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Application of HEART score: Review Article

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Abstract:

Chest pain is one of the most common presenting complaints in the emergency department and represents a diagnostic challenge due to its wide range of possible etiologies, including life-threatening acute coronary syndromes (ACS). Early and accurate risk stratification is essential to guide clinical decision-making, optimize resource utilization, and reduce unnecessary hospital admissions. The HEART score is a simple and widely used clinical risk stratification tool that incorporates History, Electrocardiogram findings, Age, Risk factors, and Troponin level to predict the risk of major adverse cardiac events (MACE). This study aims to evaluate the application and effectiveness of the HEART score in patients presenting with chest pain in the emergency department.

Keywords: HEART score; Chest pain; Acute coronary syndrome; Risk stratification; Emergency department; Major adverse cardiac events.

Introduction:

Chest pain is one of the most common, potentially serious presenting complaints for adult emergency department (ED) visits **(1).** During these visits, ED physicians must rapidly identify which presentations represent an ACS (including ST-segment elevation myocardial infarction [STEMI], none ST-segment elevation myocardial infarction [NSTEMI], and unstable angina (UA) in order to initiate appropriate management and minimize associated morbidity and mortality **(2, 3).** ED physicians should rule out acute ACS through a combination of clinical judgement, electrocardiographic (ECG) findings and high-sensitivity cardiac troponin (hs-cTn) testing **(2, 3).**

Approximately 80% of patients with chest discomfort do not have a definite ACS at the time of presentation in today's practice **(4, 5).** Even while 75-85 percent of patients with symptoms indicative of ACS go through extensive testing in the emergency department, most of these individuals do not receive final diagnosis of ACS **(5, 6, 7).** Without a perfect methodology, these evaluation processes differ from one institution to another. Clinicians frequently hospitalize these patients for observation while also treating them as ACS patients. Owing to this, over diagnosis and treatment are prevalent, leading to elevated patient burden, physician duplication of efforts, increased costs and poor patient outcomes, such as higher number of deaths **(5, 8).** Patients having all causes of chest pain are examined at the emergency department (ED) with a simple certified measure called the HEART score to enhance risk evaluation.

Development of the HEART score

The HEART score was developed in the Netherlands in 2008 by Six, Backus and Kelder as a rapid risk stratification tool for patients with chest pain according to their short-term risk MACE (defined as acute myocardial infarction (AMI), need for percutaneous coronary intervention (PCI) or coronary artery bypass graft

(CABG), and death (within 6 weeks) to help identify low-risk patients, suitable for earlier ED discharge within 30 days of index ED visit **(9).**

The HEART score is considered rather valuable for several reasons, including its ease of application, ready availability of the variables under consideration, the focus on short-term outcome, appropriate for ED management, and the identification of three discrete subpopulations (low-, moderate-, and high-risk) of ED chest pain patients suspected of ACS**.(10)**

HEART score was not developed from a database as modern scores often are. The HEART score was based on clinical experience and medical literature and designed to be as easy to use as the Apgar score for newborns HEART Score shown in table (1) **(9, 11)**

Table (1): The **HEART Score**:

Variable	Score of 0	Score of 1	Score of 2
History	nonspecific history for ACS, a history that is not consistent with chest pain concerning for ACS	mixed historic elements, a history that contains traditional & non-traditional elements of typical ACS presentation	specific history for ACS, a history with traditional features of ACS
Electrocardiogram	entirely normal ECG	abnormal ECG, with repolarization abnormalities yet lacking significant ST depression	abnormal ECG, with significant ST deviation (depression ± elevation), either new or not known to be old (i.e., no prior ECG available for comparison)
Age (years)	age less than 45 years	age between 45 & 64 years	age 65 years or older
Risk Factors	no risk factors	1 to 2 risk factors	3 or more risk factors OR documented cardiac or systemic atherosclerotic vascular disease
Troponin	troponin < discriminative level level ± AccuTroponin I < 0.04 ng/ml	troponin elevated 1e3 times discriminative level ± AccuTroponin I 0.04- 0.12 ng/ml	troponin elevated > 3 times discriminative level ± AccuTroponin I > 0.12 ng/ml

risk category & recommended management strategy.

- 0-3: low risk, potential candidate for early discharge.
- 4-6: moderate risk, potential candidate for observation & further evaluation.
- 7-10: high risk, candidate for urgent or emergent intervention.
- BBB, LVH, digoxin effect, implanted right-ventricular pacemaker, past Ml, +/- unchanged repolarization abnormalities.
- DM, tobacco smoker, HTN, hypercholesterolemia, obesity, +/- family history of CAD.
- peripheral arterial disease, Ml, past coronary revascularization procedure, +/- stroke.
- It is recommended to use the local hospital standards for troponin abnormality determination. **(9,11,12,13)**

Development of the HEART pathway

Since the inception of the HEART score, it has been validated in many trials, both retrospective and prospective **(9, 11, 14, 15)**. Yet some clinicians are hesitant to discharge low-risk patients without further testing, prolonged observation, and/or hospital admission **(16).** A common criticism was the use of a single troponin determination rather than serial testing **(17).** In response to this valid concern, the HEART Pathway was developed, combing the HEART score with an additional troponin measurement at 3 h **(18).**

In this pathway, patients were initially divided into low-risk (troponin HEART score ≤ 3) or high-risk (troponin HEART score >3) categories rather than low, intermediate, and high levels of clinical concern.

The patients were then followed with repeat troponin determination at 3 h. If low-risk initial category and negative repeat troponin determination then, similar to the HEART score, the patient is a candidate for early discharge. If high-risk category with negative repeat troponin determination, it is recommended for the patient to be admitted to an observation or inpatient unit for further evaluation. If the patient is high-risk with positive repeat troponin determination, the pathway recommends cardiology consultation, hospital admission, and further testing **(17).** The HEART Pathway has also been noted to have a higher sensitivity and greater negative predictive value for MACE as compared with the HEART score itself **(17)**.

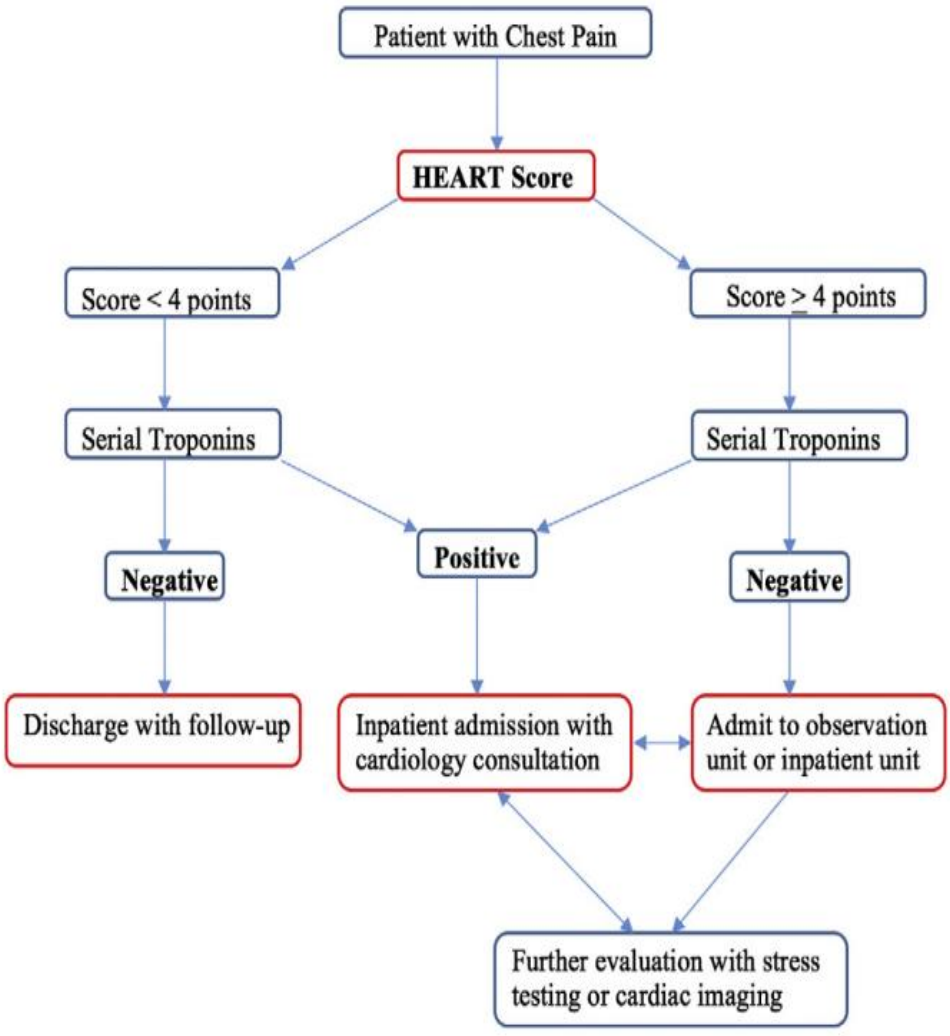

Figure (1) The HEART pathway.

Table (2) :THE E-HEART score (adding FECHO as an additional parameter in existing HEART score)

Parameters	Scores
Echo	
Definite RWMA	0
No definite RWMA	1
History	
Highly suspicious	2
Moderately suspicious	1
Mildly suspicious	0
ECG	
Significant ST-segment	2
Nonspecific repolarisation	1
Normal	0
Age (years)	
>65	2
45–64	1
<45	0
Risk factors	
>3 risk factors/history of atherosclerotic disease	2
1 or 2 risk factors	1
No risk factors	0
Troponin	
≥3 times the normal limit	2
1–3 times the normal limit	1
≤ Normal limit	0

RMWA: Regional wall motion abnormality, ECG: Electrocardiogram

The E-HEART score is stratified into low-risk, intermediate-risk, and high-risk categories based on six variables: HEART and FECHO. The scores vary from "0 to 11-point scores." A score of 0–3 indicates a patient is at "low risk" and advises consideration of discharge and further investigations can be planned during out patient department visits. Our study saw a MACE of 0% for low-risk patients. Patients with a score of 4–6 are classified as "intermediate risk " and they require hospitalization and clinical observation, including recurrent troponin levels and treadmill test (TMT) testing. About 31% of intermediate-risk patients had MACE in our study. Patients with a score of 7–11 are deemed "high risk" and require early aggressive care with invasive procedures. Approximately 97% of high-risk patients had MACE in our study. The possibility to stratify undifferentiated patients into high-risk categories increases tremendously with integrating FECHO at presentation. This highlights the importance of FECHO integration in undifferentiated chest pain patients for their risk stratification. The association between RWMA and ACS has been documented well **(18).**

1- History

As is true of all 5 categories in this decision tool, the patient history is denoted by the "H" and refers to the description of the patient's chest pain and related presentation details. The history description is divided into three levels, including nonspecific, mixed nonspecific and specific and specific elements with corresponding scores of 0, 1, and 2. The nonspecific elements were initially defined as " the absence of specific elements in terms of pattern of chest pain, onset and duration, relation with exercise, stress or cold, localization of pain, concomitant symptoms, and the reaction to sublingual nitrates." **(9,11)**

This HEART score category is the most subjective, creating the opportunity for inter-rater variability depending on which historical elements were elicited and in what way **(19, 20).** Looking to reduce this subjectivity and related inconsistent application, Marchick et al. investigated the efficacy of 3 different scoring models for the history component of the HEART score. Unfortunately, none of the three models were found to be significant predictors for the need advanced cardiac studies **(13).** Further investigation into the subjectivity and related physician agreement when eliciting the history of the event is needed; it has been suggested that the use of a scoring model as compared to individual physician judgment may be useful in increasing agreement across physicians **(13).**

While the history component may be scored simply by judgment of the experienced predictor, a guideline such as a scoring model or specific "keywords" may aid in standardization of the history for increased understanding among clinicians; including emergency physicians, hospitalists, and consulting cardiologists; such standardization may also assist physicians in training **(13).**

It is important to remember that various demographic groups, including female and elderly patients, may present nontraditionally. These patients do have higher rates of non-chest pain presentations in the setting of ACS. The obvious concern in this area would score quite low in the history category of the HEART score when, in fact, the patient is presenting in a nontraditional sense.

The following lists the scoring criteria for "H" in the history category of the HEART score:

- Score of 0: nonspecific history for acute coronary syndrome, a history that is not consistent with chest pain concerning for ACS;
- Score of 1: mixed historic elements, a history that contains traditional and non-traditional elements of a typical ACS presentation; and
- Score of 2: specific history for acute coronary syndrome, a history with traditional features of ACS **(9,11,12, 21).**

2-Electrocardiogram

The "E" in HEART score focuses on the electrocardiogram. The ECG scoring is more objective focused, yet the clinician must follow the direction from the scoring system itself, rather than personal electrocardiographic interpretation considerations. The original HEART score ECG scoring system was based on the Manchester scoring criteria **(20).** An entirely normal ECG received a score of 0. Repolarization abnormalities without significant ST-segment depression were given a score of 1; these repolarization abnormalities include those findings anticipated in the following patterns: bundle branch block (BBB), left ventricular hypertrophy by voltage criteria with strain (LVH), digoxin use (the so-called "digoxin effect"), implanted right-ventricular pacemaker, and unchanged repolarization abnormalities when compared to past electrocardiograms. Including from past myocardial infraction. Significant ST-segment deviation, either depression or elevation, - in the absence of BBB, LVH, implanted right-ventricular pacemaker or "digoxin effect" patterns - received a score of 2 **(9,11,12).**

It is vital to understand that abnormal depolarization results in abnormal repolarization; this consideration clearly impacts HEART score calculations. When one considers the E score category of 1, which focuses on the presence of repolarization abnormalities in the absence of significant ST segment depression, it is assumed that the clinician is comfortable with the recognition of the anticipated electrocardiographic findings in these patterns. These

findings include significant ST segment deviation, including both depression and elevation, as well as prominent and inverted T waves **(21).**

A comparison of prior ECGs, if such exist, is suggested. Prior ECGs winch ae very similar to the index electrocardiogram under consideration can be scored using the noted criteria. Thus, when a prior ECG does not exist or is not available for viewing, abnormalities must be considered as "not known to be old" with appropriate scoring for "new" findings. Significant changes in the serial electrocardiograms, if performed during the ED management, must be considered as concerning, in some cases transcending the HEART score. And, of course, ST-segment elevation consistent with STEMI is managed appropriately, irrespective of the HEART score; recall that STEMI patients were excluded from the original development of the score **(21).**

As should be quite clear from the discussion of the "E" variable in the HEART score, significant expertise in electrocardiographic interpretation is mandatory.

The following lists the scoring criteria for "E" in the electrocardiographic category of the HEART score:

- Score of 0: entirely normal ECG;
- Score of 1: abnormal ECG, with repolarization abnormalities as described above yet lacking significant ST-segment depression; and
- Score of 2: abnormal ECG, with significant ST segment deviation (significant depression and/or elevation) which is either new or not known to be old (i.e., no prior ECG is available for comparison) **(9,11,12,21).**

3-Age

The "A" in HEART is the patient's age, defined in years; it is quite objective with little to no opportunity for error or inconsistency among physicians. Patients younger than age 45 years receive a score of 0; patients aged 45–64 years receive a score of 1; and patients aged 65 years and older receive a score of 2.

The following lists the scoring criteria for "A" in the age category of the HEART score:

- Score of 0: age less than 45 years;
- Score of 1: age between 45 and 64 years; and
- Score of 2: age 65 years or older **(9,11, 21).**

4-Risk factors

The "R" category of the HEART score focuses on the risk factors for the development of coronary artery disease (CAD). As long as the defined risk factors are known and recognized by the clinician, then calculation of this HEART score variable is relatively straight-forward. These risk factors include the following conditions: diagnosed and treated diabetes mellitus (DM), current or recent tobacco smoker, diagnosed hypertension (HTN), diagnosed hypercholesterolemia, obesity, and established family history of CAD **(9, 11).**

Risk factor burden is expressed with sequentially higher HEART score point values. The following risk factor burden is associated with HEART score: 0 points if no risk factors, 1 point for 1 to 2 risk factors, and 2 points for 3 or more risk factors. In addition, an established history of peripheral arterial disease, myocardial infarction, past coronary revascularization procedure, or stroke results in a score of 2 points, regardless of number of other risk factors **(9,11, 21).**

Several clarifications are in order with respect to risk factor considerations. Recent tobacco use via smoking, referred to as "recent smoker," was originally defined as smoking within 1 month of presentation; later studies, however, broadened the time interval to smoking within 90 days of presentation **(9, 11).**

DM, HTN, and hypercholesterolemia must have been diagnosed prior to presentation in the ED; patients who suspect they have these illnesses, yet lack a formal physician-established diagnosis, should not be considered to have those risk factors from the HEART score perspective. Of course, "medical common sense" should be

exercised in situations in which patients lack access to ongoing medical care; the clinician at the bedside is in the position to interpret this area of HEART score determination and calculation **(9,11, 21).**

The following lists the scoring criteria for "R" in the risk factor category of the HEART score:

- Score of 0: no risk factors;
- Score of 1: 1 to 2 risk factors;
- Score of 2: 3 or more risk factors; and

Score of 2: automatic score of 2 with established diagnosis of the any of the following conditions: peripheral arterial disease, myocardial infarction, past coronary revascularization procedure, or stroke.

5- Troponin

The "T" is the single serum troponin obtained during the ED evaluation. As with the more objectively oriented HEART score variables such as age, this troponin value is easily interpreted and calculated. In the original study, Accu troponin I assays were used with a threshold for positivity of 0.04 ng/ml. Patients with a troponin value less than 0.04 ng/ml received a score of 0. Patients with a troponin ranging from once to twice the threshold for abnormal (i.e., 0.04 ng/ml) received a 1 point. And those patients with a troponin value more than twice the threshold for abnormality received 2 points. Subsequent multicenter validation studies altered the scoring as follows: one to three times the threshold for abnormality received a score of 1 while more than three times the threshold for abnormality received a score of 2. This adjustment in troponin value HEART scoring was made to validate the process in daily practice across many hospitals **(9,11,21)**

Various troponin assays including high sensitivity troponin have been also been used. There might be slight differences in various troponin measurements from one hospital to another, yet this does not appear to make a significant difference in overall application of the score and its results; it is recommended to use the local hospital standards for troponin abnormality determination**(9,11,21).**

A concern amongst providers is the theoretical situation of a patient with an isolated highly elevated troponin in a young patient with no other concerning features in the history, electrocardiogram, age, and risk factors. This hypothetical presentation would yield a score of 2, placing this patient in the low risk category, even though the elevated troponin is significantly concerning. This presentation, however, is a purely theoretical concern that has not been observed in the studies evaluating the HEART score or pathway **(22).**

In addition, it must be noted that the HEART score and related pathway for evaluation assist the emergency physician in decision making; these decision tools do not provide the "final word" in any individual presentation – the emergency physician makes the final determination in the diagnostic evaluation strategy.

The following lists the scoring criteria for "T" in the troponin category of the HEART score:

- Score of 0: troponin less than hospital lab discriminative level and/or AccuTroponin <0.04 ng/ml;
- Score of 1: troponin value elevated 1–3 times the hospital lab discriminative level and/or Accu Troponin 0.04–0.12 ng/ml; and

Score of 2: troponin value elevated more than 3 times the hospital lab discriminative level and/or AccuTroponin >0.12 ng/ml **(9,11,12,21,22).**

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