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Correlating SVEAT Score with CT or Coronary Angiography Score in Assessing Coronary Artery Disease Risk in a Tertiary Cardiac Care Center, Rawalpindi

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ABSTRACT

Around the world, coronary artery disease is a major source of morbidity and mortality. The coronary artery disease population is estimated to have increased from 9 million in 1990 to 19 million by 2020. Nurses are the major workforce working in emergencies and need a method for early risk stratification of patients. **Objective:** To find a Correlation between SVEAT score and angiography score to find the relationship between the diagnostic accuracies of both methods in assessing coronary artery disease. **Methods:** A quantitative cross-sectional study design involving 118 subjects undergoing both angiography and SVEAT score assessment. Samples from the Tertiary Cardiac Care Center's Emergency Reception were chosen using a convenient sampling technique. Data were collected between the period of January 2024 to April 2024. The frequency and percentages of participants categorized by risk levels were calculated. A Spearman correlation was calculated between the SVEAT score and the angiography score. **Results:** The demographic profile of 118 participants showed that the study included n=88 (74.6%) male and n=30 (25.4%) female. SVEAT score categorizes 44.9% of participants as low risk and safe to discharge and similarly, Angiography categorizes 46.6%. A Spearman correlation between the SVEAT score and angiography (0.790, sig. 0.000) indicated a significant positive association. **Conclusions:** It was concluded that similar to angiography, the SVEAT score is a useful non-invasive method that nurses can use for identifying early risk of coronary artery disease.

INTRODUCTION

A disease is an uncommon condition that affects one or more body parts in an individual [1]. Due to lifestyle choices and family history, the number of diseases is rising daily [2]. For the past few decades, heart disease, also known as cardiovascular disease, has been the world's leading cause of mortality. It encompasses a variety of disorders that affect the heart [3]. Heart disease is the most prevalent, and its effects are more severe than any other illness [4]. Around the world, coronary artery disease is a major source of morbidity and mortality [5]. The estimated population of coronary artery disease (CAD) is estimated to have increased from 9 million in 1990 to 19 million by 2020 [6]. Heart diseases are expected to be a contributing factor in over 23 million deaths by 2030. Despite the fact that heart disease rates were historically higher in developed nations, CVD-related deaths in low- and middle-income nations have increased [7]. Heart disease is one of the most prevalent ailments in the world [2]. After trauma, acute chest pain is the most frequent reason individuals visit the emergency reception [8]. It is the place where assessments start for evaluation [9]. Being a serious medical condition that affects millions of people each year, acute coronary syndrome (ACS) is a major public health challenge [10]. Preliminary research indicates that the newly developed SVEAT score is far more effective [11]. Roongsritong and his team [12] created the SVEAT scoring system in 2020, dependent on five different sets of variables: age, troponin, electrocardiography, history of vascular disease, and symptom features. SVEAT Score uses specific terms for chest pain to stratify symptoms

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more objectively, making it less susceptible to bias [13]. The SVEAT score and the HEART score are different in that the SVEAT score assigns a negative score when there are no ECG alterations when chronic chest pain is present and a score of three for dynamic shifts in T or ST waves, which is higher than HEART (score of two) [8]. Recent developments in CT scanner technology have enhanced image quality, making it possible to accurately analyze coronary architecture even in challenging technical situations [14]. A significant alternative to intravascular imaging is noninvasive imaging assessment of plaque burden and shape, which could eventually replace invasive procedures and has become the first line of diagnosis [15]. A non-invasive imaging method called computed tomography angiography can give specific information about the coronary arteries [16]. It can accurately rule out coronary artery disease in people who are at low to intermediate risk because of its high negative predictive value [17]. It can be particularly valuable in patients with minimal to moderate risk, where the SVEAT score may not provide a clear indication of the requirement for invasive procedures [18]. Despite research on different scores used in cardiac emergencies, the SVEAT score remained unexplored internationally and nationally. SVEAT score was introduced in 2020 in America. According to researchers' limited knowledge, there are few studies in America and only one in Pakistan. Therefore, this study was done to check the association of the SVEAT score with the angiography score to identify accuracy in identifying Risk cases in Pakistan. This study aims to confirm the SVEAT score's efficacy by comparing it with the CT/Coronary angiography risk score, which is already validated.

METHODS

A quantitative cross-sectional study design was employed to collect data from the participants of the National Institute of Heart Diseases (AFIC/NIHD), Rawalpindi between the period of January 2024 to April 2024. Patients who reported in emergency reception with chest pain, ages between 25 and 80 years old were selected by using a convenient sampling technique. The sample size (118) was calculated by using the sensitivity and specificity formula: n= [(Z^2*P*(1-P))/ (E^2*(P*(1-Sensitivity) + (1-P) *Specificity))]. Where n=sample size, Z=Score for Desired confidence level (e.g., 1.96 for a 95% confidence level), P=estimated prevalence of the Coronary Artery Disease (0.269 or 26.9%), E=expected precision or margin of error (0.10), Sensitivity of SVEAT Score=expected sensitivity value (0.90 or 90%), Specificity of SVEAT Score=expected specificity value (0.85 or 85). Patients reported in an emergency reception with diffused chest pain and underwent angiography for confirmation of coronary artery disease were included in the study. Hemodynamically unstable patients had high troponin values due to other conditions except coronary artery disease, and ST Elevation MI (STEMI) patients were excluded from the study. Ethical compliance was ensured during the study. Ethical approval was taken from the Institutional Ethical Review Board (IERB) of the Armed Forces Institute of Cardiology AFIC/NIHD, Rawalpindi (Approval letter No: 9/2/R&D/2024/300). Written informed consent was taken by the participants, and confidentiality and anonymity were guaranteed. SVEAT score and CT/Coronary Angiography score were used to find the relationship in both. Patients who were advised for CT angiography or coronary angiography were followed for further calculation of the SVEAT score. ECG assessments were done only by a consultant cardiologist within 10 minutes of patients' arrival. Concurrently, demographic information, symptoms, and vascular disease history were recorded by an MSN nurse. High sensitivity troponin levels were also measured. The categorization of scores was done(Table 1).

Table 1: Risk Categorization of Final Scores

Scoring Scale	Risk Categorization	Values
SVEAT Score	Low Risk of CAD	0-4
	Moderate Risk of CAD	5-9
	High Risk of CAD	More or Equal to 10
CT/Coronary Angiography Score	Low Risk of CAD	0-2
	Moderate Risk of CAD	3
	High Risk of CAD	4-5

Data were analyzed by using SPSS version 26.0. Descriptive and Empirical analyses were done. Descriptive statistics were calculated for demographic information and categorizations of patients in different risk categories. Spearman correlation was found between SVEAT score and angiography score and a scatter plot was made.

RESULTS

A total of 118 patients were included in the study, who visited the Emergency Department with diffused chest pain from January 2024 to April 2024. With a 100% response rate, the study included n=30 (25.4%) female and n=88(74.6%) male who reported and contributed(Figure 1).

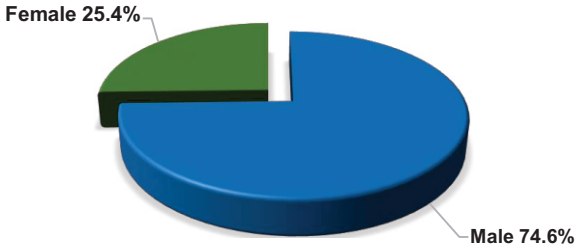

Figure 1: Percentage of Male and Female Participants

SVEAT score consists of major five sections: Symptoms, Vascular disease, EKG, Age, and Troponin. The following The information demonstrates how male and female patients differ in their angina kinds and cardiac history. Men experienced stable angina more frequently (55%), but women experienced unstable angina more frequently (60%). Myocardial infarction rates were higher in men, and

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percutaneous coronary procedures were performed on women more frequently. Abnormalities on electrocardiograms were similar in both genders. Men displayed a wider age range for coronary artery disease (CAD) than women did, according to an age study, with women aged 50 to 75 having a higher risk. Under unclear circumstances, the majority of male showed normal troponin levels, but more female had elevated troponin levels (700 ng/L or more) (Table 2).

Table 2: Frequency and Percentage of SVEAT Score Items

SVEAT Score Items	Scoring	Male	Female
		Frequency (%age)	Frequency (%age)
Stable Angina	3	49 (55.6)	12 (40)
Unstable Angina	1	39 (44.3)	18 (60)
Non-Cardiac Chest Pain	2	0 (0)	0 (0)
Recent Myocardial Infarction	2	28 (31.8)	8 (26.6)
Recent Percutaneous Coronary Intervention	2	8 (9)	5 (16.6)
Coronary Artery Bypass Grafting >5 Years	1	0 (0)	1 (3.33)
Prior Coronary Events Other Than Those Above	1	7 (8)	4 (13.3)
Prior Revascularization for Peripheral Arterial Disease or Carotid Disease	2	2 (2.27)	0 (0)
No Significant Cardiac History	0	43 (48.86)	12 (40)
Dynamic or New Ischemic ST or T Wave Changes	3	26 (29.5)	9 (30)
ST Depression of Unknown Duration Without Cause	2	28 (31.8)	9 (30)
ST Changes with Left Ventricular Hypertrophy, Intraventricular Conduction Delay, 1 Digitalis or Metabolic Issue	1	7 (7.95)	6 (20)
Old Q Wave Indicating Prior Myocardial Infarction or Pre-Existing ST Changes	1	0 (0)	0 (0)
No ST Changes	0	26 (29.5)	6 (20)
Normal EKG in the Presence of Severe Ongoing Chest Pain	-2	1 (1.13)	0 (0)
>75	2	0 (0)	0 (0)
50-75	1	18 (20.45)	26 (86.6)
30-49	0	59 (67)	4 (13.3)
<30	-1	11 (12.5)	0 (0)
700ng/L or Higher	5	22 (25)	10 (33.3)
>120 But <700	2	8 (9)	6 (20)
>40 But <or=120	1	7 (8)	4 (13.3)
Normal (<or=40ng/L) with An Unclear Duration of Chest Pain	0	50 (56.8)	10 (33.3)
Normal After >4 Hours of Constant Chest Pain	-2	1 (1.13)	0 (0)

The results of coronary angiography and CT angiography indicated that women were more likely than men to suffer significant coronary artery stenosis. Men showed a wider range of stenosis severity and more cases with no plaque, but women had more severe stenosis (33.3%–83.3%) and fewer normal results (Table 3).

Table 3: Frequency and Percentage of Angiography Score Items

Computed Tomography (CT) Angiography Characteristics	Scoring	Male	Female
		Frequency (%age)	Frequency (%age)
Absence of Plaque and No Luminal Stenosis (Normal)	0	29 (50.8)	3 (12.5)
Plaque with <25% of Stenosis (Minimal)	1	5 (8.77)	2 (8.33)
Plaque with 25-49% of Stenosis (Mild)	2	4 (7.01)	5 (20.8)
Plaque with 50-69% of Stenosis (Moderate)	3	7 (12.2)	6 (25)
Plaque with 70-99% of Stenosis (Severe)	4	12 (21)	8 (33.3)
Complete Occlusion of the Lumen (100% Stenosis)	5	0 (0)	0 (0)
Total			
Coronary Angiography Characteristics			
Absence of plaque and no luminal stenosis (Normal)	0	5 (16.1)	0 (0)
Plaque with <25% of stenosis (minimal)	1	1 (3.22)	0 (0)
Plaque with 25-49% of stenosis (mild)	2	1 (3.22)	0 (0)
Plaque with 50-69% of stenosis (moderate)	3	9 (29)	1 (16.6)
Plaque with 70-99% of stenosis (severe)	4	13 (41.9)	5 (83.3)
Complete occlusion of the lumen (100% stenosis)	5	2 (6.45)	0 (0)
Total		31 (100)	6 (100)

Using the SVEAT Score and Angiography Score approaches, the scoring scale and risk categorization data showed a stratified assessment of participants' risk for coronary artery disease (CAD). Using their SVEAT Score, participants were divided into three risk groups; a cut score indicated the limits of each category. With scores ranging from 0 to 4, 44.9% of the sample (53 people) were identified as having a low risk of CAD. In 27.1% of the participants (32), a moderate risk of CAD was observed, as characterized by scores between 5 and 9. Ultimately, with scores of 10 or higher, 28% of the subjects, or 33, were classified as high risk. Similarly, CAD risk was further stratified using the Angiography Score. Individuals who scored between 0 and 2 were classified as low-risk; these individuals made up 46.6% (55 participants) of the sample. A score of three, indicating moderate risk, was found in 19.5% of the participants (23). 33.9% of the 40 patients with scores between 4 and 5 were categorized as high risk (Table 4).

Table 4: Risk Categorization of Participants by SVEAT Score and Angiography

Scoring Scale	Risk Categorization	Cut Score for Categorization	Frequency (%Age)
SVEAT Score	Low Risk of CAD	0-4	53 (44.9)
	Moderate Risk of CAD	5-9	32 (27.1)

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	High Risk of CAD	≥10	33 (28)
CT/Coronary Angiography Score	Low Risk of CAD	0-2	55 (46.6)
	Moderate Risk of CAD	3	23 (19.5)
	High Risk of CAD	4-5	40 (33.9)

Spearman correlation was executed to show an association between the SVEAT score and the Angiography score because the data were in ordinal order. Bivariate Spearman correlation coefficient (r) was analyzed. 790, suggesting a significant positive correlation, p-value 0.000 at 0.01(two tail). A strong positive correlation indicates that higher scores of SVEAT are associated with positive CAD results in angiography. The study results revealed a significant positive correlation between SVEAT score and Angiography, suggesting that SVEAT scoring helped assess the risk of CAD in participants. These findings underscore the importance of the SVEAT score in categorizing risk in patients with coronary artery disease (Table 5).

Table 5: Association Between SVEAT Score and Angiography Score

Spearman Correlation Between SVEAT Score and Angiography		Results
Correlation Coefficient	0.790	Significant Positive Correlation
Sig. (Two-Tailed)	0.001 (0.000)	

Note. Correlation is significant at the 0.01 level (2-tailed)

A scatter plot between the angiography and the SVEAT score is shown. The study results revealed a significant positive correlation between SVEAT score and Angiography, suggesting that SVEAT scoring helped in assessing the risk of CAD in participants. These findings underscore the importance of the SVEAT score in categorizing risk in patients with coronary artery disease (Figure 2).

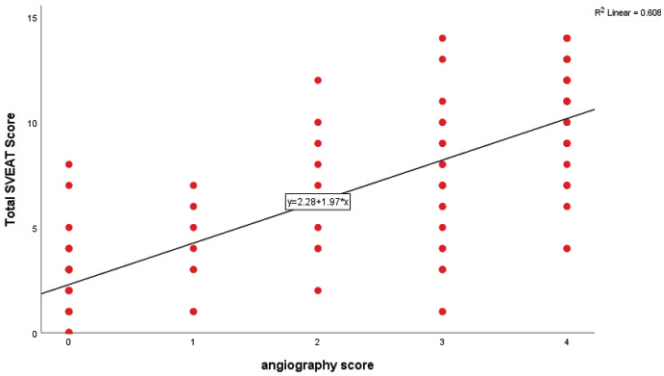

Table 2: Scatter Plot for Spearman Correlation Between SVEAT Score and Angiography Score

DISCUSSION

In the present study, the SVEAT score, which is used to predict the risk of CAD, considers age an important factor in determining CAD. The analysis showed that the likelihood of developing CAD enhances with age by 40% as evidenced by the likelihood increases by more than 80% in individuals aged between 70-80 or older. This increased risk with age can be attributed to various age-related factors, such as cumulative arterial damage, prolonged exposure to cardiovascular risk factors, and decreased physiological resilience. These results underscore the need for vigilant monitoring of older adults. In the current study, 52% of participants had stable or typical angina symptoms and 30% had recent myocardial infarction history similar to the findings in another study conducted at Lady Reading Hospital of Peshawar during the period of two years 2020 to 2021 in the department of cardiology, in which 68% of patients had typical angina pectoris symptoms and 33.2% has myocardial infarction history and later diagnosed with coronary artery disease . In the present study, 48% of participants had high troponin values, 72% had EKG changes, and 20% had a history of coronary artery disease. Similar results were found in another research that was done in 37 hospitals in the United Kingdom by using a randomized controlled trial on patients who underwent computed tomography intervention to predict acute coronary syndrome. According to this UK study, most of the people diagnosed with CAD had raised troponin levels (57%), abnormal EKG (61%) and previous history of coronary artery disease (34%). These findings evidenced the significance of taking troponin I levels, noting EKG changes and taking a history of coronary artery disease '. In this study, results showed that the SVEAT score categorizes patients into low to high-risk patients for CAD. Findings suggest that the SVEAT score effectively categorizes more patients into low-risk categories and safe discharge as evidenced by Angiography results which also categorize them as low-risk. In the present study, 44.9% of patients were stratified as low risk by SVEAT score and 46.6% by Angiography. Similarly, in another study, it was found that the SVEAT score categorized 71% of patients in low risk more than any other category and those patients were less likely to experience Major Adverse Cardiac Event (MACE) in a further 30 days. This similarity indicates the validity of the SVEAT score in low-risk stratification of chest pain patients [20]. The main strength of the present study is its comparative analysis between the SVEAT score and Angiography, establishing a strong foundation for evaluating the SVEAT scores's diagnostic accuracy. It also included nurses along with physicians in the risk assessment of patients who reported in emergency reception. Nurses can use this scoring system and can benefit organizations by lowering healthcare costs, Allowing regular non-invasive assessments for tailored CAD management, Promotes the creation of innovative non-invasive diagnostic methods. Besides these, nurses can also use the SVEAT score for early stratification of

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patients into low, moderate and high risk and timely management according to condition, can create customized nursing care plans with the aid of the SVEAT score, and able to control monitoring intervals based on CAD severity and provide a recommendation, can ensure adequate care through cooperative teamwork by utilizing the SVEAT score to facilitate efficient communication with other health professionals and it provides effective continuous treatment, nurses can keep track of patient's medical records based on the results of the SVEAT score, correct recordkeeping, and appropriate reporting.

CONCLUSIONS

It was concluded that the SVEAT score is a reliable and promising non-invasive method for determining the severity of coronary artery disease, as shown by the comparison study between it and CT/coronary angiography. SVEAT score can be utilized as a screening tool for patients whose symptoms are suggestive of CAD like diffused chest pain, ECG variations and high troponin levels. High SVEAT scores in patients would warrant further evaluation by angiography or other advanced imaging techniques. Low scores would indicate that there is no need for invasive methods and safe discharge. The current study showed the SVEAT score as a valid and promising non-invasive tool for the preliminary assessment of coronary artery disease.

Authors Contribution

Conceptualization: AJ
Methodology: AJ, MA, MAY
Formal analysis: MA, SP
Writing review and editing: AJ

All authors have read and agreed to the published version of the manuscript

Conflicts of Interest

All the authors declare no conflict of interest.

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