involves three common types, ST segment elevation myocardial infarction (STEMI), non-ST segment elevation myocardial infarction (NSTEMI), and unstable angina. As a non-invasive and easy bedside strategy, TIMI is a valuable scoring tool that is widely accepted for prompt assessment of cardiac events in ACS patients. The aim was to investigated the added value of the presence of ST elevation in lead aVR of the 12-lead admission ECG to the TIMI clinical scoring system in predicting the angiographic severity of CAD in patients admitted with NSTEACS.

Materials & Methods: A hospital based prospective non-randomized study done on 100 acute coronary syndrome (ACS) patients in department of cardiology at JLN Medical College, Ajmer, Rajasthan during one-year period. For all patients, TIMI score calculated based on all the seven variables. After scoring patients were further categorized in three groups. Statistical analyses were performed using the Med calc statistical software version (14.8.1). The comparison between groups was done by Mann-Whitney U test for continuous variables and by Chi-square or Fisher`s exact test for categorical variables.

Results: Total 34 participants belong to group-I (low risk group). In intermediate risk group 42 participants were included in this study whereas 24 participants were from high-risk group. Sensitivity of either high TIMI (5-7 SCORE) or ST-elevation in lead aVR present for prediction of significant coronary artery involvement was64%. Specificity of either high TIMI (5-7 SCORE) or ST-elevation in lead aVR present for prediction of significant coronary artery involvement was 69%.

Conclusion: In conclusion, STE in lead aVR has a diagnostic and prognostic value in patients with NSTEACS and may provide an additional prognostic value to the conventional cardiovascular risk factors, particularly in patients from the TIMI low-risk and intermediate-risk groups.

Keywords: TIMI score, ST elevation, CAD, NSTE-ACS.

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 non-invasive 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 non-invasive 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 the spectrum of ACS, UA/NSTEMI is defined as-

- sudden onset of symptoms at rest (or with minimal exertion) that last at least 10 minutes unless treated promptly;
- severe pain, pressure, or discomfort in the chest;
- an accelerating pattern of angina that develops more frequently, with greater severity, or that awakens the patient from sleep.

Patients with typical symptoms without persistent (>20 minutes) ST-segment elevation in at least two contiguous electrocardiographic leads.[10]

In patients with NSTEMI, ST-segment depression has also been related to the presence of extensive coronary artery disease (CAD) and to a greater benefit of an early invasive therapeutic approach. STE in lead aVR, in combination with other repolarization changes, has been associated with severe coronary artery lesions in patients with UA or NSTEMI.[11]

A number of risk assessment tools have been developed to assist in assessing risk of death and ischemic events in patients with UA/NSTEMI, thereby providing a basis for therapeutic decision making. Antman et al,[12] developed the thrombolysis in myocardial infarction (TIMI) risk score, which is a simple tool composed of 7 (1/point) risk indicators that are rated on presentation. TIMI risk score has been correlated with the severity of CAD with each increase in the score; nevertheless, it was found to lack sensitivity in low-risk and intermediate-risk groups; among them, high-risk CAD was diagnosed by coronary angiography.[13] The aim was to investigated the added value of the presence of ST elevation in lead aVR of the 12-lead admission ECG to the TIMI clinical scoring system in predicting the angiographic severity of CAD in patients admitted with NSTEACS.

MATERIALS AND METHODS

A hospital based prospective non-randomized study done on 100 acute coronary syndrome (ACS) patients in department of cardiology at JLN Medical College, Ajmer, Rajasthan during one-year period. 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

- NSTE-ACS PATIENTS
- Patients/Relatives giving written informed consent

Exclusion Criteria

- Patients with persistent STE (>20 minute) in the surface ECG
- patients with conditions precluding the evaluation of QRS duration or ST-segment changes on ECG (left bundle branch block, left ventricular hypertrophy, ventricular antiarrhythmic drugs), pacing, ventricular pre-excitation and

Methods

All patients were subjected to full history taking with special emphasis on demographic criteria including age and sex; a detailed medical and cardiac history including smoking, hypertension, history of diabetes, previous ischemic heart disease either STEMI or NSTEACS (documented by an old ECG showing evidence of ischemia as STE or depression, pathological Q waves, biochemical markers of necrosis or radioisotope scan showing an area of infarction), previous PCI and previous coronary artery bypass grafting operation; and clinical examination including local cardiac examination.

ECG was done on admission of the patients at a paper speed of 25 mm/s and amplification of 10 mm/mV. ST-segment shifts will measure 20 ms

after the J-point for ST-segment depression using the preceding TP segment as the baseline. ST-segment deviation greater than 0.5 mm in any lead is consider significant.[14]

Each ECG was analysed to assess the following

1. The presence and degree of STE in lead aVR (ST-segment shifts measure 20 ms after J-point for STE using the preceding TP segment as the baseline.[11]
2. The presence and degree of ST-segment depression in leads other than lead aVR Risk stratification was done through TIMI scoring system.

All patients undergo risk stratification for CAD according to 7 (1/point) indicators of the TIMI clinical scoring system.[12] The seven indicators are as follows

1. Age greater than 65 years,
2. Three or more risk factors for CAD, (hypertension, hypercholesterolemia, DM, F/H/O – CAD, current smoker)
3. Known CAD (CA showing stenosis ≥50%),
4. Severe anginal symptoms (≥2 anginal events in preceding 24 h),
5. Use of aspirin in the last 7 days
6. ST-segment deviation greater than 0.05 mv
7. Elevated serum cardiac markers of necrosis.

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

The coronary angiography was assessed for the severity and distribution of coronary artery disease where stenosis greater than or equal to 50% in the diameter of the left main coronary artery,[15] or stenosis greater than or equal to 70% in one or more of the major epicardial vessels or their main branches was considered clinically significant.[16]

Statistical Analysis

Statistical analyses were performed using the Med calc statistical software version (14.8.1). The comparison between groups was done by Mann-Whitney U test for continuous variables and by Chi-square or Fisher`s exact test for categorical variables. P < 0.05 was considered statistically significant.

RESULTS

Our study showed that the mean age of all patients was approximately 60.65 years and SD of 9 years only. Most common risk factors were smoking in 74% followed by hypertension present in 72% of cases followed by 27% dyslipidaemia, 24% diabetes mellitus and 20% of cases have family H/O CAD / CVA. Total 34 participants belong to group-I (low risk group). In intermediate risk group 42 participants were included in this study whereas 24 participants were from high-risk group. ECG changes present in 80% of cases, troponin positive in 46% of cases and ST elevation in aVR lead was found in 28% of cases. [table 1]

Our study showed that normal or non-significant CAD was present in one group-I members compared to group-II & III participants. In group-I participants significant one vessel CAD was more common 17 (50%) then group-I and III. 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 as compared to group II & group III. [table 2 & 3]

Receiver operator characteristics (ROC) curve for ability of the high TIMI score (5-7) to identify triple vessel disease (TVD) or left main vessel (LM) disease. Sensitivity was 40.5% & specificity was 85.7% in our study. [figure 1]

Receiver operator characteristics (ROC) curve for ability of the ST elevation in aVR lead to identify triple vessel disease (TVD) or left main vessel (LM) disease. Sensitivity was 48% & specificity was 84% in our study. [figure 2 & table 4]

Receiver operator characteristics (ROC) curve for ability of the either high TIMI (5-7) or ST elevation in aVR lead to identify triple vessel disease (TVD) or left main vessel (LM) disease. Sensitivity of either high TIMI (5-7 SCORE) or ST-elevation in lead aVR present for prediction of significant coronary artery involvement was 64%. Specificity of either high TIMI (5-7 SCORE) or ST-elevation in lead aVR present for prediction of significant coronary artery involvement was 69%. [Figure 3]

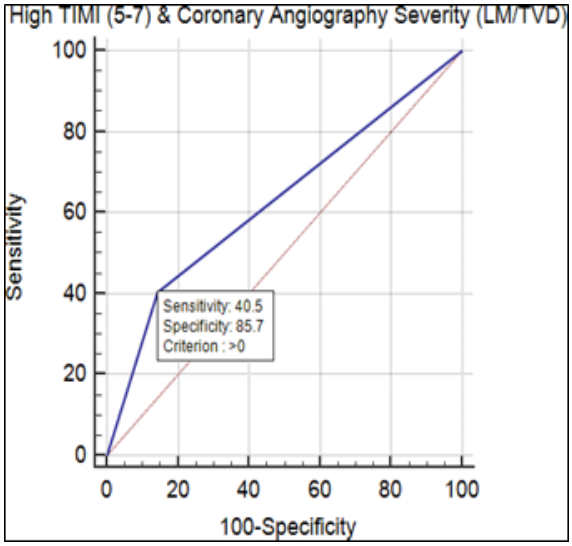

Figure 1: Receiver operator characteristics (ROC) curve

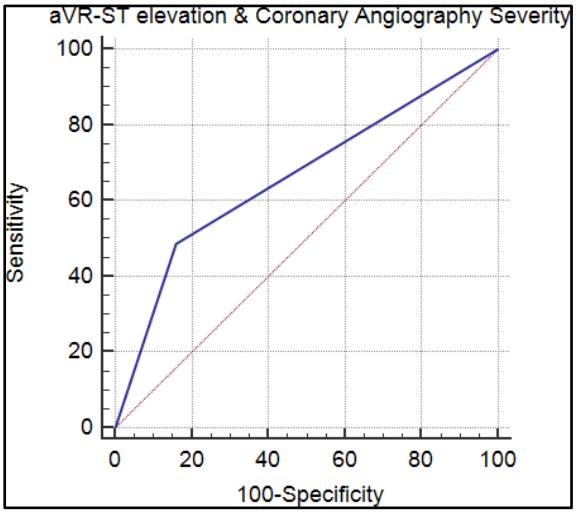

Figure 2: Receiver operator characteristics (ROC) curve

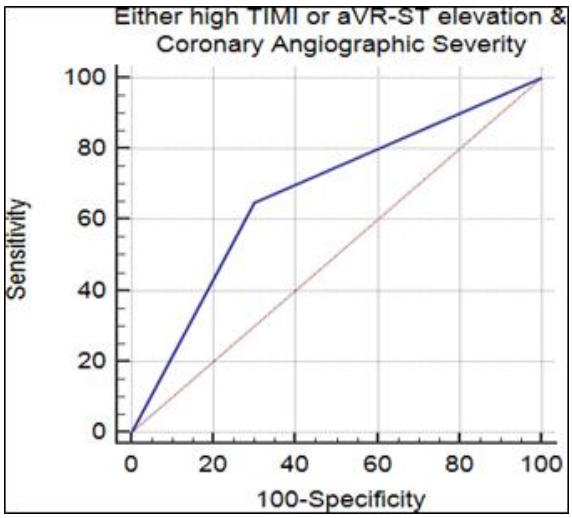

Figure 3: Receiver operator characteristics (ROC) curve

Table 1: Patients' Baseline Characteristics, Electrocardiogram, Angiography Findings

Baseline Characteristics, Electrocardiogram, Angiography Findings	No. of patients
Age (years) (Mean±SD)	66.5±9.27
Female	41
BMI (Kg/m^2) (Mean±SD)	26.48±5.3
Hypertension	72
Diabetes	24
Smoking	74
Dyslipidemia	27
Family History of CAD/CVA	20
Previous History of CAD	18
ECG Changes	80
Troponin T Positive	46
Clinical TIMI Score 0-2 3-4 5-7	 34 42 24
ST elevation in aVR lead	28

Table 2: Angiographic Results by TIMI Risk Score Category

Angiogram results	TIMI Score 0-2(n- 34)	TIMI Score 3-4(n-42)	TIMI Score 5-7(n-24)
Normal angiogram or non-significant CAD	1	0	0
Significant 1-vessel CAD without left main CAD	17	11	4
Significant 2-vessel CAD without left main CAD	11	14	5
Significant 3-vessel CAD without left main CAD	5	14	12
Significant left main CAD	0	3	3
Significant 3-vesselor left main CAD	5	17	15

Table 3: Angiographic Results by TIMI Risk Score Category

	Low and intermediate TIMI Score (0-4)	High TIMI Score (5-7)	p Value
NO Significant 3-vessel or left main CAD	54	9	<0.01
Significant 3-vessel or left main CAD	22	15	<0.01
Sensitivity	15/37=40.5%		
Specificity	54/63=85.7%		

Table 4: Angiographic Results by ST elevation in aVR lead

Angiographic Results	aVR ST elevation Present (n-28)	aVR ST elevation Absent (n-72)	P Value
Significant 3-vesselor left main CAD	18	19	<0.01
No Significant 3-vessel or left main CAD	10	53	
Sensitivity	18/37= 48%		
Specificity	53/63= 84%		

DISCUSSION

The Thrombolysis in Myocardial Infarction (TIMI) risk score predicts adverse clinical outcomes in patients with non-ST-elevation acute coronary syndromes (NSTEACS). Whether this score correlates with the coronary anatomy is unknown. We sought to determine whether the TIMI risk score correlates with the angiographic extent and severity of coronary artery disease (CAD) in patients with NSTEACS undergoing cardiac catheterization.

Clinical risk factors and risk scores may be used to identify higher risk patients in whom potent antithrombotic agents and early invasive management are particularly advantageous.[17]

The use of TIMI risk score in prediction of angiographic severity of CAD was investigated in multiple previous studies. The finding in our study was that high TIMI risk score and STE in lead aVR was a predictor of angiographic severity of CAD, in those patients with LM or multi vessel diseases.

Moreover, when added to the TIMI clinical risk score, STE-aVR significantly improved sensitivity for the prediction of severity of CAD. Garcia et al.[13] studied the correlation between the TIMI risk score and angiographic findings in NSTEACS. Despite correlating well with LM and three-vessel disease in high-risk group with a cut-off point greater than 5, it was found that TIMI score was less sensitive. Similar finding was found in our study.

This low sensitivity of TIMI score was supported by a previous study of Isilak et al,[18] who compared different scoring systems in predicting 3VD and culprit lesions in patients with NSTEACS and concluded that the TIMI and GRACE risk scores have more predictive value than the others but TIMI score has low sensitivity with cut-off value greater than 4.

previous studies have found analysis of lead aVR to be useful in estimating the severity of cad and the likelihood of left main or three-vessel disease. Kosuge et al,[19] have shown that the predictive value of ST elevation-aVR for mortality is based on its relationship with multi vessel disease and left main coronary artery obstruction.

In our study, 28 patients with significant CAD had STE in lead aVR, with none of the normal CA cases had elevated ST in this lead. STE-aVR was found in 18 (48%) cases of patients with LM/TVD disease (37Patient's) Thus, STE-aVR could predict another 9cases (24%) of LM/TVD that have low TIMI score.

Finally, for those patients thought to have a potential NSTE-ACS, our data suggest that among ow TIMI risk and intermediate TIMI risk groups, some patients may be still at higher risk CAD than addressed by TIMI score. Those patients may need to be re-stratified by another tool (ST elevation in aVR lead) for their risk and the decision of a specific urgent strategy for their treatment.

CONCLUSION

In conclusion, STE in lead aVR has a diagnostic and prognostic value in patients with NSTEACS and may provide an additional prognostic value to the conventional cardiovascular risk factors, particularly in patients from the TIMI low-risk and intermediate-risk groups. The use of STE in lead aVR in addition to TIMI risk score may improve the early stratification and management of those patients at high-risk CAD, with subsequent effect on morbidity and mortality.

Limitations

- It included a single medical center.
- The study included only 100 patients, which is a relatively small number; therefore, it will be useful to confirm our findings by larger studies.
- Although coronary angiography being assessed by an experience according to the visual assessment method without applying there centrally developed standard scores.

In our study, we did not examined the relation of findings to different magnitudes of STE in aVR lead.

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