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Comparison of SVEAT and HEART scoring in acute chest pain

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ABSTRACT

Aims: It is very important to evaluate patients presenting with chest pain in terms of major adverse cardiovascular events (MACE) and many risk scoring systems have been developed for this purpose. In this study, we aimed to evaluate the MACE prediction performance of the newly developed symptoms, history of vascular disease, electrocardiography, age and troponin (SVEAT) score for patients presenting with chest pain.

Methods: This study was designed as a retrospective observational clinical trial. MACE occurring within 30 days; Myocardial infarction (MI), percutaneous coronary intervention (PCI), coronary artery bypass graft (CABG) and sudden cardiac death were considered the primary endpoints of the study. Patients over 18 years of age presenting with chest pain were included in the study. Patients with ST segment elevation on electrocardiography (ECG), hemodynamic instability and traumatic chest pain were excluded.

Results: The study included 557 patients and the mean age was 54.52±12.56 and the age distribution range was 23-95. Significant results for SVEAT score (AUC:0.988, 95%CI:0.978-0.997, p<0.001) and history, electrocardiography, age, risk factors and troponin (HEART) score (AUC:0.960, 95%CI:0.942-0.979, p<0.001) were obtained from ROC analysis of the effect of SVEAT and HEART scores on MACE.

Conclusion: The newly developed SVEAT score was superior to the HEART score in predicting adverse negative cardiac events in patients presenting with chest pain.

Keywords: Chest pain, emergency, risk score, cardiovascular event

INTRODUCTION

Chest pain is one of the most common reasons for being admitted to the emergency department. Clinically, acute chest pain may be associated with a clinical condition with a high mortality rate such as myocardial infarction (MI), pulmonary thromboembolism, aortic dissection; it may also be associated with musculoskeletal diseases, pain reflected from internal organs such as gastrointestinal tract or sometimes psychiatric causes.[1]

Coronary artery disease (CAD) is now one of the most common causes of mortality and morbidity. In the United States, it is estimated that approximately 1.0 million people present with acute chest pain annually and 300.000 to 400.000 people die due to MI.[2] Studies show that cardiovascular diseases account for 45% of deaths in women and 38% of deaths in men under the age of 75 in Europe.[3,4] Heart and artery diseases are predicted to be staying as the top cause of death for a long time as a result of the expected increase in the estimated life expectancy.[5]

Acute coronary syndrome (ACS) must be quickly differentiated from other clinically similar conditions. Studies have shown that approximately 2-4% of patients with undetected MI on initial presentation are wrongly discharged, accounting for 20-39% of all emergency malpractice cases.[6,7] Therefore, early diagnosis of ACS in patients defined as low risk group is of critical importance. Many risk scoring systems have been developed in this patient group in order to start treatment with early diagnosis and to decrease the median mortality related to ACS.

The usability of the risk scoring system can be evaluated by its performance in detecting the possibility of developing MACE in the early period.[8] The Thrombolysis in Myocardial Infarction (TIMI) score,[9] the Global Registry of Acute Coronary Events (GRACE)[10] and the History, Electrocardiography, Age, Risk Factors and Troponin (HEART) generation HEART score[11] are risk scoring systems used in patients presenting with chest pain. However, there is no current consensus on which of these scoring systems is more reliable for the emergency department.[12]

Symptoms, Vascular Disease History, Electrocardiography, Age and Troponin (SVEAT) risk score, presented as a slightly

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better performance than the currently widely used HEART score.[13] SVEAT scoring system, in the case of an acute attack event, higher acceleration, negative scoring in the event of no event and a much wider scoring range. The ratios of the clinical risk composite were seen to increase with a wider score range.[14] In addition, a change in the ECG in the SVEAT scoring was defined with much sharper boundaries and the characteristics of chest pain were considered in detail and vascular diseases were also included in the score.[14] This study aimed to compare SVEAT and HEART scores in terms of MACE predictability in patients presenting to the emergency department with chest pain.

METHODS

Ethics

The study followed the principles of the Declaration of Helsinki revised in 2013. This study has been approved by the Ankara Etlik City Hospital No. 1 Local Ethics Committee for Clinical Researches (Date: 01.11.2023, Decision No: AEŞH-EK1-655-2023).

Study Design and Participants

The study consisted of patients who were admitted to the city hospital emergency department with complaints of acute chest pain between 01.01.2022 and 31.12.2023. Patients who had not previously been used for either scoring system (SVEAT and HEART) for patient outcomes were included in the study. Patients with hemodynamic instability, acute MI detected on admission ECG, those presenting with chest pain due to trauma, and those with incomplete medical records were excluded from the study. A total of 557 patient files from 1162 patients presenting with chest pain who met the study criteria were analyzed (**Figure 1**). The number of patients to be included in the study was determined using the G-power 3.1.9.4 program with a power of 80% and a significance level of p<0.05.

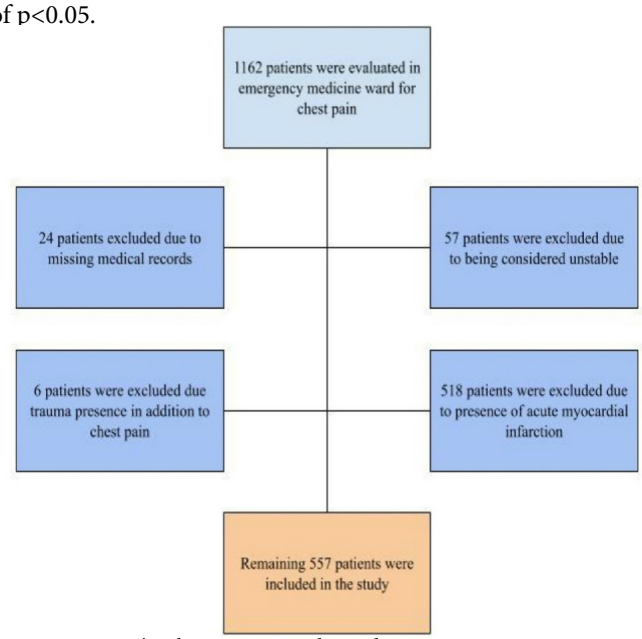

Figure 1. Patients' inclusion status in the study

Troponin level was obtained from the data of the fourth generation ultra-high sensitivity troponin assay (Elecysd Roche Kit) and determined as the upper normal limit Troponin (TnT-hs) level equivalent to 14 ng/L (pg/ml).

Data Collection

The risk scores of all patients were calculated according to SVEAT and HEART scores. The parameters required for SVEAT scoring are given in **Table 1**. In addition, age, gender and underlying medical comorbidities (diabetes, hypertension, intracranial hemorrhage and stroke) were recorded. MI requiring revascularization or medical treatment and sudden cardiac arrest MACE occurring after readmission within 30 days were accepted as the study endpoints.

Table 1. SVEAT scoring system

Component	Characteristics	Points
Symptoms	Typical unstable angina pectoris	3
	Stable angina, Canadian Cardiovascular Society Class I or II	1
	Non-cardiac chest pain	-2
Vascular disease	Recent myocardial infarction or percutaneous coronary intervention <90 days	2
	Coronary artery bypass grafting >5 years	2
	Prior coronary event other than above	1
	Prior revascularization for peripheral disease or carotid disease	2
ECG	Dynamic or new ischemic ST or T wave changes	3
	ST depression of unknown duration without cause	2
	ST changes with left ventricular hypertrophy, intraventricular conduction delay, digitalis, or metabolic issue	1
	Old Q wave indicating prior myocardial infarction or pre-existing ST changes	1
	No ST changes	0
	Normal ECG in the presence of severe ongoing chest pain	-2
Age (years)	>75	2
	50-75	1
	30-49	0
	<30	-1
Troponin I (ng/ml)	0.7 or higher	5
	>0.12 but <0.7	2
	2>0.04 but <or=0.12	1
	Normal (<or=0.004) with unclear duration of chest pain	0
	Normal after >4 h of constant chest pain	-2

SVEAT: Symptoms, Vascular Disease History, Electrocardiography, Age and Troponin, ECG: Electrocardiography

Statistical Analysis

SPSS 20.0 for Windows® statistical software (IBM Inc. Chicago, IL, USA) was used for statistical analysis. Number

(n), percentage (%), mean, standard deviation, median, minimum and maximum values were used in the presentation of descriptive data. The conformity of the data to normal distribution was assessed using the Kolmogorov-Smirnov test. Pearson Chi-square test and Fisher's exact test were used for comparison of categorical data, T test for comparison of two independent numerical data, Mann-Whitney U test for unequal distribution of data, Kruskal-Walles Test and ANOVA tests were used for comparison of two numerical data. ROC analysis of the area under the curve was used to compare the predictability of MACE of SVEAT and HEART scores. p<0.05 and 95% confidence interval were accepted for statistical significance.

RESULTS

The files of 1162 patients who presented with chest pain were reviewed and 557 patients were included in the study. The mean age of the patients was 54.52±12.56 years and the age distribution was 23-95. 233 (41.7%) of the patients included in the study were female. Mortality was observed in only 3 (0.5%) of the patients included in the study.

MACE was positive in 110 patients and MACE was negative in 447 patients. When the factors affecting MACE were examined, advanced age, hypertension, diabetes, history of MI, percutaneous coronary intervention (PCI), coronary artery bypass grafting (CABG), low SVEAT and HEART scores were statistically significant (p<0.001). Similarly, the effect of hyperlipidemia history on MACE was also found to be significant (p:0.016). Gender and stroke history had no significant effect on MACE (**Table 2**). Significant results were obtained in ROC analysis for SVEAT (AUC:0.988, 95% Cl:0.978-0.997, p<0.001) and HEART (AUC:0.960, 95% Cl:0.942-0.979, p<0.001) (**Table 3, Figure 2**).

Table 2. MACE distribution based on risk factors

	MACE (-) (n:447)	MACE (+) (n:110)	p value
Age	52.66±12.04	62.09±11.88	<0.001
Female sex	197	35	0.055
Hyperlipidemia	121	42	0.016
Hypertension	149	71	<0.001
Diabetes	99	51	<0.001
Stroke	9	2	0.626
MI history	108	68	<0.001
PCI	96	63	<0.001
CABG	16	14	<0.001
SVEAT	(-) 0.32±2.04	8.41±3.07	<0.001
HEART	2.40±1.67	6.85±1.68	<0.001

MACE: Major adverse cardiovascular events, MI: Myocardial infarction, PCI: Percutaneous coronary intervention, CABG: Coronary artery bypass grafting, SVEAT: Symptoms, Vascular Disease History, Electrocardiography, Age and Troponin, HEART: History, Electrocardiography, Age, Risk Factors and Troponin

The mean scores of SVEAT and HEART were calculated as 1.40±4.16 and 3.28±2.44, respectively. The best thresholds for SVEAT and HEART were determined as 3.5 and 4.5, respectively. While the sensitivity and specificity for SVEAT were 96.4% and 97.3%, respectively; these rates were found as 93.6% sensitivity and 87.5% selectivity for HEART. According to the best threshold values, the accuracy values for SVEAT and HEART were calculated as 541/557 (97.1%) and 494/557 (88.7%), respectively (**Table 4**). These results showed that the SVEAT score was significant in detecting major adverse cardiovascular events (MACE). It was observed that MACE was missed by not being predicted in only 16 patients at the value determined as the best SVEAT threshold value. On the other hand, MACE unpredictability was found in 63 patients in HEART scoring. According to the study results, it was determined that the SVEAT scoring had better sensitivity and specificity values than the HEART score.

Table 3. SVEAT ve HEART scoring based on ROC analysis

Test result variable(s)	Under the curve	Std. error	p value	95% confidence interval	
				Lower bound	Upper bound
HEART	0.960	0.010	<0.001	0.942	0.979
SVEAT	0.988	0.005	<0.001	0.978	0.997

SVEAT: Symptoms, Vascular Disease History, Electrocardiography, Age and Troponin, HEART: History, Electrocardiography, Age, Risk Factors and Troponin, ROC: Receiver operating characteristic

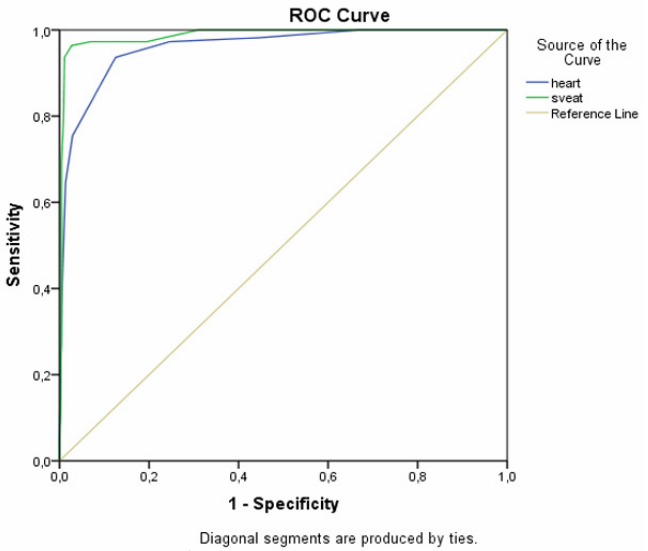

Figure 2. ROC Curve of SVEAT and HEART scoring
SVEAT: Symptoms, Vascular Disease History, Electrocardiography, Age and Troponin, HEART: History, Electrocardiography, Age, Risk Factors and Troponin, ROC: Receiver operating characteristic

Table 4. MACE prediction of the SVEAT and HEART scoring

Parameters	Definitions	SVEAT	HEART
Under the curve		0.988	0.96
95% confidence interval		0.978-0.997	0.942-0.979
p-value		<0.001	<0.001
The best threshold		>3.5	>4.5
Event size	N	557	557
Sensitivity	TP/(TP+TN)	106/110 (96.4%)	103/110 (93.6%)
Selectivity	TN/(TN+FP)	435/447 (97.3%)	391/447 (87.5%)
PPV	TP/(TP+FP)	106/118 (89.8%)	103/159 (64.8%)
NPV	TN/(FN+TN)	435/439 (99,1%)	391/398 (98.2%)
Truth	(TP+TN)/(N)	541/557 (97.1%)	494/557 (88.7%)
p value		<0.001	<0.001

MACE: Major adverse cardiovascular events, SVEAT: Symptoms, Vascular Disease History, Electrocardiography, Age and Troponin, HEART: History, Electrocardiography, Age, Risk Factors and Troponin, TP: True positive, FN: False negative, TN: True negative, FP: False positive, PPV: Positive predicted value, NPV: Negative predicted value

DISCUSSION

Early identification of risk groups in patients presenting to the hospital with chest pain may be the most important point for predicting MACE, and many different risk scoring systems have been developed for this purpose. Although the HEART score was developed for use in emergency departments for patients presenting with chest pain and is the most widely used risk score in the United States, there are studies in the literature showing that this scoring is not sufficient for the low-risk patient group.[15-17]

In the HEART score, patients are divided into low, medium and high risk groups according to the risk of developing MACE. It is recommended that those in the low risk group be discharged and those with medium and high risk scores be hospitalized.[18] In our study, the sensitivity of the HEART score of 93.6% and the specificity of 87.5% were found to be consistent with previous studies in the literature.[16,18,19] However, it was observed that the classification of the risk into high, medium and low risk groups in the distinction of chest pain varied depending on the evaluator. In addition, it was noted that some important cardiac clinical information in the initial evaluation was not fully used in this scoring and especially that significant ST depression was not clearly defined in the scoring.

A new scoring system (SVEAT score), developed by Roongsritong et al.[13] and based on five clinical variables: chest pain symptom characteristics, history of vascular disease, electrocardiography, age, and troponin, has been reported to outperform the HEART score. Unlike the HEART and TIMI risk scores, the SVEAT score assigns a 5-point value to symptoms suggestive of ischemia and a negative value to non-cardiac chest pain to better distinguish between subgroups. Furthermore, this scoring system uses the presence of cardiovascular disease rather than traditional risk factors and focuses more specifically on possible electrocardiographic (ECG) changes. It also assigns a higher score for troponin levels, resulting in a wider score range. This is thought to aid clinicians in their decision-making process. A limited number of studies in the literature have shown that the SVEAT score outperforms the HEART score.[13]

Roongsritong et al.[13] compared the SVEAT score with HEART and TIMI scores in a prospective study of 321 patients. The calculated AUC values were found to be 0.982, 0.921 and 0.884 for the SVEAT score, HEART score and TIMI score, respectively. Male gender, hypertension, diabetes mellitus and hyperlipidemia are seen as statistically significant determinants for the 30-day MACE score. Similarly, in our study, the AUC value of the SVEAT score was found to be higher than the HEART score, and the obtained results support Roongsritong's[13] study.

In the Antwi-Amoabeng[20] study, the threshold value was taken as ≤4 and the SVEAT score was compared with the HEART score, and it was concluded that the SVEAT score is a reliable predictor of cardiovascular morbidity. Similarly, we determined the threshold values as 3.5 for SVEAT and 4.5 for HEART. With these results, it was concluded that the SVEAT score has statistical significance in predicting MACE.

In the prospective study of Shahid et al.,[21] which included 60 patients and compared the SVEAT, HEART and TIMI risk scores, the sensitivity and specificity for the SVEAT and HEART scores were found to be 63.2%, 84.2% and 75.6%, 73.2%, respectively, at similar threshold values for SVEAT and HEART scores, and it was concluded that the SVEAT score was not superior to the HEART score in predicting 30-day MACE. In our study, 96.4% sensitivity and 97.3% selectivity were found for SVEAT, and 93.6% sensitivity and 87.5% selectivity were found for HEART, which is consistent with the original SVEAT study and the limited number of studies in the literature. This difference found by Shahid et al.[21] may be due to the study including only a very limited patient population aged 45 and over. In addition, unlike this study, we found that male gender was more dominant and stroke did not have a significant effect on MACE.

In this study, factors affecting the MACE parameter in hospitalized patients were found to be statistically significant, including advanced age, hypertension, diabetes, history of hyperlipidemia, current MI, PCI, history of CABG, high SVEAT and HEART scores, and were consistent with the findings in the original SVEAT study.[13,20]

Limitations

The study was conducted in a single tertiary care center with a specific sample size and the SVEAT score was compared only with the HEART score, which may be limitations of the study. It is thought that studies using other risk scoring systems and conducted on a larger population will contribute to the literature.

CONCLUSION

Based on the results of this study, we suggest that the SVEAT scoring system outperforms the HEART score in predicting the risk of MACE in patients presenting to the emergency department with chest pain. Further studies with diverse populations and larger sample sizes are needed before the SVEAT score can be widely applied in risk stratification.

ETHICAL DECLARATIONS

Ethics Committee Approval

This study has been approved by the Ankara Etlik City Hospital No. 1 Local Ethics Committee for Clinical Researches (Date: 01.11.2023, Decision No: AEŞH-EK1-655-2023).

Informed Consent

Because the study was designed retrospectively, no written informed consent form was obtained from patients.

Referee Evaluation Process

Externally peer-reviewed.

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

Financial Disclosure

The authors declared that this study has received no financial support.

Author Contributions

All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

REFERENCES

1. Chang AM, Fischman DL, Hollander JE. Evaluation of chest pain and acute coronary syndromes. *Cardiol Clin.* 2018;36(1):1-12. doi:10.1016/j.ccl.2017.08.001
2. Benjamin EJ, Virani SS, Callaway CW, Chamberlain AM, Chang AR, Cheng S. Heart disease and stroke statistics—2018 update: a report from the American Heart Association. *Circulation.* 2018;137(12):e67-e492. doi:10.1161/CIR.0000000000000558
3. Perk J, De Backer G, Gohlke H, Graham I, Reiner Ž, Verschuren M. European guidelines on cardiovascular disease prevention in clinical practice (version 2012). *Eur Heart J.* 2012;33(13):1635-1701. doi:10.1093/eurheartj/ehs092
4. SCORE2 working group and ESC Cardiovascular risk collaboration. SCORE2 risk prediction algorithms: new models to estimate 10-year risk of cardiovascular disease in Europe. *Eur Heart J.* 2021;42(25):2439-2454. doi:10.1093/eurheartj/ehab309
5. Türkiye Kalp ve Damar Hastalıkları Önleme ve Kontrol Programı 2015–2020 Klavuzu. Ankara: Anıl Matbaa Ltd. Şti; 2005. T.C. Sağlık Bakanlığı Yayın No: 988.
6. Fuller M, Hamilton D, Holly J, Mallin M, Rayner T, Eshenroder N. Prospective evaluation of a simplified risk stratification tool for patients with chest pain in an emergency department observation unit. *Crit Pathw Cardiol.* 2013;12(3):132-136. doi:10.1097/HPC.0b013e31829a79cd
7. Halpern EJ, Deutsch JP, Hannaway MM, Estepa AT, Kenia AS, Neuburger KJ. Cardiac risk factors and risk scores vs cardiac computed tomography angiography: a prospective cohort study for triage of ED patients with acute chest pain. *Am J Emerg Med.* 2013;31(10):1479-1485. doi:10.1016/j.ajem.2013.08.001
8. Akyea RK, Leonardi-Bee J, Asselbergs FW, Patel RS, Durrington P, Wierzbicki AS. Predicting major adverse cardiovascular events for secondary prevention: protocol for a systematic review and meta-analysis of risk prediction models. *BMJ Open.* 2020;10(7):e034564. doi:10.1136/bmjopen-2019-034564
9. Antman EM, Cohen M, Bernink PJ, et al. The TIMI risk score for unstable angina/non–ST elevation MI: a method for prognostication and therapeutic decision making. *JAMA.* 2000;284(7):835-842. doi:10.1001/jama.284.7.835
10. Eagle KA, Lim MJ, Dabbous OH, et al. A validated prediction model for all forms of acute coronary syndrome: estimating the risk of 6-month postdischarge death in an international registry. *JAMA.* 2004;291(22):2727-2733. doi:10.1001/jama.291.22.2727
11. Poldervaart JM, Reitsma JB, Koffijberg H, et al. The impact of the HEART risk score in the early assessment of patients with acute chest pain: design of a stepped wedge, cluster randomised trial. *BMC Cardiovasc Disord.* 2013;13(1):1-8. doi:10.1186/1471-2261-13-77
12. Sakamoto JT, Liu N, Koh ZX, et al. Comparing HEART, TIMI, and GRACE scores for prediction of 30-day major adverse cardiac events in high acuity chest pain patients in the emergency department. *Int J Cardiol.* 2016;221:759-764. doi:10.1016/j.ijcard.2016.07.147
13. Roongsritong C, Taha ME, Pisipati S, et al. SVEAT score, a potential new and improved tool for acute chest pain risk stratification. *Am J Cardiol.* 2020;127:36-40. doi:10.1016/j.amjcard.2020.04.009
14. Hollander JE, Than M, Mueller C. State-of-the-art evaluation of emergency department patients presenting with potential acute coronary syndromes. *Circulation.* 2016;134(7):547-564. doi:10.1161/CIRCULATIONAHA.116.021886
15. Backus BE, Six AJ, Kelder JC, et al. A prospective validation of the HEART score for chest pain patients at the emergency department. *Int J Cardiol.* 2013;168(3):2153-2158.1 doi:10.1016/j.ijcard.2013.01.255
16. Backus BE, Six AJ, Kelder JC, et al. Chest pain in the emergency room: a multicenter validation of the HEART score. *Crit Pathw Cardiol.* 2010;9(3):164-169. doi:10.1097/HPC.0b013e3181ec36d8
17. Poldervaart JM, Langedijk M, Backus BE, et al. Comparison of the GRACE, HEART and TIMI score to predict major adverse cardiac events in chest pain patients at the emergency department. *Int J Cardiol.* 2017;227:656-661. doi:10.1016/j.ijcard.2016.10.080
18. Van den Berg P, Body R. The HEART score for early rule out of acute coronary syndromes in the emergency department: a systematic review and meta-analysis. *Eur Heart J Acute Cardiovasc Care.* 2018;7(2):111-119. doi:10.1177/2048872617710788
19. Mahler SA, Hiestand BC, Goff DC Jr, Hoekstra JW, Miller CD. Can the HEART score safely reduce stress testing and cardiac imaging in patients at low risk for major adverse cardiac events? *Crit Pathw Cardiol.* 2011;10(3):128-133. doi:10.1097/HPC.0b013e3182315a85
20. Antwi-Amoabeng D, Roongsritong C, Taha M, et al. SVEAT score outperforms HEART score in patients admitted to a chest pain observation unit. *World J Cardiol.* 2022;14(6):454-461. doi:10.4330/wjc.v14.i8.454
21. Shahid MF, Malik A, Kashif N, Siddiqi FA, Hammad M, Saeed HA. Risk stratification of acute-onset chest pain: SVEAT score versus HEART and TIMI scores. *Cureus.* 2023;15(5):e39590. doi:10.7759/cureus.39590