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Evaluating the Diagnostic Accuracy of Heart Diseases with Chest Pain

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ABSTRACT

Cardiac diseases refer to sudden, severe cardiac events with life-threatening consequences, often linked to underlying cardiovascular issues, requiring immediate medical intervention. **Objectives:** To determine the predictive accuracy of the HEART score versus electrocardiogram (ECG) changes for predicting Cardiac events in patients with chest pain. **Methods:** The study was carried out at the Mekran Medical College, Turbat, from September 2020 to March 2021. The cross-sectional study included 385 patients. The samples of blood were collected and measured. Patients' HEART scores were calculated. The data were stratified by gender, age, duration of symptoms, smoking, and diabetes. The positive and negative predictive value, sensitivity, specificity, and diagnostic accuracy of the HEART score for each stratum were calculated. **Results:** There were 269 (69.9%) male and 116 (30.1%) female. The average age was 62.34 ± 8.48, and the age ranged from 35 to 75 years old. The mean duration of the symptom was 4.71 ± 2.24 hours. In predicting adverse events on the HEART score, results showed that 327 (84.9%) were positive, while 373 (96.9%) were positive for ECG changes. The sensitivity, specificity, positive and negative predictive value for predicting adverse events on the HEART score versus ECG changes were 86.7%, 66.7%, 98.7%, and 13.7% respectively. **Conclusions:** The HEART score effectively predicts major adverse events in chest pain patients, suggesting its continued validation as a clinical tool for risk stratification in emergency departments.

INTRODUCTION

In emergency departments throughout the world, chest pain is the major complaint [1, 2]. But only 10-20% were diagnosed with acute coronary syndrome [2]. This is a serious condition that requires to be assessed and management. Chest pain may arise from many kinds of causes, from harmless to fatal. Therefore, to provide appropriate care and avoid overusing resources. Patients suffering chest pain must be categorized according to their risk of major adverse cardiac events (MACE) [3, 4]. MACE was recorded in 19% of individuals with chest discomfort [5]. Acute coronary syndrome is a variety of disorders that often arise from a sudden drop in coronary artery blood flow and can be challenging to identify. Emergency physicians need to develop a prognostic method for those who may have acute coronary syndrome, given the diagnostic difficulties. To assist in identifying patients who are more likely to experience unfavorable outcomes, several prediction models have been developed. The initial model to be created, validated, and tested in clinical settings on patients who may have acute coronary syndrome and are admitted to the Emergency Department is the HEART Score. [6]. Both men and women may develop myocardial infections (MI), although males tend to develop them earlier in life. After menopause, the incidence rises in

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women. Men and women experience their first MI at ages 65.1 and 72 years, respectively [7, 8]. The earlier mortality rates have been higher at 30 days in women with STEMI, even after controlling for primary percutaneous coronary intervention, medication, and other underlying co-morbidities [9]. The most widely used risk stratification techniques are the Global Registry of Acute Coronary Events (GRACE) scores, thrombolysis in myocardial infarction (TIMI), age, risk factors, electrocardiogram (ECG), and history that have been created throughout the years [10, 11]. The major objectives of treatment are to minimize future remodeling, which may adversely affect ventricular function and prognosis, and to prevent myocardial damage by rapidly restoring myocardial blood flow [12].

Although tools such as ECG and established risk scores are widely used, uncertainty remains regarding their comparative effectiveness in early risk prediction. Limited local evidence exists comparing the HEART score with ECG changes alone for timely identification of high-risk patients. Therefore, this study aims to compare the utility of the HEART score versus ECG changes in screening chest pain patients to enable early prevention of MACE and optimized management strategies.

METHODS

The cross-sectional study was conducted at Mekran Medical College, Turbat. The study duration was 7 months, from September 2020 to March 2021. The ethical review committee (ERC 05/2020) of Mekran Medical College of Turbat has given written Permission. 385 patients who fulfilled the selection criteria were enrolled. Informed consent was obtained. The confidence level was 95%, taking the expected percentage of MACE, i.e., 19% with a sensitivity of HEART score, i.e., 95.9% with 5% margin of error, and a specificity of HEART score, i.e., 44.6% with 5% margin of error [13]. Non-probability consécutive sampling was used. Their demographic information (name, age, gender, duration of symptoms, diabetes (BSR>186 mg/dl and smoking) was also noted. The blood sample was obtained by using a 5cc disposable syringe for assessment of troponin and CK-MB levels at the time of presentation. The study used cardiac biomarker evaluation and electrocardiographic monitoring to assess adverse cardiac events. ECGs (Bionet, MODEL: Cardiocare-2000(EKG-2000) were used to examine ischemia or arrhythmic alterations, while immunoassay methods evaluated cardiac biomarkers like CK-MB and Troponin, indicating myocardial damage. Troponin and CK-MB were measured using immunoassay techniques and enzymatic kinetic methods. Cardiac Troponin was measured photometrically by an immunochemical ELISA method on plates of microtitre plates by using reagents from Roche Diagnostics. CK-MB was measured by using an immunochemical microparticle technique by the Abbott CK-MB assay. This method uses a monoclonal anti-CK-MB antibody bound to latex microparticles. Normal levels were below 0.04 ng/mL and 25 U/L, while elevated values indicate damage. To ensure accuracy and provide a sensitive assessment of cardiac damage, proper sample handling, reagent storage, and quality control were provided. Suspected MI was defined as the presence of chest pain or compression >30 minutes at rest and dyspnea, sweating on clinical examination, and pain in the left arm or shoulders. MACE: On the HEART score, it was labeled as positive if the score was ≥ 4. On clinical findings, it was labeled as ECG changed >1mm ST segment elevation in II, III, and aVF (STEMI), or no ST-elevation (NSTEMI), CKMB >25, and troponin>100 present during 3 months. True positive (TP): If the HEART score ≥4 and MACE is present clinically. True negative (TN): If the HEART score <4 and MACE is not present clinically. False positive (FP): If the HEART score is ≥4, but MACE is not present clinically. False negative (FN): If the HEART score <4, but MACE is present clinically. Sensitivity: TP / (TP + FN) x 100. Specificity: TN / (TN + FP) x 100. PPV: TP / (TP + FP) x 100. NPV: TN / (TN + FN) x 100. Reports were assessed, and patients' HEART score was calculated, and patients were labelled as positive or negative (as per operational definition). The patient followed up for 3 months for MACE, including STEMI and NSTEMI attacks, was labelled (as per operational definition). All this information was recorded on a proforma. Patients aged 35-75 years of either gender presenting with suspicion of MI (as per operational definition) were included. Patients with recurrent myocardial infarction, congestive heart failure, valvular heart disease, previous bypass surgery, percutaneous intervention (on medical record), and Patients with abnormal liver profile, renal failure, respiratory disease, and anaemia were excluded. SPSS version 25.0 was used and statistically analyze the gathered data. The mean and standard deviation were applied to display quantitative information (age and illness duration). Frequencies and percentages were used to display qualitative characteristics such as MACE, diabetes, smoking, and gender. The HEART score's diagnostic accuracy, sensitivity (Sp), specificity (Se), positive predictive value (PPV), and negative predictive value (NPV) were calculated using 2x2 tables. Data were stratified for age, gender, duration of symptoms, diabetes, and smokingFollowing stratification, 2x2 tables were created to determine each stratum's Se, Sp, PPV, NPV, and diagnostic accuracy (DA) of the HEART score.

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RESULTS

In our study, male and female were 269 (69.9%) and 116 (30.1%), respectively. The mean age was 62.34 ± 8.48 years, with a minimum of 35 and a maximum of 75 years. The results of the frequency distribution of age groups showed 171(44.4%)patients were in the <50 years age group and 214 (55.6%)were in the>50 years age group. The mean duration of symptoms was 4.71 ± 2.24 hours. The duration of symptom results showed that 334 (86.8%) had <6 hours duration of symptom and 51(13.2%)had >6 hours duration of symptom. The frequency distribution results of diabetes showed that 324 (84.2%) had diabetes. The frequency distribution results of smoking showed that 157(40.8%)had the habit of smoking(Table 1).

Table 1: Frequency of Demographic

Variables	Frequency (%)
Gender	
Male	269(69.9%)
Female	116(30.1%)
Age Groups	
<50 Years	171(44.4%)
>50 Years	214(55.6%)
Duration of Symptoms	
<6 Hours	334(86.8%)
>6 Hours	51(13.2%)
Diabetes	
Yes	324(84.2%)
No	61(15.8%)
Smoking	
Yes	157(40.8%)
No	228(59.2%)
Adverse Events on ECG Changes	
Positive	373(96.9%)
Negative	12(3.1%)
Adverse Events on the HEART Score	
Positive	327(84.9%)
Negative	58(15.1%)

In our study, for predicting adverse events, on HEART score results showed that 327 (84.9%) were positive, while 373 (96.9%)were positive on ECG changes(Table 2).

Table 2: Cross-tabulation of Adverse Events on HEART Score vs. ECG Changes

Adverse Events on the HEART Score	Adverse Events on ECG Changes		Total	Percentage
	Positive	Negative		
Positive	323	4	327	Sn=86.6%, Sp=66.7% PPV=98.77%, NPV= 13.79%, DA=85.97%
Negative	50	8	58	
Total	373	12	385	

The Se, Sp, PPV, and NPV predicting adverse events on HEART score vs. ECG changes were 86.7%, 66.7%, 98.7% and 13.7% respectively(Table 3).

Table 3: Stratification of Adverse Events on HEART Score vs. ECG Changes with Respect to Gender

Variables	Adverse Events on the HEART Score	Adverse Events on ECG Changes		Total	Percentage
		Positive	Negative		
Gender					
Male	Positive	233	3	236	Sn=89.2%, Sp=62.5%, PPV=98.7%, NPV=15.15%, DA=88.4%
	Negative	28	5	33	
Female	Positive	90	1	91	Sn=80.3%, Sp=75.0%, PPV=98.9%, NPV=12.0%, DA=80.17%
	Negative	22	3	25	
Age Groups					
<50 Years	Positive	126	2	128	Sn=76.83%, Sp=71.43%, PPV=98.4%, NPV=11.62%, DA=76.60%
	Negative	38	5	43	
	Total	164	7	171	–
>50 Years	Positive	197	2	199	Sn=94.2%, Sp=60.0%, PPV=98.9%, NPV=20.0%, DA=93.45%
	Negative	12	3	15	
Duration of Symptoms					
<6 Hours	Positive	283	4	287	Sn=87.08%, Sp=55.5%, PPV=98.60%, NPV=10.63%, DA=86.22%
	Negative	42	5	47	
>6 Hours	Positive	40	0	40	Sn=83.3%, Sp=100.0%, PPV=100.0%, NPV=27.3%, DA=84.31%
	Negative	8	3	11	
Diabetes Mellitus					
Yes	Positive	272	4	276	Sn=86.6%, Sp=60.0%, PPV=98.5%, NPV=12.5%, DA=85.8 %
	Negative	42	6	48	
No	Positive	51	0	51	Sn=86.4%, Sp=100.0%, PPV=100.0%, NPV=20.0%, DA=86.8%
	Negative	8	2	10	

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Smoking					
Yes	Positive	144	1	145	Sn=93.5%, Sp=66.7%, PPV=99.3%, NPV=16.6%, DA=92.9%
	Negative	10	2	12	
No	Positive	179	3	182	Sn=81.7%, Sp=66.6%, PPV=98.3%, NPV=13.04%, DA=81.14%
	Negative	40	6	46	

DISCUSSION

Our research shows that the HEART score provides exceptional diagnostic precision. Age, ECG alterations, and troponin components shared by the HEART score are the most predictive of the TIMI, according to a prior study [14]. Therefore, doctors should use the HEART score as the preferred tool, assessing the ultimate probability of MACE in their patients who present with chest pain, after applying their clinical judgment to estimate the pretest risk of MACE. A patient with a score below the threshold (≤3) and pretest likelihood of 25% for MACE, for instance, would have a posttest probability of 3.0%. The posttest likelihood for the same patient would be 7.8% if their TIMI score was below the low-risk cutoff (≤1). The GRACE score's predictive accuracy could not be evaluated since the included studies that examined it used different evaluation thresholds [15, 16]. These proven results have significant ramifications for pertinent clinical policies and guidelines. As previously stated, the AHA/ACC guidelines presently advise physicians to use a clinical tool when determining a patient's risk for chest discomfort [14]. Our findings imply that the HEART score ought to be the go-to instrument for these objectives, especially when looking to detect a low-risk that can be discharged right away. When estimating chest pain, the emergency physician's priority is to effectively diagnose "clinically significant" cardiac ischemia. However, as discussed extensively in the cardiovascular literature, there is no objective criterion standard to establish this diagnosis. Consequently, MACE is most frequently used as the benchmark for a practical method of identifying clinically severe ischemia based on the incidence of negative consequences or the requirement for significant intervention. In this study of diagnostic test accuracy, the target outcome was clinically severe cardiac ischemia, using the score as the index test and MACE as the reference standard. Although MACE is frequently used result of a notable risk of incorporation when the diagnostic test aids. The issue of identifying the diagnostic value of troponins for identifying "clinically significant" ischemia that necessitates revascularization is one example. This condition lacks a standard of care, and the presence of elevated troponins is likely to influence any prospective outcome assessor. Furthermore, the use of composite outcomes suggests that each segment has similar significance. It is crucial to keep in mind that men have a much higher risk of MACE across all HEART risk categories when using the HEART score to support clinical decision-making. Men with acute chest pain appear to be less safe to be discharged early with a low-risk HEART score than women [17]. According to one study, the HEART score (≥4) had a specificity of 44.6% (95% CI = 38.8% - 50.5%) and sensitivity of 95.9% (95% CI = 93.3% - 97.5%) [13]. According to another study, the HEART score demonstrated 53% specificity and 100% sensitivity for MACE [18]. In contrast, the HEART score for MACE in the Indian population exhibited an 86.7% sensitivity and a 50.2% specificity [19]. In China, the HEART score for MACE had a 52.9% sensitivity and an 83.2% specificity [20].

This study is limited using MACE as a composite reference standard, which may introduce incorporation bias and assumes equal weight for all outcome components. Additionally, variability in HEART score performance across different populations and sexes may affect generalizability. Future research should validate the HEART score across diverse populations and settings, considering sex-specific risk differences and standardized outcome definitions.

CONCLUSIONS

For patients experiencing chest pain, the HEART score is a reliable indicator of significant unfavorable cardiac events. It is recommended that the HEART score be further verified as a clinical risk assessment tool for Emergency Department patients with chest pain.

Authors' Contribution

Conceptualization: AA
Methodology: AA, TH, SU, BM
Formal analysis: MS, MM
Writing and Drafting: AA
Review and Editing: AA, TH, MS, SU, BM, MM

All authors approved the final manuscript and take responsibility for the integrity of the work.

Conflicts of Interest

All the authors declare no conflict of interest.

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