

The Potential of Heart Risk Score to Detect the Existence and Severity of Coronary Artery Disease According to Syntax Score at the Emergency Department

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Abstract

Background: Patients presenting with chest pain (CP) at the emergency departments are challenging cases for the physicians to make valid decisions with regard to acute coronary syndrome, which needs urgent medical intervention while the majority of the admitted patients are free from serious cardiac problems. The present study was done to investigate the potential of Heart Risk Score in detecting the existence and severity of coronary artery disease in CP patients based on Syntax score.

Methods: Among CP patients who were admitted at the emergency department, 100 participants were selected. Heart Risk Score was calculated for each participant on admission. Two independent cardiologists also calculated the Syntax score after angiography was done for each patient. Statistical analysis was performed to assess the correlation between Heart Risk Score and Syntax score.

Results: The median age of participants was 58.42 ± 12.42 with the majority (65%) being male. The mean Heart Risk Score of the patients was 5.76 ± 1.56 (min=3, max=9) and the mean Syntax score was 14.82 ± 11.42 (min=0, max=44.5). Pearson correlation coefficient was 0.493 ($P < 0.001$) between Heart Risk Score and Syntax score which was statistically significant ($P < 0.001$). According to our findings a Heart Risk Score of more than 6 has a 52% sensitivity and a 74.7% specificity to detect extensive coronary artery involvement (Syntax score > 22).

Conclusion: We found that there is a positive and significant correlation between Heart Risk Score and Syntax score which underlines the importance of using Heart Risk Score in emergency departments to reduce unnecessary invasive interventions in patients presenting with chest pain.

What This Paper Adds

What is already known on this subject

- Chest pain is a prevalent reason for referring to emergency department.
- Heart risk score was mainly used to predict adverse events in these patients.
- Correlation of heart risk score with angiography findings has been ignored in most studies.

What this study adds

- Heart risk score and syntax score are found to be in a direct and positive correlation.
- Existence and severity of coronary artery disease could be determined by heart risk score at the emergency department.

Introduction

Chest pain (CP) is one of the most prevalent reasons of admission in emergency departments (ED) (1). As there is a possibility that CP relates to life-threatening events such as acute coronary syndrome (ACS), precise diagnosis and efficient treatment improves prognosis significantly (2). In real practice, physicians at the ED assume CP cases as coronary artery disease until proved otherwise, possibly because of legal medical concerns and uncertainties, starting a series of invasive and non-invasive treatments while only less than 25% of such patients truly have ACS. Patients with CP are hospitalized and undergo different testing, imaging, and even invasive procedures like coronary angiography (2).

This approach leads to unnecessary hospitalization, and unnecessary cost. Reduction in the burden of hospitals relies on the ability to differentiate patients with ACS from those without ACS.

Normal levels of troponin or normal ECGs do not warrant absence of ACS completely (2). Risk stratifying tools are advised by international guidelines to be implemented in patients with CP (3). Heart Risk Score is one of the valuable risk scores in risk stratification of patients presenting with chest pain. Heart Risk Score is based on five convenient elements in ED including history, ECG, age, coronary risk factors, and troponin (3). Patients with risk score of 3 are considered low risk, more than 7 high risk and between these two values are considered moderate risk for major adverse cardiac events (MACE) (3). While there are also other scoring systems like TIMI and GRACE and they are beneficial in patients with proven ACS, they are less practical in low-risk patients presenting with CP to ED (1, 4–6).

As stated, studies on Heart Risk Score mainly sought to find the incidence of MACE during early and late follow-up period and the correlation of Heart Risk Score with angiography findings was mainly ignored in previous studies. (7–12). In this study we tried to assess the ability of Heart Risk Score to identify the extension of coronary artery disease according to Syntax score -which is a standard tool used to determine the extent and severity of coronary artery disease- in patients with CP admitted to ED (13).

Materials And Methods

This study was performed on all CP patients above the age of 18 who referred to the ED of Al-Zahra Heart Hospital, Shiraz, Iran. All the participants were asked to sign an informed consent. All methods were carried out in accordance with relevant guidelines and regulations. Patients who were discharged from ED immediately, or had a diagnosis of ST-elevation myocardial infarction or patients with non-coronary etiology of CP like aortic dissection, pneumothorax, and pneumonia were excluded from the study. We made sure that the study and the participation of patients did not influence diagnosis and therapeutic approaches.

A 12-lead ECG was obtained from all the participants upon entry to the ED. ECGs were interpreted by a cardiologist according to Manchester scoring criteria (14). A predefined questionnaire was filled in order to obtain the patients' characteristics including demographic data, presence of risk factors like smoking, hypertension, diabetes, hypercholesterolemia, obesity (BMI > 30), and prior stroke or MI or peripheral atherosclerotic diseases. Serum troponin level was measured in all the participants.

Heart Risk Score was calculated for each patient. They were followed up until after angiography. Two expert independent cardiologists, who were blinded to the patient's characteristics, calculated their syntax score separately by an online software (www.syntaxscore.com) and the mean value was considered for the following analysis. Syntax score of ≥ 23 was considered as significant occlusive coronary artery disease. Patients who were not candidate of angiography or did not perform angiography due to personal dissent or any other reasons that resulted in inaccessibility of angiogram were omitted from the study. Finally, statistical analyses were done on 100 patients by SPSS software, version 16. Categorical and continuous variables were presented as number (%) and mean \pm SD, respectively. Pearson correlation coefficient, ROC curve, and AUC were measured.

Results

The age range was 20–87 years old with a median of 58.42 ± 12.42 years. Male was the dominant gender (65%) among participants. Baseline characteristics of patients are demonstrated in Table 1. Patients were classified according to the severity of Heart Risk Score into low, moderate, and high with 6%, 62%, and 32% of total patients in each category, respectively. The syntax score in 75% of patients were below 22. The angiography results were also analyzed according to the number of main vessels involved (Table 2).

Table 1
Patients' demographics and baseline characteristics

Variables		Mean ± SD or N (%)
Age		58.42 ± 12.42
< 45		13 (13.0)
≥ 45 and < 64		55 (55.0)
≥ 64		32 (32.0)
Gender	Male	65 (65)
Angiography result	Normal & mild	20 (20)
	SVD	16 (16)
	2VD	27 (27)
	3VD	29 (29)
	SF, MB*	8 (8)
Plan	CABG	23 (23)
	Medical therapy	42 (42)
	PCI MV	10 (10)
	PCI SV	25 (25)
HEART risk score Low		5.76 ± 1.56 (min = 3, max = 9)
Moderate		6 (6)
High		62 (62)
		32 (32)
SYNTAX score		14.82 ± 11.42 (min = 0, max = 44.5)
< 22		75 (75)
≥ 22		25 (25)
Data were presented as mean ± sd or n (%). SVD: single vessel disease, SF: slow flow, MB: muscle bridge, CABG: coronary artery bypass grafting, PCI: percutaneous coronary intervention.		

Figure 1 demonstrates the changes in Heart Risk Score and Syntax score according to the severity of coronary artery disease classified as normal, single vessel disease, two vessel disease, and three vessel disease based on angiography findings. With increasing complexity of the disease, both scores increased, although the Heart Risk Score in patients with 3VD was lower than patients with 2VD.

Table 2
The results of angiography according to Heart Risk Score

Variables		Heart risk score			P-value (trend)	
		Low (n = 6)	Moderate (n = 6)	High (n = 32)		
Angiography result	Normal & mild	4(15.4)	21(80.8)	1(3.8)	< 0.001	
	SVD	2(11.1)	11(61.1)	5(27.8)		
	2VD	0(0)	13(48.1)	14(51.9)		
	3VD	0(0)	17(58.6)	12(41.4)		
SYNTAX score			4.66 ± 6.31	12.35 ± 10.77	21.5 ± 10.1	< 0.001
Data were presented as mean ± sd and number(%) for continues and categorical data, respectively.						

The correlation between Heart Risk Score and Syntax score was found to be 0.493 ($P < 0.001$) (Fig. 2). This significant positive correlation revealed that both indices are changed in association with each other and in the same direction.

ROC curve was used in order to assess the prediction value of Heart Risk Score based on Syntax score. Figure 3 show that at a cut-off point of 6, the sensitivity of Heart Risk Score is 52%, and the specificity is 74.7% for the prediction of extensive coronary artery disease as evidenced by high Syntax score. AUC was statistically significant (67%).

Discussion

This study aimed to evaluate the correlation of Heart Risk score with Syntax score thereby evaluating the ability of Heart Risk Score to predict the existence and severity of coronary artery disease in an Iranian population who were admitted to ED with CP. As far as we know, this is the first time that a study has been done to directly correlate Heart Risk Score with Syntax score. Our study showed that the early diagnosis of patients with complex coronary artery disease is possible by using Heart Risk Score at ED. High Heart Risk Score indicates severe CAD substantiated by a significant positive correlation with Syntax score ($p < 0.001$, $R = 0.493$). Syntax score is an approved scoring system that considers number of lesions, functional importance, and complexity of lesions. This score classifies patients into low (≤ 22), medium (23–32), and high risk (≥ 33) (15). Syntax score is a suitable indicator for early and long-term

clinical outcomes (13, 15, 16). Also, it helps cardiologist to choose the appropriate revascularization modality (17). However, its use is restricted because it is an angiography-based scoring system.

In the present population, coronary angiography was performed in 6 patients who had Heart Risk Score of ≤ 3 . All these patients had normal or nearly normal coronary arteries with respect to atherosclerotic plaque formation (syntax of < 15). We showed that a Heart Risk Score of ≥ 6 identifies coronary artery disease patients with syntax score ≥ 22 with sensitivity, specificity, and negative predictive value of 52%, 74.7%, and 82.3%, respectively. Of all the patients with normal angiography results only one of them had a Heart Risk Score more than 7 which shows that Heart Risk Score can differentiate patients with extensive coronary artery disease from those without extensive coronary artery involvement. There is consistency between our study and prior findings on implementing urgent and detailed interventions in patients with Heart Risk Score of ≥ 7 (7–12). These findings reinforces the need for a valid and reliable tool like Heart Risk Score to reduce unnecessary angiography and consequently increased burden.

Heart Risk Score was initially developed to identify patients who benefited from early discharging. Low Heart Risk Score indicates low-risk patients and is useful for decreasing the duration of hospitalization and relevant costs (1, 18, 19). Heart Risk Score was reported to be a good to excellent indicator for determining risk of MACE in patients with CP at ED (1). In a retrospective study on 29196 patients who were referred to ED because of CP, a Heart Risk Score of 5 was considered for early discharging. They reported that the probability of repeated cardiovascular events in those with a Heart Risk Score of < 5 was only 1.1% (20). Defining an accurate cut-off value is useful in postponing administration of clopidogrel and ticagrelor, ADP-receptor inhibitors, for patients who may undergo CABG after primary examinations.

In a prospective study on 2440 patients with CP in ED, Heart Risk Score of nearly one third of patients was 0–3 with a risk of 1.7% for MACE showing the feasibility of quick discharge without any serious concerns about upcoming adverse events. Also, this strategy saves incurred unnecessary costs. Those with Heart Risk Score of 7–10 constituted 17.5% of the population with 50.1% risk of MACE who were referred for quick coronary intervention (1). Risk of MACE in a population of low-risk (Heart Risk Score of ≤ 3) CP patients was reported to be 0.6% (21, 22). This shows the substantial potential of Heart Risk Score as a reliable tool in reducing cardiac testing.

In some studies, the association of other risk score systems like GRACE and TIMI were evaluated with regard to Syntax score (23–25). TIMI and GRACE are among scoring systems that were developed for risk stratification of ACS patients in CCU (1). Sometime clinicians use these scoring systems for CP patients in ED which includes an undifferentiated population, despite the fact that they are not tailored for this purpose (26–29). Heart Risk Score is superior to TIMI and GRACE in predicting risk of cardiovascular events for all-cause CP patients in ED. It helps care providers to choose appropriate treatment. Screening of 1748 patients presenting with CP at ED revealed that the ability of Heart Risk Score to identify low-risk individuals as well as prediction of MACE was higher than GRACE and TIMI (11). Also, GRACE score calculation needs a computer which limits its use. In contrary, Heart Risk Score, which could be calculated from admission data typically within 1 h, is specifically designed for patients with CP in ED.

The strongest scoring system should identify maximum number of true low- risk patients along with low-risk patients who are at risk of developing MACE. Available clinical data and computer-independent calculation of Heart Risk Score make it a valuable tool for early evaluation of patients with CP admitted to ED with respect to prognosis, clinical outcome, and applying therapeutic choice (1). Our Study further added evidence for the utility of this score by incorporating Syntax score and showing the correlation of Heart Risk Score with Syntax score.

Limitations Of Study

The main limitation is the low number of patients with low Heart Risk Score who underwent coronary angiography. Another study with longer duration to include more of such patients could be especially useful. Also despite the fact that Heart Risk Score increased with Syntax score but the Heart Risk Score of patients with 3VD involvement was lower than patients with 2VD, but because of the low number of cases we could not analyze the reason for this unexpected finding.

Conclusion

There is a direct and positive correlation between Heart risk Score and Syntax score showing the higher the Heart Risk Score the more extensive the involvement of coronary arteries in the process of atherosclerosis.

Declarations

Ethics approval and consent to participate: This study was conducted in accordance to Helsinki declaration. We also received approval by the Research Ethics Committee of Shiraz University of Medical Sciences. All the patients signed an informed consent.

Consent for publication: Not applicable

Availability of data and material: The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Competing interests: The authors declare that they have no competing interests.

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Authors' contributions: FD, AZ, PI, and HBD contributed substantially in design and conducting the study. FD, AZ, PI, MB, and, HBD acquired data. FD, IRJ, and HBD had roles in data interpretation. All authors read and approved the final manuscript

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Figures

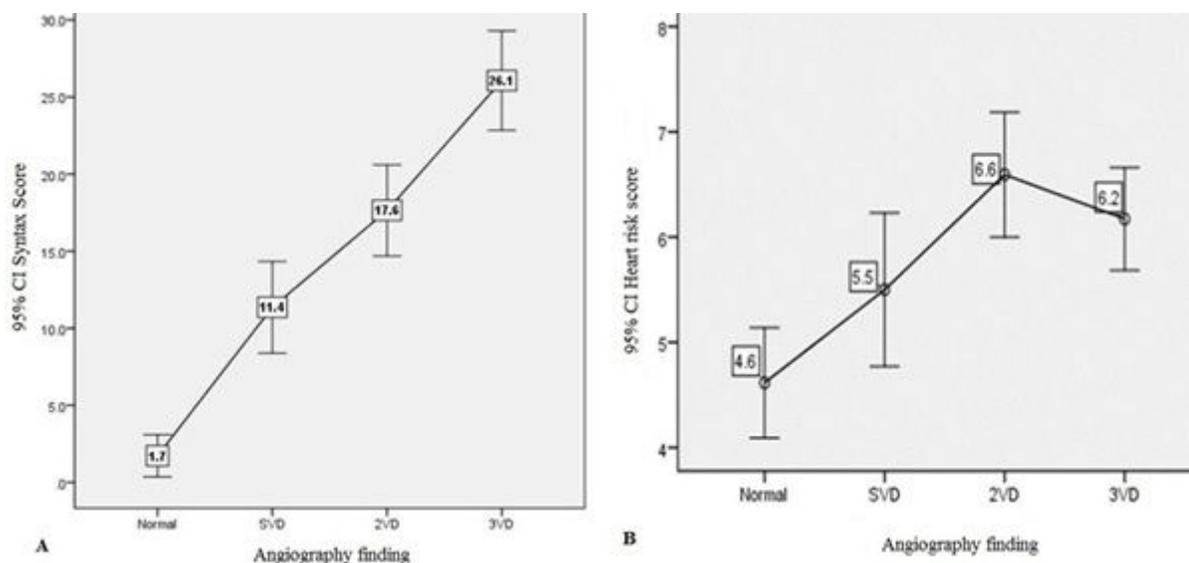


Figure 1

Mean (95% CI) of the Heart Risk Score and Syntax score according to angiography result. Table 2 shows the results of angiography according to Heart Risk Score. As seen of the patients without obstructive coronary artery disease only one of them was in high risk category according to Heart Risk Score and of the 6 patients in the low risk category of the score none of them had extensive coronary artery occlusion classified as 2 or 3VD.

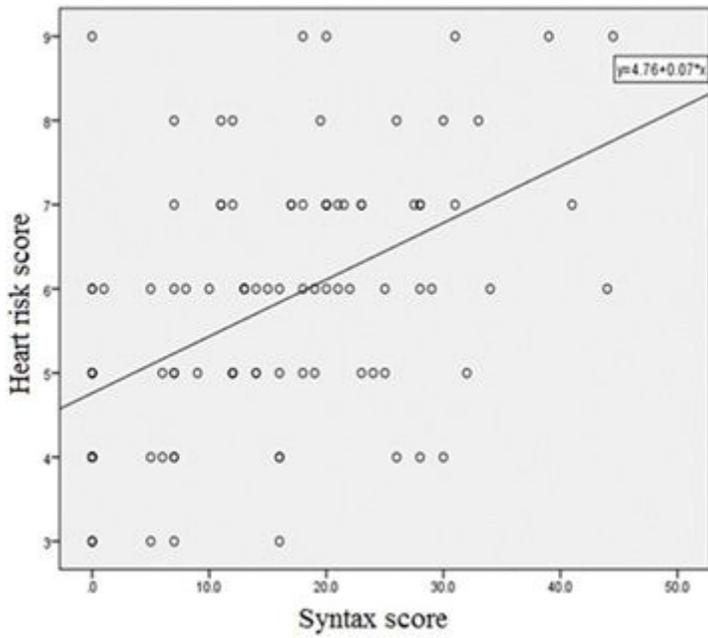


Figure 2

Correlation line between Heart Risk Score and Syntax score.

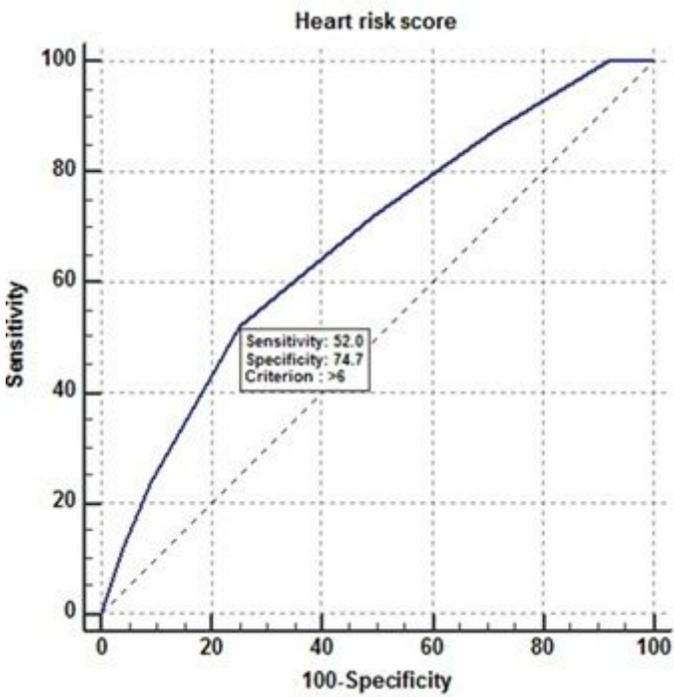


Figure 3

ROC curve analysis for Heart Risk Score.