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Research Article

Heart or Grace Score for Diagnostic and Risk Stratification in Acute Coronary Syndrome Patients

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ABSTRACT

Background: Some studies found that HEART score is better than GRACE score either as a rule-in method for myocardial infarction or as a risk stratification. However, GRACE score was also found to have better discriminatory ability as a prognostic model for patients with myocardial infarction. **Objective:** This study aims to evaluate whether the HEART and GRACE scores have equal capabilities either as a diagnostic method for myocardial infarction or risk stratification to predict in-hospital Major Adverse Cardiovascular Events (MACE) in Acute Coronary Syndrome (ACS) patients at Adam Malik Hospital. **Methods:** This research is a retrospective and prospective observational study. Retrospective data was collected from all medical records of ACS patients from January to December 2022. Prospective data was collected by consecutive sampling until 46 samples were fulfilled from October 2023 at Adam Malik Hospital. Samples included in the research analysis were those who met the inclusion criteria. To compare each score, we use the area under the receiver-operating characteristics (AUC) method. **Results:** HEART score is superior to GRACE score as a diagnostic method with an AUC of 0.903, a cutoff of 6.5, sensitivity of 86%, and specificity of 80%. The GRACE score is superior to the HEART score as a risk stratification with an AUC of 0.719, a cutoff of 128.5, sensitivity of 66%, and specificity of 65%. **Conclusion:** HEART score is superior for diagnosis, and GRACE score is superior for risk stratification.

Keywords: acute coronary syndrome, hospital, risk assessment

1. Introduction

Coronary heart disease is the leading cause of death due to cardiovascular disorders in many countries. It contributes to a 14,4% cause of death in Indonesia. A patient usually seeks a hospital because of symptoms due to Acute Coronary Syndrome (ACS) [1,2,3,4]. Early diagnosis of ACS is important to reduce the mortality rate, but misdiagnosis is still possible. Factors that can lead to misdiagnosis include non-specific chest pain and no ECG changes [5,6]. Clinicians have to make a prognosis based on patient risk, either to triage the patient's treatment room (ward or intensive) or determine patient therapy. Risk stratification is needed to predict major adverse cardiovascular events (MACE) in patients presenting with chest pain to the emergency department [4,7,8].

Several scoring systems have been developed to help make a diagnosis and carry out risk stratification, such as History, ECG, Age, Risk factors, and Troponin (HEART) and Global Registry of Acute Coronary Events (GRACE) score [4, 8]. HEART was considered the most suitable score for diagnosis in the emergency unit. Some studies found that HEART score is better than GRACE score either as a rule in method or risk stratification for myocardial infarction [4,9,10]. However, the GRACE score was also known for having better discriminatory abilities [11-13].

This study aims to evaluate whether the HEART and GRACE scores have equal capabilities either as a diagnostic method for myocardial infarction or risk stratification to predict inhospital Major Adverse Cardiovascular Events (MACE) in ACS patients at Adam Malik Hospital.

2. Methods

Samples in this research were patients at thr cardiac emergency unit in Adam Malik hospital who were diagnosed with ACS and fulfilled the inclusion criteria. This research is a retrospective and prospective observational study. Retrospective data was collected from all medical records of ACS patients from January to December 2022. Prospective data was collected by consecutive sampling until 46 samples was fulfilled from October 2023.

Inclusion Criteria:

1. Patients at the cardiac emergency unit in Adam Malik hospital who were diagnosed with ACS.
2. Age ≥ 18 years old

Exclusion Criteria:

1. Incomplete data on medical record to calculate the score
2. There were diagnoses which indicate major adverse cardiac event on the admission day at cardiac emergency unit, such as: cardiac arrhytmias (high degree av block, atrial/ ventricular fibrillation, ventricular tachycardia), cardiogenic shock, acute heart failure, stroke, cardiac arrest, and mortality.

HEART and GRACE scores were calculated from the data and inhospital MACE were also noted. HEART score is the total points obtained by adding up the scores from 5 components, including: history (anamnesis), ECG changes, age, number of risk factors for coronary heart disease, and troponin value [6,14-17]. The GRACE score is the total points obtained by adding up the scores from 8 components, including: age, heart rate, systolic blood pressure, creatinine, presence or absence of cardiac arrest on admission day in the hospital, ST segment deviation on the ECG, abnormal heart enzymes, and Killip class [8,18]. Major Cardiovascular Events are diagnoses or clinical conditions that occur during inhospital treatment obtained from medical records, such as: cardiac arrhythmias (high degree AV block, atrial/ventricular fibrillation, ventricular tachycardia), cardiogenic shock, acute heart failure, stroke, cardiac arrest, and death.

After all the data was collected, data was analyzed using SPSS Version 26. Sample characteristics either as a diagnostic method or risk stratification were assessed using the mean difference test and p value <0,05 was considered significant. To compare each score, assess sensitivity, specificity, and cut off points either as diagnostic method or risk stratification, the area under the receiver-operating characteristics (AUC) method was used. This research has been approved by the Ethics Committee of Health Research, Faculty of Medicine, Universitas Sumatera Utara (USU).

3. Results

The total number of ACS patients who came to the cardiac emergency unit at Adam Malik Hospital in the period of January to December 2022 recorded in medical records was 429 patients. There were 307 patients who met the inclusion criteria. In the period since October 2023, we collected data concecutively from 46 ACS patients' medical records. The total sample of this study was 353 patients.

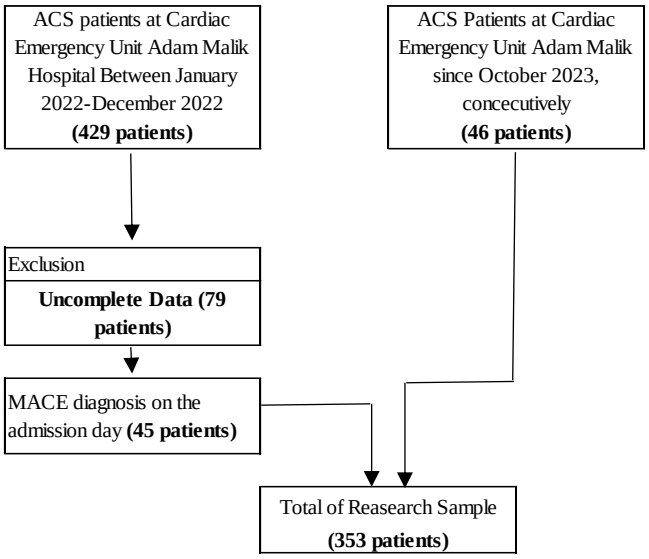

Figure 1. Research Sample

Myocardial infarction is a condition where there is an increase and/or decrease in cardiac troponin values with at least one value being above the 99th percentile upper limit of the laboratory and at least one criterion, including: symptoms of acute myocardial ischemia, ST segment elevation in 2 adjacent leads or new bundles branch block on the ECG, pathological Q waves appearing on the ECG, imaging results showing abnormalities in myocardial wall movement, visible coronary thrombus on angiography or autopsy [19].

Patients who experienced myocardial infarction had a mean age of 57.77 ± 9.86 years. There were more men than women. Those patients underwent percutaneous coronary intervention. Patients who experienced myocardial infarction generally have <3 risk factors for coronary heart disease. The average length of stay was 4.3±2.83. The mean of HEART and GRACE scores of patients who experienced myocardial infarction were 7.93 ± 1.24 and 143.11 ± 38.632, respectively.

There was no significant difference between age and number of risk factors for coronary heart disease in patients who experienced myocardial infarction compared to those who did not ($p>0.05$). There were significant differences in the HEART score, GRACE score, length of stay, gender, ECG, and whether percutaneous coronary intervention was performed, between patients who experienced myocardial infarction compared to those who did not ($p<0.05$).

Table 1. Samples' Characteristics as A Diagnostic Method for Myocardial Infarction

Characteristic	Myocardial Infarction (Mean ± SD)		*p* Value
	Yes (n: 245)	No (n: 108)	
Age (Years)	57,77±9,86	59,23±10,43	0,302[a]
Gender (n)			
Men	194	72	0,012[c]
Women	51	36	
Percutneous Coronary Intervention (n)			
Yes	156	33	0,000[c]
No	89	75	
Risk Factors			
<3	134	53	0,330[c]
≥3	111	55	
Length of Stay	4,3±2,83	3,71±2,05	0,049[b]
HEART Score ($\overline{X}$)	7,93±1,24	5,44±1,34	0,000[a]
Low risk (n)	0 36	9 77	0,000[c]

Moderate risk (n)	209	22	
High risk (n)			
GRACE Score ($\overline{X}$)	128,17±32,69	96,14±30,66	
Low risk (n)	66	69	0,000[b]
Moderate risk (n)	97	31	0,000[c]
High risk (n)	82	8	
ECG changes (n)			
Yes	163	23	0,000[c]
No	82	85	

a. Mann-Whitney Test
b. Independent T-Test
c. Chi-square

Characteristics as a risk stratification are sample's characteristics which can be used to predict inhospital major adverse cardiovascular events (MACE) such as cardiogenic shock, cardiac arrhythmia, acute heart failure, stroke and death [20].

Patients who experienced inhospital MACE had a mean age of 59.38 ± 11.04 years. There were more men than women. Patients who underwent percutaneous coronary intervention experienced more inhospital MACE. Patients who experienced inhospital MACE generally have <3 risk factors for coronary heart disease. The average length of stay was 4.914 ± 3.55 days. The mean HEART and GRACE scores were 7.89±1.34 and 143.11±38.63, respectively.

There were no significant differences between age, gender, risk factors, and whether percutaneous coronary intervention was performed or not, between patients who experienced inhospital MACE compared to those who did not (p>0.05). There were significant differences in HEART score, GRACE score, and length of stay between patients who experienced inhospital MACE compared to those who did not (p<0.05).

Table 2. Samples' Characteristics as Risk Stratification

Characteristic	Inhospital MACE (Mean ± SD)		*p* Value
	Yes (n: 47)	No (n: 306)	
Age (Years)	59,38±11,04	58,04±9,89	0,305[a]
Gender (n)			
Men	38	228	0,348[c]
Women	9	78	
Percutaneous coronary intervention (n)			
Yes	29	160	0,228[c]
No	18	146	
Risk Factors (n)			
<3	31	156	0,055[c]
≥3	16	150	
Length of Stay	4,914±3,55	4,003±2,43	0,026[b]
HEART Score	7,89±1,34	7,05±1,74	
Low risk (n)	1	8	0,002[b]
Moderate risk (n)	6	107	0,009[c]
High risk (n)	40	191	
GRACE Score	143,11±38,63	114,57±33,21	
Low risk (n)	5	130	0,000[a]
Moderate risk (n)	17	111	0,000[c]
High risk (n)	25	65	
ECG changes (n)			
Yes	35	151	0.005[c]
No	12	155	

a. Mann-Whitney Test
b. Independent T-Test

c. Chi-Square

As a diagnostic method, the HEART score has better capability than the GRACE score with a greater ROC curve, AUC: 0.903. The cut-off point for the HEART score is 6.5 with a sensitivity of 86% and specificity of 80%. As a risk stratification, the GRACE score has better capability than the HEART score with a greater ROC curve, AUC: 0.719. The cut-off point for the GRACE score is 128.5 with a sensitivity of 66% and specificity of 65%.

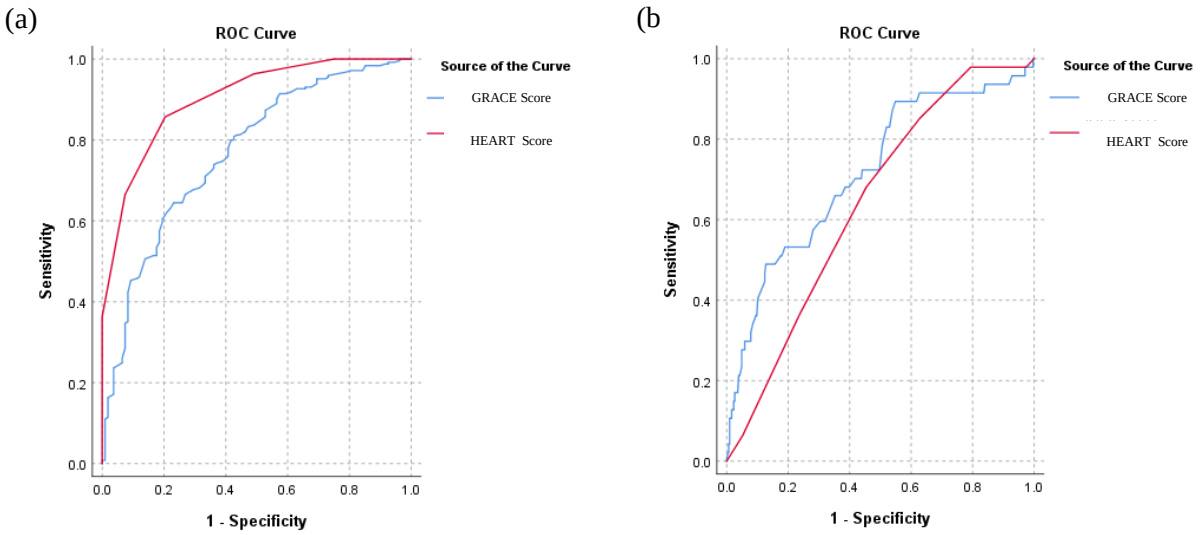

Figure 2. (a) ROC Curve as Diagnostic Method; (b) ROC Curve as Risk Stratification

Table 3. AUC and Cut Off Point

Score	AUC	Sensitivity (%)	Specificity (%)	Cut Off Point
Diagnostic Method				
HEART	0,903	86	80	6,5
GRACE	0,768	68	68	113,5
Risk Stratification				
HEART	0,642	68	54	7,5
GRACE	0,719	66	65	128,5

4. Discussion

In this study, we found that as a diagnostic method the HEART score has better capability than the GRACE score. The same result was also found in a retrospective study by Hrecko J et al where the HEART score had higher specificity to rule in acute myocardial infarction (83.2%) than the GRACE score (81.6%). The HEART score was also recommended by the European Society of Cardiology working group because it was considered to be the most appropriate clinical approach in the diagnostic process of acute chest pain in the emergency unit [9,10].

In this study, we found that the GRACE score has better capability as a risk stratification than the HEART score. This result is in contrast to the research by Y.S. Shin et al who compared HEART, TIMI, GRACE, and EDACS scores in predicting major adverse cardiovascular events (a diagnosis of acute myocardial infarction, undergoing percutaneous intervention, undergoing bypass surgery, and death) within 30 days onset of chest pain. They found that the HEART score had the best performance of all the scores with an AUC of 0.763. The difference between our study and those by Y.S. Shin et al may be caused by the differences in type of MACE and the time of its assessment. In this study, we defined MACE as a diagnosis of cardiogenic shock, cardiac arrhythmia, acute heart failure, stroke and death during inhospital treatment. The difference may also be due to the fact that at the beginning of its development, HEART score was intended to assess MACE within 6 weeks after the onset of chest pain, while the GRACE score was developed to be able to assess mortality during inhospital treatment. Our results also indicate that GRACE score can be recommended as a risk stratification for patients experiencing myocardial infarction as in the 2017 ESC Guidelines for the management of acute myocardial infarction in patients presenting with ST-

segment elevation, contrary to the lowering recommendation class of it in the 2023 ESC Guidelines for the management of acute coronary syndromes written should be considered for estimation of prognosis [4,6,8,13,21].

In this study, we found that, as a risk stratification, the HEART score had a cutoff point of 7.5 (more than 4) with a sensitivity and specificity of 68% and 54% (less than 80%). Meanwhile, the GRACE score had a cut point of 128.5 (more than 100) with a sensitivity and specificity of 66% and 65% (less than 70%). We also found that the HEART score had better ability than GRACE in diagnosing a myocardial infarction with a greater AUC area. These results are in line with a meta-analysis by A. Kabiri et al in 2023 about the ability of HEART and GRACE scores to predict the outcome of acute coronary syndrome patients. They found that these two scores could predict a myocardial infarction and MACE with good sensitivity. They divide it into several cutoff points. HEART score as a predictor of MACE had cutoff point >4 with a sensitivity of 77% and specificity of 78%, as a diagnostic method for myocardial infarction with an AUC of 0.86. GRACE score as a predictor of MACE had cut off point >100, a sensitivity of 58% and specificity of 69%, as a diagnostic method for myocardial infarction with an AUC of 0.72 [22].

Limitations

In this study, we did not analyze the entire spectrum of acute coronary syndrome. We did not analyze according to each unstable angina pectoris, non ST-segment elevation myocardial infarction, or ST-segment elevation myocardial infarction. This was because the total outcome (MACE) was only around 13%. It was small and may cause bias. In this study, we did not analyze the association between therapy or intervention with inhospital MACE. However, we found that there was no significant difference in MACE between patients who underwent percutaneous coronary intervention versus those who did not.

5. Conclusion

As a diagnostic method, the HEART score is superior to the GRACE score. As a risk stratification, the GRACE score is superior to the HEART score. Based on the ROC curve, the HEART and GRACE scores have good capabilities either as a diagnostic method or risk stratification but their sensitivity and specificity are less than 90%.

6. Data Availability Statement

The datasets generated and analyzed during the current study are not publicly available due to privacy and ethical considerations but are available from the corresponding author upon reasonable request.

7. Ethical Statement

Sumatera Medical Journal (SUMEJ) is a peer-reviewed electronic international journal. This statement below clarifies ethical behavior of all parties involved in the act of publishing an article in Sumatera Medical Journal (SUMEJ), including the authors, the chief editor, the Editorial Board, the peer-reviewer and the publisher (TALENTA Publisher Universitas Sumatera Utara). This statement is based on COPE's Best Practice Guidelines for Journal Editors

8. Author Contributions

All authors contributed to the design and implementation of the research, data analysis, and finalizing the manuscript.

9. Funding

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10. Conflict of Interest

Authors declares no conflict of interest.

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