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Significance of CHA2DS2-VASc-Hs score in the prediction of adverse in-hospital outcomes in patients with Non-St segment elevation myocardial infarction

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Abstract
Background: (NSTEMI) cases have higher chances of cardiac as well as non-cardiac comorbidities than STEMI patients. The aim of this work was aimed at assessing the CHA2DS2-VASc-HS score's impact on predicting negative hospital-based consequences among cases having NSTEMI.
Methods: Our prospective cohort study involved 100 cases, both sexes, having NSTEMI present with acute coronary syndrome (ACS)-like symptoms as well as an increased Troponin but no ST-segment elevation abnormalities consistent with STEMI on the electrocardiogram (ECG). The adverse in-hospital outcomes were heart failure, recurrent ischemia, major arrhythmias, cardiogenic shock, and death.
Results: A statistically significant variation was documented between absent as well as present (adverse in-hospital outcomes) regarding CHDA2S2VASC-HS score (P=0.019). The ideal cut off point of CHDA2S2VASC- HS score for Adverse in-hospital outcome's prediction was found ≥ 4.0 with sensitivity (83.3%), specificity (56.82%), positive predictive value (20.8%), negative predictive value (96.2%) as well as a total accuracy (68.0%).
Conclusion: CHA2DS2-VASc-HS scores could be utilized while predicting the unfavorable clinical events' probability, during hospital stay among NSTEMI cases such as: HF, recurrent ischemia, major arrhythmias, cardiogenic shock and death. NSTEMI cases having a CHA2DS2-VASc-HS score equal or above four were associated with exaggerated negative hospital-based consequences.

Keywords: CHA2DS2-VASc-HS, adverse in-hospital outcomes, non-ST segment elevation myocardial infarction, prognosis

Introduction

Every year, cardiovascular disorders attribute to almost seventeen million fatalities throughout the world. More than a third of annual deaths can be attributed to it. It's possible that as many as 80% of them live in low- and middle-income nations. By 2030, it's expected that this number will rise to 23,6 million. In 2010, coronary artery disease (CAD) was responsible for seven million fatalities globally, a 35% increase from 1990 [1].

Silent ischemia, stable angina pectoris, non-ST segment elevation myocardial infarction (NSTEMI), ST segment elevation myocardial infarction (STEMI), HF, and sudden cardiac death are all clinical presentations of CAD [2].

As the population ages and illnesses like diabetes grow more prevalent, the NSTE-ACS incidence is rising at the expense of STEMI [3].

The prognosis for patients with NSTEMI varies according to several criteria, including the coronary stenosis' severity, ventricular dysfunction, as well as cases' overall health [4].

Individuals having NSTEMI develop higher chances for cardiac and non-cardiac comorbidities than others having STEMI [5]. The hospital-based death rates for NSTE-ACS are between 3 to 5%, while they exhibit 7% for STEMI [6].

Utilizing the CHADS2 as well as CHA2DS2-VASc scores allows to assess the cardiac thromboembolism associated risks among cases, thus guiding the direct antithrombotic therapy's usage for non-valvular atrial fibrillation [7].

The CHADS2 as well as CHA2DS2-VASc scores, both widely utilized within clinical practice, involve CAD risk factors.

These scores have been shown to be predictive of mortality risk among those having stable CAD, (ACS) [5], coronary artery bypass graft (CABG) [7] recipients, and after cerebrovascular stroke [8].
The aim of this work was aimed at assessing the CHA2DS2-VASc-HS score's impact on predicting negative hospital-based consequences among cases having NSTEMI.

Patients and Methods

Our prospective cohort study involved 100 cases, both sexes, diagnosed with NSTEMI present with ACS-like symptoms and an increased Troponin but no ST-segment elevation abnormalities consistent with (STEMI) on the electrocardiogram. This research was done from April 2020 to September 2021 following the Ethical Committee Tanta University Hospitals' approval, Tanta, Egypt. All participants were asked to fill an informed consent.
Exclusion criteria were STEMI, negative cardiac enzymes, congenital anomalies, previous coronary artery stent insertion and previous CABG.
All patients were subjected to: history taking [history of hypertension, (DM), heart failure (HF), (CHF), transluminal angioplasty (TLA) or stroke and vascular disease], clinical examination, twelve lead surface ECG on presentation[using ECG did not rule out ACS as well as NSTEMI, which may be indicated by findings, involving transient ST elevation, ST depression, or new T wave inversions [9] and laboratory investigations [complete blood count (CBC), creatinine, urea, sodium, potassium, and cardiac enzymes (CK-MB, Troponin)].

Signs of CHF: Based on the widely recognised Framingham Diagnostic Criteria, the HF diagnosis needs either two major criteria or one major criterion along with two minor criteria. This approach is very sensitive for detecting HF but lacks diagnostic specificity [10].

Major Criteria: acute pulmonary edema, cardiomegaly, palpable enlargement of neck veins, orthopnea or paroxysmal nocturnal dyspnea, symptoms of pulmonary rales, the Third Heart sound (S3 Gallop), the treatment-induced weight reduction of >_ 4.5 kg or r in 5 days, hepatojugular reflux, the presence of a central venous pressure higher than 16 centimetres of water and cardiomegaly in imaging.

Minor criteria: Ascites, or swelling, of the ankles, breathing difficulties during exercise, hepatomegaly, cough especially at night (nocturnal), tachycardia (HR more than 120 beats per minute), pleural effusion and there was a 33% drop from the highest recorded vital capacity.

Conventional transthoracic echocardiographic assessment: Standard echocardiographic views were obtained with all patients when they were lying on their left side (left lateral decubitus) (parasternal long-axis, parasternal short axis view, apical four–chamber, apical five–chamber as well as apical two- chamber views). Recordings as well as computations of various cardiac chambers along with ejection fractions were conducted following the guidelines set by the American Society of Echocardiography [11]. The conventional 2-dimensional as well as M-mode transthoracic views were acquired, and the physiologic ECG signal was shown with the echo pictures and loops. Left ventricular measures included: (LVEDd). Left ventricular end systolic dimension (LVESd). The (LVEF). Thickness of the interventricular septum at the end of diastole (IVSd). Thickness of the posterior wall of the left ventricle at the end of diastole (LVPWd). Peak E-wave velocity was divided by peak e'-wave velocity to get the E/e' ratio [11].

CHA2DS2-VASc-HS

CHF (C), hypertension (HTN) (H), age ≥ seventy-five y (A2), DM (DM) (D), as well as prior strokes or transient ischemic attack (S2), vascular disorders (V), age (A) between 65 and 74, and male (as the sex category), hyperlipidaemia (HL), along with smoking (S) make up the CHA2DS2-VASc-HS nomenclature. The use of males rather than females and the inclusion of both smoking as well as HL as CAD primary risk factors are features of this scoring system [12].

C	Congestive heart failure	1 point
H	Hypertension	1 point
A_2	Age >75 years	2 point
D	Diabetes mellitus	1 point
S_2	Previous stroke or TIA	2 point
V	Vascular disease	1 point
A	Age 65–74 years	1 point
Sc	Sex category, male gender	1 point
H	Hyperlipidemia	1 point
S	Smoker	1 point
Maximum total score=11 points		

Fig 1: Definition of CHA2DS2-VASc-HS score [5, 12]

The adverse in-hospital outcomes

It includes HF, recurrent ischemia, major arrhythmias, cardiogenic shock, and death.

Statistical analysis

Data went through a statistical analysis utilizing SPSS v26 (IBM Inc., Chicago, IL, USA). Quantitative variables were displayed as mean as well as (SD) then compared among the two groups utilizing unpaired Student's t-test. Qualitative variables were displayed as frequency as well as percentage (%) then went through analysis utilizing the Chi-square or Fisher's exact test when appropriate. The cut-off value of the CHA2DS2-VASc-HS score for unfavorable hospital outcomes' prediction was determined using a receiver

operator characteristic curve (ROC curve). A two-tailed P value less than 0.05 was deemed to exhibit a statistical significance.

Results

The mean age was 55.86±14.02 years. There were more males than females in the study population (74% vs. 26%). there were 72 (72.0%) patients with Smoking, 34 (34.0%) Patients with HTN, 20 (20.0%) Patients with DM, 16 (16.0%) patients with MI history, 7 (7.0%) Patients with Peripheral artery disease, 6 (6.0%) Patients with CHF and 2 (2.0%) patients with stroke. The mean weight was 72.45±8.92kg, the mean height was 1.72±0.10m while the mean BMI exhibited 27.88±4.03 Kg / m^2. The mean SBP was 113.90±12.36mmHg. The mean of DBP was 72.20±9.05mmHg. The mean HR was 85.06±10.24 B/min. Table 1.

Table 1: The studied cases' distribution based on demographic data, history taking and vital data

		N= 100
Age (years)		55.86±14.02
Sex	Male	74 (74.0%)
	Female	26 (26.0%)
Weight (Kg)		72.45±8.92
Height (m)		1.72±0.10
BMI (Kg / m^2)		27.88±4.03
Medical history		
Smoking		72(72.0%)
HTN		34(34.0%)
DM		20(20.0%)
MI history		16(16.0%)
PAD		7(7.0%)
CHF		6(6.0%)
Stroke		2(2.0%)
Vital data		
SBP (mmHg)		113.90±12.36
DBP (mmHg)		72.20±9.05
HR (B/min)		85.06±10.24

Data exhibited as mean ± SD or frequency (%). HTN: hypertension, DM: diabetes mellitus, MI: myocardial infarction, PAD: Peripheral artery disease, CHF: Congestive heart failure, BMI: Body Mass Index, SBP: systolic blood pressure, DBP: diastolic blood pressure, HR: heart rate.

The mean RBS exhibited 131.58±50.4 mg/dl. The mean of S. creatinine exhibited 1.17±0.27 mg/dl. The mean total cholesterol exhibited 198.83±23.94 mg/dl, The mean LDL level reached 98.85±21.21 mg/dl. The mean of HDL Level reached 40.30±5.09 mg/dl. The mean TG exhibited 256.96±20.05 mg/dl. The mean HS Troponin was 942.50±605.19 ng/L. The mean of peak troponin 52.58±17.61 ng/ml. The peak CK-MB was 184.69±67.39 IU/L. There were 90 (90.0%) patients with RWMA and 10 (10.0%) patients without RWMA. For the Location of RWMA, there was 64 (64%) patients with anterior RWMA, 44(44%) patients with lateral RWMA, 37(37%) patients with anterior RWMA and 4 (4%) patients with septal RWMA. The mean LV volume MAX was 84.32±26.57. The mean of LV volume MIN was 59.35±21.65. The mean left ventricular ejection fraction was 53.18%±4.39% and the mean of E/e` was 0.72±0.56. Table 2

Table 2: The studied cases' distribution based on laboratory as well as echocardiogram investigations

		No= 100
RBS (mg/dl)		131.58±50.4
Serum creatinine (mg/dl)		1.17±0.27
Total Cholesterol (mg/dl)		198.83±23.94
LDL Level (mg/dl)		98.85±21.21
HDL Level (mg/dl)		40.30±5.09
TG (mg/dl)		256.96±20.05
Peak Troponin (ng/ml)		52.58±17.61
Peak CK-MB (IU/L)		184.69±67.39
HS Troponin (ng/L)		942.50±605.19
Trans-thoracic echocardiography		
RWMA	With	90(90.0%)
	Without	10(10.0%)
Location of RWMA	RWMA anterior	64(64%)
	RWMA lateral	44(44%)
	RWMA posterior	37(37%)
	RWMA septal	4(4%)
LV volume MAX		84.32±26.57
LV volume MIN		59.35±21.65
left ventricular ejection fraction		53.18±4.39
E/e`		0.72±0.56

Data exhibited as mean ± SD. RBS: random blood sugar, LDL: low-density lipoprotein, HDL: high-density lipoprotein, TG: triglycerides, HS: High sensitivity, (%). RWMA: regional wall motion abnormality, TTE: trans-thoracic echocardiograph, LV: left ventricle, HF: Heart failure.

There were 10 (10.0%) patients with HF, 8 (8.0%) patients with recurrent ischemia, 7 (7.0%) patients with cardiogenic shock, 2 (2.0%) patients with significant arrhythmia and 2 (2.0%) patients with death. For the adverse in-hospital outcome there were 88 (88.0%) patients with absent and 12 (12.0%) patients with present. Table 3.

Table 3: The studied cases' distribution based on HF, recurrent ischemia, significant arrhythmia, death, and adverse in-hospital outcome

	N=100
HF	10(10.0%)
Recurrent ischemia	8(8.0%)
Cardiogenic shock	7(7.0%)
Significant arrhythmia	2(2.0%)
Death	2(2.0%)
Present adverse in-hospital outcome	12(12.0%)

Data exhibited as mean ± SD or frequency (%). RWMA: regional wall motion abnormality, TTE: trans-thoracic echocardiograph, LV: left ventricle, HF: Heart failure.

A statistically significant variation was documented between absent as well as present (adverse in-hospital outcomes) regarding CHDA2S2VASC-HS score (P=0.019). Table 4.

Table 4: Comparison between absent as well as present (adverse in-hospital outcomes) regarding CHDA2S2VASC-HS score

	Absent	**Present**	**P**
	N= 88	**N= 12**	
CHDA2S2VASC-HS score	3.03±1.10	3.95±1.73	0.019

Data exhibited as mean ± SD. * significant p value <0.05. CHD: coronary heart disease, HS: highly significant.

The ideal cut off point of CHDA2S2VASC-HS score for Adverse in-hospital outcome's prediction was found ≥ 4.0 in 10 patients, possessing sensitivity (83.3%), specificity (56.82%) as well as accuracy (88.0%) and found < 4 in 2 patients, possessing sensitivity (83.3%), specificity (56.82%) as well as accuracy (88.0%). Table 5 and Figure 1

Table 5: Performance test of CHA2DS2-VASc-HS score in the setting of NSTEMI

CHDA2S2VASC-HS score	**Adverse in-hospital outcomes**		**Sensitivity**	**Specificity**	**Accuracy**
	Present	**Absent**			
High: score ≥ 4	10	40	83.3%	54.5%	88.0%
Low: scored < 4	2	48			

Data are presented as frequency (%). CHD: coronary heart disease, HS: highly significant.

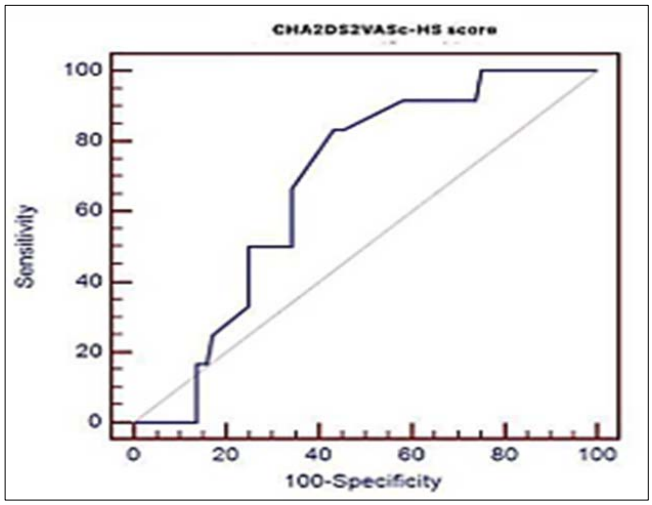

Fig 2: ROC curve (absent and present adverse in-hospital outcomes) group regarding CHDA2S2VASC-HS score

Discussion

ACS encompass a range of conditions, involving unstable angina, NSTEMI, and STEMI [5]. The NSTEMI pathophysiology remains district when compared to STEMI since it arises from coronary stenosis, thus reducing the myocardial blood flow [13].

The overall NSTEMI patients' survival rate was affected by a few variables, including but not limited to HF, AFib, DM, renal dysfunction, as well as advanced aging [14].

Additionally, a greater CHA2DS2-VASc score indicated increased chances for hospital-acquired fatalities in a retrospective investigation [15].

According to lab investigations, the mean RBS were 131.58±50.4 mg/dl. The S. creatinine mean exhibited 1.17±0.27 mg/dl, while the mean total cholesterol exhibited 198.83±23.94 mg/dl, The mean LDL level exhibited 98.85±21.21 mg/dl. The mean HDL Level exhibited 40.30±5.09 mg/dl. The mean TG exhibited 256.96±20.05 mg/dl. The mean HS Troponin was 942.50±605.19 ng/L. The mean of peak troponin 52.58±17.61 ng/ml. The peak CK-MB was 184.69±67.39 IU/L.

Another study confirmed no significant change regarding blood Creatinine or RBS levels among both groups, which agrees with our own findings [16]. Furthermore, they did not find significant variations regarding serum Creatinine as well as RBS among both groups [17].

This supported Mahmoud *et al*. [18] reported that the mean LDL (112.1±30.2) cholesterol within the Lipid profile exhibited a substantial greater value within Group I (CHA2DS2-VASc-HS ≥ 4). Elevated LDL has been deemed to be a primary etiology for (ASCVD). Also, it was documented that LDL cholesterol exhibited 112.1±43 [12].

Based on in-hospital TTE and the regional wall motion abnormalities' existence or absence, 90 patients met the criteria for RWMA, and 10 individuals did not. A total of 64 individuals were diagnosed with anterior RWMA, 44 with lateral RWMA, 37 with posterior RWMA, and 4 with septal RWMA.

Also, Ommen *et al*. [19] addressed, several clinical criteria could result in reducing this correlation's strength. Additionally, the correlation coefficient between E/e′ as well as LVEDP could vary according to the LVEF. It has been addressed that the association between E/e′ as well as LVEDP could be influenced by underlying disorders, as seen by the variations observed between primary and secondary mitral regurgitation. The association between E/e′ as well as τ could exhibit reduced stability in some clinical circumstances, however this is still debatable [20].

According to Cardiogenic shock, HF, Recurrent ischemia, significant arrhythmia, death and adverse in-hospital outcome, there were 10 patients with HF, 8 patients with recurrent ischemia, 7 patients with cardiogenic shock, 2 patients with significant arrhythmia and 2 Deaths. For the Adverse in-hospital outcome there were 88 patients with absent and 12 patients with present negative hospital-based consequences. Aligned with our research, Islam *et al*. [21] conducted a study in the National Institute of Cardiovascular Diseases on NSTEMI cases who develops negative outcomes of this research.

The identical research addressed that about 6.4% developed recurrent ischemia, while five percent exhibited cardiogenic shock along with 1.4% died cases in coparison with 8%, 7% as well as 2% exhibited recurrent ischemia, CS, as well as fatalities regarding this research. According to LV volume MAX, LV volume MIN, left ventricular ejection fraction and E/e', The Mean LV volume MAX Were 84.32±26.57, their LV volume MIN ranged from 36 to 145, The mean LVEF was 53.18%±4.39% and their E/e' ranged from 0.3 to 2.5. Mahmoud *et al*. [18] reported that their study population average LVEF was 54.6±7.1. In CHA2DS2-VASc-HS score ≥ 4 (53.2±6.3) LVEF dropped from CHA2DS2-VASc-HS score < 4 (56.9±7.1) with significant difference.

The ROC showed that the ideal cut off point of CHA2DS2 VASC-HS score for detecting Adverse in-hospital outcome Present was found ≥ 4.0 with sensitivity of 83.3%, specificity of 56.82%, (PPV) of 20.8%, (NPV) of 96.2% as well as total accuracy reached 68.0%.

In a similar study, Tasolar *et al*. [22] found that 23.2% of individuals having cardiac events among those with CHA2DS2-VASc-HS equal or more than four as opposed to 3.8% in score less than four. Measuring risk was accomplished utilizing relative risk (RR). Furthermore, (RR) for developing negative hospital-based consequences was above 1,. Therefore, CHA2DS2-VASc-HS equal or above four represented a risk factor.

ROC analysis addressed an optimal cutoff value for CHA2DS2- VASc-HS score (equal or above four) for cardiac outcomes' prediction, possessing a sensitivity (85.7%) as well as specificity (54.7%). Therefore, the prediction was significantly good with 89% accuracy. A meta-analysis assessing the prognosis of over 20,000 cases having AMI who exhibited PCI addressed, a greater CHA2DS2-VASc score was linked to an increased hospital-based deaths' risks in AMI, which is in line with our findings [23]. According to recent findings, Jeong *et al*. [24] addressed. CHADS2 as well as CHA2DS2-VA scores accurately predict deaths' risk from cardiovascular causes among cases having ACS. Additionally, the CHADS2 score has predictive value within CAD irrespective of the AF existence.

Additionally, a greater CHA2DS2-VASc score was linked to an increased hospital-based deaths' risk among cases having underwent primary percutaneous coronary intervention for STEMI, as determined by the Tabata *et al*. [25] retrospective research.

In Performance test of CHA2DS2-VASc-HS score regarding the NSTEMI setting, the ROC showed that the sensitivity of 83.3%, specificity of 54.5% and total accuracy of 88.0%to detect the best Relation between CHA2DS2-VASc-HS score and Negative hospital-based outcomes. It has been found that among cases with no AFib, the CHADS2 score significantly links to vascular endothelial function as determined through flow-mediated dilation, Chan *et al*. [26] suggested that CHA2DS2-VASc score is useful for MI and HF prediction among cases with no AF. Additional evidence-based research suggests that CHA2DS2-VASc score can forecasr thrombus burden, no-reflow phenomenon, severe negative cardiac outcomes, hospital-based fatalities, as well as prolonged unfavorable clinical consequences among cases having underwent primary PCI [27]. By considering virtually all known risk variables, the CHA2DS2-VASc-HS score provides an accurate assessment regarding cardiovascular disorders' danger [28].

Limitations: A modest sample size as well as a single-centered study.

Conclusions

CHA2DS2-VASc-HS scores could be utilized while predicting the unfavorable clinical events' probability, during hospital stay among NSTEMI cases such as: HF, recurrent ischemia, major arrhythmias, cardiogenic shock and death. NSTEMI cases having a CHA2DS2-VASc-HS score equal or above four were associated with exaggerated negative hospital-based consequences.

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Conflict of Interest: Nil

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