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ORIGINAL ARTICLE

CORRELATION OF COMORBIDITIES AND OUTCOME IN CAD PATIENTS: A NOVEL TANGENTS SCORE STUDY

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Summary

Background: Cardiovascular diseases (CVD) are influenced by various established risk factors, including the ratio of neutrophils to lymphocytes and platelets, which has been shown to be an independent risk factor for acute coronary syndrome (ACS). This study aims to create a new scoring system called TANGENTS that utilizes discrete parameters of risk factors and diagnostic parameters to analyze the outcome of coronary artery disease (CAD) patients with comorbidities, particularly Type 2 diabetes mellitus (T2DM).

Methods: We included 151 subjects (mean age 57.92 ± 23.86) who presented with ST-elevation and ST-depression on admission and were treated with heparin, clopidogrel, aspirin, and atorvastatin while undergoing all the necessary diagnostic tests. We obtained ECG and complete blood picture (CBP) results on admission, day 3, and day of discharge.

Results: ST-depression on ECG on day-1 was 0.35 and decreased to 0.30 on the day of discharge. ST-elevation on ECG on day-1 was -0.89 and decreased to -0.16 on the day of discharge. The average neutrophil-to-lymphocyte ratio (NPR) was 0.49, which was high in 144 patients. The mean NLR value was 5.52, indicating a correlation between high NLR values and the magnitude of current injury on admission.

Conclusion: The TANGENTS scoring system can be used as an early evaluation tool for CAD patients with comorbidities to manage and prevent further complications. It allows for progressive differentiation in the severity of clinical outcomes using all the parameters of the score, and the parameters creating the TANGENTS score scale were found to be reliable.

Key words: TANGENTS Score; ECG (ST-Elevation And ST-Depression); Troponin-I, Stress Scoring Scale; Morisky Adherence Scale

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1. Introduction

The TANGENT'S scoring system is a simplified tool that utilizes eight parameters to assess various types of coronary artery disease (CAD). Established risk factors for cardiovascular diseases (CVD) include smoking, alcohol consumption, obesity, hypertension, diabetes, and dyslipidemia, while advancing age and male gender also increase the risk of CVDs (1, 2). Recent studies have shown that independent risk factors for cardiovascular events include neutrophil to platelet ratio (NPR) and neutrophil-lymphocyte ratio (NLR). Diabetes mellitus (DM) also significantly increases the risk of CVD through microvascular and macrovascular changes, as well as by augmenting other risk factors (3-6).

In many studies, the level of platelet-to-neutrophil ratio (PNR) has demonstrated higher accuracy in predicting the 3-month prognosis of infarction compared to the level of platelet-to-lymphocyte ratio (PLR). The PNR level is also correlated with the 3-month prognosis of infarction. Two acute inflammatory indexes, NLR and NPR, are used to evaluate the inflammatory response. The triglycerides to high-density lipoprotein cholesterol (HDL-C) ratio indicates insulin resistance and has an independent association with the risk of developing CAD. PLR typically increases in later stages of DM but is significantly reduced in prediabetes (7-10). Additionally, the NPR at admission is an independent predictor of short- and long-term mortality in CAD patients. If confirmed in other large cohorts, NPR could be easily introduced in clinical practice (11-13). Diabetic patients with CAD also had higher levels of troponin, a sensitive marker of MI that plays a vital role in diagnosis. Finally, identifying patients with higher levels of stress over a prolonged period following a diagnosis of CAD is also essential (14, 15).

The ratios of NPR and NLR can be easily generated from complete blood picture (CBP) reports, making them readily available and affordable. The total TANGENTS score analysis is calculated by adding the clinical data values of a patient as per the scoring assigned for each parameter and determining the final score to be low, moderate, or high. The TANGENTS scoring system provides a reliable tool for the early evaluation of CAD patients with comorbidities to manage and prevent further complications. It shows progressive differentiation in the severity of clinical outcomes using all parameters of the score.

2. Materials and Methods

A prospective observational study was conducted between September 2019 and February 2020 in the department of physiology and cardiology at the University. Informed consent was obtained from all subjects, after providing a brief explanation about the study and the lab tests to be performed, via an informed consent form.

Study Patients

The study enrolled 151 patients, above 18 years of age, with a diagnosis of STEMI on admission (mean age 57.92 ± 23.86). The patients were diagnosed with STEMI based on their complaint of chest pain, discomfort in the chest, and shortness of breath before admission, with cumulative ST-segment elevation of ≥0.2mV in limb leads or ≥0.1mV shown in at least two succeeding chest leads. Demographic data (age, gender) and cardiovascular disease risk factors (Hypertension, Diabetes, Smoking, and Alcohol consumption) were noted from all patients. Patients with ongoing infection or systemic inflammatory conditions, severe renal or liver disease, hematological disease, and pregnant women were excluded from the study.

Methodology

ECG of all patients on admission, day 3, and the day of discharge was obtained, and the magnitude of ST-elevation was measured at the J point from leads II, III, aVF for Inferior myocardial infarction, leads I, aVL, V5-V6 for Lateral wall myocardial infarction, leads V3-V4 for Anterior myocardial infarction, and V1-V2 for septal myocardial infarction. Stress scoring and Morisky scale results were carried out for all the subjects, and each patient was advised regarding the management strategies and importance of medication adherence as per their results. The baseline parameters recorded in the analysis were: Troponin-I, Age, Neutrophil Platelet Ratio, Gender, ECG (ST-elevation & ST- depression), Neutrophil Lymphocyte Ratio, Lipid Profile, Stress Scoring Scale, HbA1c,

Morisky Adherence Scale, Comorbidities (hypertension, diabetes, hypothyroidism & other diseases), History of CAD, Intervention, Smoking and alcohol intake, and Type of MI.

Laboratory Measurements

Venous blood samples were collected from all patients at the time of admission, on day 3, and at the time of discharge from the antecubital vein while the patient was in the supine position. Complete blood count was obtained, from which Neutrophils, lymphocyte, platelet counts, Lipid profile, Troponin-I were analyzed. NPR was calculated by dividing the Neutrophil count by Platelet count. NLR was calculated by dividing the Neutrophil count by Lymphocyte count. Patients who were diabetic were advised for HbA1c tests. NPR results were 95.36% high.

Statistical analysis

Statistical tests were performed using SPSS 23.0 version, IBM, Chicago, IL. Continuous data were expressed as mean± standard deviation (SD), while categorical data were expressed by number and percentages. Correlation analysis was performed by Pearson Correlation Test, Spearman's Rho Test, Chi-Square Test, Kaiser-Meyer-Olkin Test, Bartlett's Test, Mann Whitney U Test, Wilcoxon W Test, and Z-test. Mean and standard deviation for all the parameters were calculated, and statistical testing was done, with p-values determined (9).

3. Results

Baseline demographics

From September 2019 to February 2020, 151 patients were hospitalized with a primary diagnosis of CAD and STEMI. The mean age of the patients was 57.92 ± 23.86 years, with 103 (63.21%) male and 48 (31.79%) female patients. It is known that males are more susceptible to developing CAD in the early stages of life, while individuals over 65 years of age are more likely to suffer from CVD due to increased comorbidities and complications. The baseline characteristics and comorbidities of the patients are provided in table 1.

Table 1. Baseline characteristics and clinical data of the study population.

Age (years)	**Percentage**	**No. of patients**
18-35	7.95%	13
36-50	28.48%	42
51-65	31.79%	48
>65	31.79%	48
Gender	**Percentage**	**No. of patients**
Males	68.21%	103
Females	31.79%	48
Coronary risk factors		
Hypertension	67.55%	
Diabetic	50.33%	
Smoker	40.40%	
Alcoholic	28.48%	
Cad	46.36%	
Other diseases	27.81%	
Morisky scale (adherent)	45.03%	

Complete blood picture characteristics

The hematological tests were analyzed to assess the inflammation associated with the injury using both the NPR and NLR. Troponin-I, which is a better marker of MI than CK-MB, was also measured. NPR and NLR have emerged as easy, cost-effective, and effective predictive indicators of CVD. They not only indicate inflammation but also the progression and complications of the disease. NPR has been found to predict both short- and long-term mortality in CAD patients. Additionally, triglycerides and HDL-C, which are correlated with insulin resistance, are considered independent predictors of dyslipidemia and a risk factor for developing or progressing CAD. The hematological characteristics of the patients are provided in table 2.

Table 2. Hematological characteristics of the study population.

NPR results	**Percentage**	**No. of patients**
Moderate	4.64%	7
High	95.36%	144
NLR results	**Percentage**	**No. of patients**
Normal	50.33%	74
Moderate	24.50%	38
High	25.17%	39
Triglycerides results	**Percentage**	**No. of patients**
Normal	58.28%	88
Moderate	27.15%	41
High	14.57%	22
Troponin-I	**Percentage**	**No. of patients**
Negative (up to 19 iu)	33.11%	50
Positive (≥ 19 iu)	66.89%	101
Haematological *parameters*	***Cases (n=30)***	
Troponin-I		
On day of admission	3739.2	
Day of discharge	823.3	
Neutrophil to lymphocyte ratio		
On day of admission	5.52	
Day of discharge	0.46	
Neutrophil to platelet ratio		
On day of admission	0.49	
Day of discharge	0.06	

Electrocardiographic (ECG) Characteristics

The diagnostic evaluation of CAD relies primarily on ECG changes, which confirm patients with STEMI. Of the 151 patients included in the study, significant elevations and depressions in the ST segment were observed on the day of admission. The changes in the ST segment were noted on both the day of admission and the day of discharge, and the changes on subsequent days are presented in table 3.

Table 3. Electrocardiographic characteristics of the study population.

ST-segment	Percentage	No. of patients
Normal	11.92%	18
ST-depression	43.05%	65
ST-elevation	45.03%	68

Stress scoring scale (Perceived Stress Scale)

The Perceived Stress Scale is a well-established assessment tool that has been used in a wide range of psychological studies since its inception in 1983. We utilized this scale in our study to quickly assess the mental state of individuals without requiring specialized expertise. Although the scale does not diagnose any specific mental disorder, it is a useful tool for determining the level of stress that an individual may be experiencing, which can contribute to the prognosis of CAD. An overview of stress levels is provided in table 4.

Table 4. Stress scoring scale of the study population.

Stress score results	Percentage	No. of patients
Low	30.46%	46
Moderate	63.58%	96
High	5.96%	9

Table 5.TANGENTS scoring scale of the study population.

Parameters	TANGENTS score		
	Low (0-5) Cases:2	Moderate (6-10) Cases:72	High (11-16) H Cases:77
Troponin-I (+ve) (-ve)	none	39 cases 33 cases	62 cases 15 cases
Age	28 yr,40 yr	18-35: 10 cases 36-50: 29 cases 51-65: 24 cases >65: 9 cases	18-35: 1 case 36-50: 13 cases 51-65: 25 cases >65: 38 cases
Neutrophil-platelet ratio	Borderline: 2 cases	Borderline: 68 cases High:4 cases	Normal: 0 cases Borderline: 2 cases High: 75 cases
Gender	Male-1, Female-1	Male-41, Female-31	Male-60, Female-17
ECG	Normal	ST-Elevation-20 ST-Depression-39 Normal-13	ST-Elevation-46 ST-Depression-31
Neutrophil-lymphocyte ratio	Normal :2 cases	Normal: 57 cases Borderline: 12 cases High: 3 cases	Normal: 17 cases Borderline: 24 cases High: 36 cases
Triglyceridemia	Normal (0,0)	Normal: 50 cases Borderline: 17 cases High: 5 cases	Normal: 34 cases Borderline: 23 cases High: 20 cases
Stress score	Low stress (1,0)	Low- 29 cases Moderate- 41 cases High- 2 cases	Low- 15 cases Moderate- 51 cases High- 11 cases
Type of vessel disease (Small vessel disease / Deep Venous Disease/ Triple-Vessel Disease)	SVD: none DVD: none TVD: none	SVD: 19 cases (26.38%) DVD:25 cases (34.72%) TVD:28 cases (38.88%)	SVD:14 cases (18.18%) DVD:31 cases (40.25%) TVD:32 cases (41.5%)
Need for PTCA	NO: 2 cases	YES: 45 cases (62.5%) NO: 27 cases (37.5%)	YES:49 (63.63%) NO:28 (36.36%)
Length of Hospital Stay	5 days	6-9 days	10-15 days

The tables 5 indicate that there is a greater number of males in both the moderate and high TANGENTS score categories. In the moderate score category, there are more cases of ST-Depression, while in the high score category, there are fewer cases of ST-Depression. The NPR is found to be in the borderline range in the moderate score category and higher in the high Tangents score category. Furthermore, there are an increased number of cases experiencing moderate to high levels of stress. there were more cases of triple vessel disease in both moderate and high total Tangents Score. There was increased need for PTCA in both moderate and high cases. The length of hospital stay was maximum in the highest score cases.

4. Discussion

The 10-year CVD Framingham risk score includes parameters such as age, total cholesterol, HDL, systolic BP, and history of smoking. However, the scoring system discussed in reference 28 includes more precise and accurate parameters to determine the progression of CAD and to treat the disease with an appropriate regimen (16, 17).

The TIMI risk score provides a patient's risk of death and ischemic events based on parameters such as age ≥65 years, ≥3 risk factors of CAD, known CAD history, ASA use in the past 7 days, severe angina, ECG, ST changes ≥0.5mm, and cardiac markers. However, this scoring system is more accurate, simple, and easy to calculate compared to the TIMI risk score as discussed in previous study (18). The Atherosclerotic Cardiovascular disease risk score consists of age, gender, race, BP, cholesterol, history of DM, smoking, hypertension, and medication history of statin and aspirin therapy, which is similar to the above scores as discussed in previous study (19).

The Heart score consists of a history of CAD, ECG, age, risk factors, and troponin. It concludes that the TANGENTS scoring system has more parameters to determine the progression of the disease, which is more convenient to evaluate with precision and reliability, as discussed in previous study (16). The average age for males was calculated as 56.06 years, and for females, it was 59.79 years. Out of 151 subjects, it was found that 66.23% had an anterior wall type of MI. Half of the diabetic population had uncontrolled HbA1c. It was observed that 32.45% of subjects had high HbA1c results, and 32.45% had normal results. Additionally, 40.40% of subjects had a history of smoking, while 46.36% had a history of CAD. There were 25.48% of subjects consuming alcohol. Of the subjects in our study, 67.55% had a history of HTN, 50.33% had a history of DM, and 27.81% had a history of other diseases. Our study found that 54.97% of subjects were non-adherent to treatment and were therefore counseled about the importance of medication adherence.

We used troponin-I as the grouping variable because it is a sensitive marker of MI and is necessary for establishing the diagnosis of MI. Additionally, since DM is associated with a marked increase in the risk of CAD, it was also considered in the grouping variable. We observed a risk of bleeding due to heparin overdosing in a few patients among our subjects. For our study, the cut-off value for NPR is >0.06, and for NLR, it is >3.8. Our findings showed that NPR values higher than 50% were associated with ST-segment due to myocardial infarction, which requires immediate intervention. The stress scoring and Morisky scale results were found to be associated with the progression of CAD.

This new scoring system is extremely useful compared to other cardiology/heart scoring systems because it has eight different parameters that are equally important for diagnosis, slowing the progression of CAD, better patient care, long-term medical management planning, acquiring proper treatment options, and better patient counseling about the disease and medication.

5. Limitations

The study was conducted at a single center, which may limit the generalizability of the findings to broader populations. Factors such as regional variations in patient demographics, access to healthcare, and treatment practices may not be adequately represented. The study enrolled 151 patients, which may be considered relatively small for evaluating the effectiveness of a scoring system for CAD prognosis. A larger sample size would provide more statistical power and increase the reliability of the results. Patients were recruited based on a diagnosis of STEMI, which may introduce selection bias. Patients with less severe forms of CAD or those who did not present with STEMI were not included in the study, potentially skewing the results towards more severe cases. Certain

patient groups, such as those with ongoing infections, systemic inflammatory conditions, severe renal or liver disease, hematological diseases, and pregnant women, were excluded from the study. This exclusion may limit the applicability of the findings to these populations. The study relied on various laboratory measurements and diagnostic tests, such as complete blood count, ECG, and stress scoring scales. The accuracy and reliability of these measurements can vary depending on factors such as equipment calibration, observer variability, and standardization protocols. While the study accounted for several demographic and clinical variables, there may be other unmeasured confounding factors that could influence the outcomes. For example, lifestyle factors, socioeconomic status, and concomitant medications could affect the progression of CAD but were not explicitly addressed in the analysis. The study's duration was limited to between September 2019 and February 2020, which may not capture the long-term outcomes and complications of CAD. Longer follow-up periods would provide a more comprehensive understanding of the prognostic utility of the TANGENTS scoring system. Addressing these limitations would strengthen the study's validity and enhance the applicability of its findings to clinical practice.

6. Conclusion

Our study used parameters to develop a new scoring system, TANGENTS, for patients with comorbidities. The results demonstrate a significant association between multiple cardiovascular disease risk factors and low, moderate, and high levels of coronary artery changes assessed by the TANGENTS score in the Indian population. As CAD is a major concern for the Indian healthcare system, our study provides valuable information on the screening and clinical characteristics of CAD, and their association. This information can help cardiologists improve and assess the management of patients with CAD.

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Competing Interest

The authors have no conflict of interest to declare.

Adherence to Ethical Standards

Written informed consent was obtained from the patient for publication of this research including the clinical information and accompanying images. Also, the patient was assured that his name and initials would not be published.

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