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ORIGINAL ARTICLE

Superiority of CHA2DS2-VASc-HSF Score to CHADS2 and CHA2DS2-VASc Scores for Predicting the Severity of Coronary Artery Disease; a Cross-sectional Study

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ABSTRACT

Background: The degree of coronary artery disease (CAD) can be predicted using a variety of risk score techniques. However, their use in primary care settings is limited because most of them are complicated and call for sophisticated tools. A new risk score called CHA2DS2-VASc-HSF based on the CHA2DS2-VASc score was developed.Aim of the current study is to compare the efficacy of CHA2DS2-VASc-HSFscore versus CHADS2 and CHA2DS2-VASc scores for the prediction of severity of coronary artery disease (CAD)to improve the management of CAD patients.

Methods: This study was carried out in a cross-sectional fashion including 162 patients undergoing elective coronary angiography.Assessment of CHA2DS2-VASc-HSF, CHADS2 and CHA2DS2-VASc scores.Severity of CAD was assessed for all patients using Syntax score.

Results: Syntax score was significantly higher among CHADS2 >1 group, CHA2DS2-VASc >2 group and CHA2DS2-VASc-HSF >4 group (P<0.001). There was a significant positive correlation between Syntax score with both CHA2DS2-VASc (r=0.572, P<0.001) and CHA2DS2-VASc-HSF (r=0.420, P<0.001).Also, on conducting ROC analysis on CHADS2-VASc-HSF score, analysis showed that CHADS2-VASc-HSF score had highest sensitivity (88.39%) and specificity (85.71%) at 4 with area under the curve was (0.907). After applying logistic regression analysis for predictors of high Syntax score (>22); CHA2DS2-VASc-HSF can be used as independent factor for predicting high Syntax score with more significant p value than CHA2DS2-VASc score *(P=0.006 vs P=0.02)*.

Conclusions: Our study concluded that CHA2DS2-VASc-HSF score is superior to CHADS2, CHA2DS2-VASc for prediction of CAD severity.

Keywords: CHADS2; CHA2DS2-VASc-HSF Score; CHA2DS2-VASc Score; CAD.

INTRODUCTION

Coronary artery disease (CAD) has become the leading cause of death and morbidity for people over 35 worldwide. If CAD is not identified and treated promptly, the cost of CAD therapy may increase and the risk of mortality may increase. Choosing the optimal risk factor evaluation for CAD is critical for early detection and treatment. In affluent nations, coronary angiography is performed for diagnosis of CAD as indicated per guidelines[1].There are several established risk factors for CAD. Smoking, diabetes, obesity, high blood pressure, high blood cholesterol, poor diet, and psychological stress and excessive alcohol use are a few of these. In almost half of instances, genetics have a role. The bulk of cases are linked to obesity and smoking. The risk of developing CAD is nearly doubled by smoking only one cigarette a day [2].

Nowadays, a number of metrics are employed to determine the severity of CAD. CHADS2 and CHA2DS2-VASc scores have been shown in every previous study to be useful in predicting the risk of thromboembolism in patients with non-valvular atrial fibrillation. Even determining the severity of CAD may be helped by these scores [3].

The previously mentioned abbreviations refer to; C: Congestive heart failure (or left ventricular systolic dysfunction);H: High blood pressure; A2: 75 years of age or older; D: Diabetes mellitus; S2: History of thromboembolism, TIA, or stroke; V: Vascular illness (such as aortic plaque, myocardial infarction, and peripheral artery disease); A: 65–74 years of age; Sc: Category of sex (feminine sex) [4].

Since these scores resemble the CAD risk factors, primary care providers may easily recall and utilize them. A new score known as CHA2DS2-VASc-HSF has been established to assess the risk of CAD in addition to the current risk factors. These variables include smoking (S), hyperlipidemia (H), and family history of CAD (F) [5].

Aim of the current study is to compare the efficacy of CHA2DS2-VASc-HSF score versus CHADS2 and CHA2DS2-VASc scores for the prediction of severity of CAD.

METHODS

This cross-sectional study was performed at Mahalla cardiac center and Cardiology department at Zagazig University from June 2023 to April 2024. We studied 162 patients undergoing elective coronary angiography including patients > 18 years old from both sexes. While patients who may refuse to participate in the study, patients with congenital cardiac anomalies, patients with history of previous heart surgery, and patients with significant valvular heart disease were excluded.

Each participant signed a consent form. The local research ethical committee authorized the research technique {ZU-IRB≠10741-21-5-2023}.

All participants were subjected to complete history taking including personal, complaint, present, past, and family history. Also general and local cardiological examination was performed. Routine laboratory investigations (CBC, INR, Serum creatinine and viral markers) were sampled and ECG was performed. Risk stratification for all patients was done by assessment of CHA2DS2-VASc-HSF, CHADS2 and CHA2DS2-VASc scores. Echocardiography was done to assess regional wall motion abnormality and ejection fraction (EF) by modified Simpson method. Coronary angiography was performed and calculation of Syntax score for each patient to assess CAD severity.

Statistical analysis:

IBM SPSS 23.0 for Windows, a database software tool, was used to code, input, and analyze the gathered data (SPSS Inc., USA). The means and standard deviations (SD) or medians and interquartile ranges were used to report quantitative data (IQR) using the Shapiro-walk test of normality, whilst qualitative data were expressed as numbers and percentages. P > 0.05 is considered non-significant, whereas P < 0.05 is considered significant at the level of significance value (P value). The Mann-Whitney U test, Pearson's correlation test, and independent t-test were employed. Based on a collection of independent factors, the presence or absence of an outcome was predicted using logistic regression analysis. Receiver operating characteristics analysis (ROC curve) was performed to determine the cut-off value of different risk scores which better predict CAD severity.

RESULTS

The current study included 162 patients coronary artery disease undergoing elective coronary angiography. Their ages ranged from 38 to 75 years with mean ± SD of 57.9 ± 9.77. (82.7%) were males and (17.3%) were females. (40.7%) were non-smokers and (59.3%) were smokers. Baseline data of the studied patients were mentioned in **(Table 1)**.Among the studied patients, CHADS2 score ranged from 0 to 3 with mean ± SD of 1.34 ± 0.83, CHA2DS2-VASc score ranged from 0 to 5 with mean ± SD of 1.85 ± 1.12, CHA2DS2-VASc-HSF score ranged from 0 to 7 with mean ± SD of 3.06 ± 1.45 and Syntax score ranged from 17.6 to 47 with mean ± SD of 34.71 ± 6.09.Syntax score was significantly higher (>33)among CHADS2 ≥1 group, CHA2DS2-VASc ≥2 group and CHA2DS2-VASc-HSF ≥4 group (P<0.001)as shown in **(Table 2)**.There was a significant positive correlation between Syntax score with both CHA2DS2-VASc (r=0.572, P<0.001) and CHA2DS2-VASc-HSF (r=0.420, P<0.001)as shown in **(Table 3)**.**(Table 4)** showed that after applying logistic regression analysis for predictors of high Syntax score (>33); CHA2DS2-VASc-HSF can be used as independent factor for predicting high Syntax score with more significant p value than CHA2DS2-VASc score (P=0.006 vs P=0.02). On conducting ROC analysis (Receiver Operating Characteristics) to determine the optimal cutoff value to detect high Syntax score, analysis showed that CHADS2 score had highest sensitivity (63.23) and specificity (51.53%) at 1 with area under the curve was (0.811). Also, on conducting ROC analysis on CHADS2-VASc score, analysis showed that CHADS2-VASc score had highest sensitivity (85.16%) and specificity (57.14%) at 2 with area under the curve was (0.876). Also, on conducting ROC analysis on CHADS2-VASc-HSF score, analysis showed that CHADS2-VASc-

HSF score had highest sensitivity (88.39%) and specificity (85.71%) at 4 with area under the curve was (0.907) **(Figure 1).**

Table 1: Demographic data and associated comorbidities among studied patients

Variables		**All patients (n=162)**
Age *(years)*	*Mean ± SD*	57.9 ± 9.77
	Range	(38 – 75)
Sex *(N. %)*	Male	134 (82.7%)
	Female	28 (17.3%)
Smoking status *(N. %)*	Non-smoker	66 (40.7%)
	Smoker	96 (59.3%)
Hypertension *(N. %)*	Absent	87 (53.7%)
	Present	75 (46.3%)
Diabetes mellitus *(N. %)*	Absent	102 (63%)
	Present	60 (37%)
Dyslipidemia *(N. %)*	Absent	113 (69.8%)
	Present	49 (30.2%)
Cholesterol *(mg/dl)*	*Median (IQR)*	220 (72.16)
Triglycerides *(mg/dl)*	*Median (IQR)*	125.94 (28.93)
HDL *(mg/dl)*	*Median (IQR)*	46.77 (11.33)
LDL *(mg/dl)*	*Median (IQR)*	123.76 (59.9)
HbA1C *(%)*	*Median (IQR)*	6.93 (1.66)
CHADS2	*Mean ± SD*	1.34 ± 0.83
CHA2DS2-VASc	*Mean ± SD*	1.85 ± 1.12
CHA2DS2-VASc-HSF	*Mean ± SD*	3.06 ± 1.45
Syntax score	*Mean ± SD*	34.71 ± 6.09

HDL*; high density lipoprotein,* ***LDL****; low density lipoprotein,* ***HbA1C****; glycosylated hemoglobin,* ***CHADS2****,* ***CHA2DS2-VASc****,* ***CHA2DS2-VASc-HSF****;* ***C:****Congestive heart failure (or left ventricular systolic dysfunction);* ***H:*** *Hypertension;* ***A2:*** *Age ≥75 years;* ***D:*** *Diabetes Mellitus;* ***S2:*** *Prior Stroke or TIA or thromboembolism;* ***V:*** *Vascular disease (e.g., peripheral artery disease, myocardial infarction, aortic plaque);* ***A:*** *Age 65–74 years;* ***Sc:*** *Sex category (i.e., female sex);* ***IQR:*** *inter-quartile range*

Table 2: Association of syntax score according to different scores among studied patients

	CHADS2<1	**CHADS2≥1**	**P value**
Syntax score	30.4 ± 5.57	35.1 ± 6.03	**<0.001**[2]
	CHA2DS2-VASc<2	**CHA2DS2-VASc≥2**	**P value**
Syntax score	28 ± 5.12	35.1 ± 5.86	**<0.001**[2]
	CHA2DS2-VASc-HSF<4	**CHA2DS2-VASc-HSF≥4**	**P value**
Syntax score	27.4 ± 5.48	35.5± 5.49	**<0.001**[1]

**[1]Student's T test, [2]Mann-Whitney U test, Non-significant: P >0.05, Significant: P ≤0.05*

Table 3: Correlation of Syntax score with different parameters among studied patients

Variable	**Syntax score**	
	r	***P***
CHA2DS2-VASc	0.572	**<0.001**[1]
CHA2DS2-VASc-HSF	0.420	**<0.001**[2]

**[1]Pearson correlation, [2]Spearman rank correlation test, Non-significant: P >0.05, Significant: P ≤0.01, Highly-significant: P ≤0.001*

Table 4: Logistic regression analysis for predictors of high syntax score (>33)

Variables	Univariate analysis		Multivariate analysis	
	Odds (CI 95%)	P value	Odds (CI 95%)	P value
Age	1.35 (1.05 – 1.74)	**0.02**	1.83 (0.98 – 3.45)	0.06
Sex	0.76 (0.36 – 1.63)	0.99	-	-
Smoking	2 (0.43 – 9.25)	0.38	-	-
HbA1C	1.47 (0.75 – 2.89)	0.26	-	-
Total cholesterol	0.99 (0.98 – 1.00)	0.26	-	-
Triglycerides	0.99 (0.97 – 1.02)	0.61	-	-
HDL	0.9 (0.82 – 0.99)	**0.03**	1.089 (0.97 – 1.23)	0.16
LDL	1.01 (1.001 – 1.023)	**0.04**	0.99 (0.98 – 1.01)	0.63
EF (%)	1.04 (0.95 – 1.15)	0.38	-	-
CHADS2	5.5 (1.56 – 19.4)	**0.008**	59.8 (0.06 – 5.6)	0.17
CHA2DS2-VASc	6.8 (1.94 – 23.86)	**0.003**	1.24 (1.03 – 1.52)	**0.02**
CHA2DS2-VASc-HSF	1.81 (1.06 – 3.09)	**0.03**	1.93 (1.01 – 3.7)	**0.006**

HDL*; high density lipoprotein,* ***LDL****; low density lipoprotein,* ***EF****; ejection fraction,* ***CHADS2****,* ***CHA2DS2-VASc****,* ***CHA2DS2-VASc-HSF****;* ***C:****Congestive heart failure (or left ventricular systolic dysfunction);* ***H:*** *Hypertension;* ***A2:*** *Age ≥75 years;* ***D:*** *Diabetes Mellitus;* ***S2:*** *Prior Stroke or TIA or thromboembolism;* ***V:*** *Vascular disease (e.g., peripheral artery disease, myocardial infarction, aortic plaque);* ***A:*** *Age 65–74 years;* ***Sc:*** *Sex category (i.e., female sex)*

Table 5: ROC curve analysis of different scores in detecting high syntax score.

	Value	Sensitivity	Specificity	AUC	P value
(CHADS2) score	**1**	63.23%	51.53%	0.811	**<0.01**
(CHA2DS2-VASc) score	**2**	85.16%	57.14%	0.876	**<0.01**
(CHA2DS2-VASc-HSF) score	**4**	88.39%	85.71%	0.907	**<0.001**

ROC*; Receiver operating characteristics,* ***AUC****; Area Under Curve.*

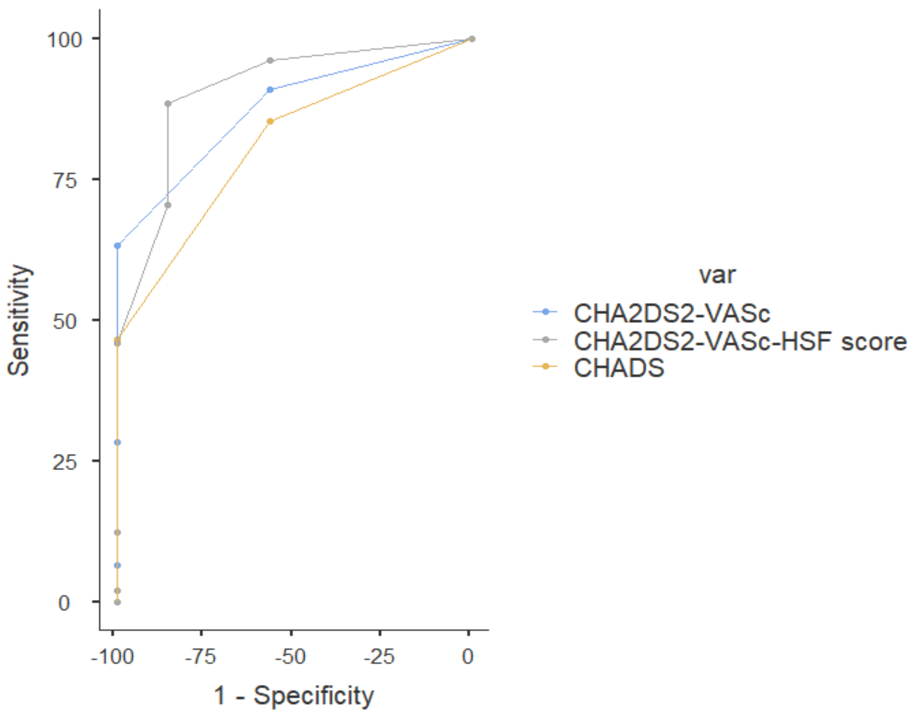

Figure 1: ROC curve analysis of different scores in detecting high syntax score

DISCUSSION

For people 35 years of age and older, coronary artery disease (CAD) remains the primary cause of death and morbidity worldwide. The mortality rate is significantly reduced by early CAD identification and therapy. In the USA, it is expected that one-third of middle-aged people may experience CAD manifestation **[6]**. For the purpose of early prevention and treatment of CAD, determining the most appropriate risk factor evaluation is crucial. Coronary angiography is performed for diagnosis of CAD as indicated per guidelines[7].

Currently, The CHADS2 and CHA2DS2-VASc scores are clinical predictors of cardiac thromboembolism in patients with non-valvular AF and are used to recommend antithrombotic therapy. These scores' risk variables can likewise result in CAD[8].

The study intends to assess the efficacy of CHA2DS2-VASc-HSF score in relation to CHADS2 and CHA2DS2-VASc scores for the prediction of CAD severity in order to improve treatment for CAD patients.

Our study illustrated that regarding associated comorbidities; the most frequently associated comorbidity detected was hypertension which was detected among (46.3%) of the patients, followed by diabetes mellitus which was detected among (37%) of the patients, while the least detected comorbidity was dyslipidemia which was detected among (30.2%) of the patients. Also, a study by Al-Farabi et al.[9]was carried out on 210 coronary angiography patients, who were divided into three groups: normal angiogram, moderate CAD, and severe CAD. They found that age was a differentiating factor, with those in the severe CAD group being older. Similarly, Liu et al.[10]used the Gensini score to examine the relationship between the ACS severity and the CHA2DS2-VASc-HSF score. Additionally, they contrasted the diagnostic worth of different ACS scores. The ACS group's median age was found to be marginally greater than that of the control group. Another study by Cetin et al.[11,12]examined the application of the CHADS2-VASc and CHADS2-VASc scores, as well as the recently developed CHA2DS2-VASc-HS score, to predict CAD severity. The youngest patients were in the group with normal coronary angiograms, followed by the group with mild CAD and the oldest were in the severe CAD group.

Males were more affected than females in Al-Shorbagy et al.'s study[13]. On the other hand, women made up the majority of CAD patients, according to Donal et al.[14], and this is most likely because gender has an impact on cardiac remodeling. In women compared to males, the left ventricle hypertrophies more and dilates less when subjected to pressure overload. The persistence of gender-related variations in cardiac remodeling may be attributed to a decreased rate of cardiac myocyte loss in females and estrogen-mediated transcriptional regulation of genes linked to ventricular hypertrophy [15].

It was also found that the ACS group had significantly higher rates of hypertension, dyslipidemia, T2DM, vascular disease, and a history of ischemic stroke without significant difference regarding family history [16].

In a study done by Liu et al. [16] ACS group had a significantly higher systolic not diastolic blood pressure. In addition, the ACS group's HDL-C levels were noticeably lower than those of the Control group, while its triglyceride levels were much greater. Furthermore, the ACS group had noticeably higher LDL-C values.

Our study showed significantly positive correlation between all the studied risk scores and Syntax score in agreement with Al-Farabi et al. [9] and Liu et al.[16]. In accordance with these findings, Cetin et al. [11]observed that the CHA2DS2-VASc-HSF score was the most effective in predicting CAD severity. According to Al-Farabi et al., the CHA2DS2-VASc-HSF score had a better predictive value for CAD severity than the CHADS2 and CHA2DS2-VASc scores, as evidenced by its greater area under the curve (AUC)[9].

The study conducted by Al-Shorbagy et al. [13]additionally found that, while not triglyceride levels, there was a statistically significant positive association between the CHA2DS2-VASc-HSF score and cholesterol ($P > 0.05$).

According to our research, the Syntax score was significantly higher among (CHADS2 >1) group, (CHA2DS2-VASc >2) group and (CHA2DS2-VASc-HSF >4) group ($P<0.001$). The results showed that the CHA2DS2-VASc score exhibited a significant positive correlation with age, HbA1C, CHADS2, CHADS2-VASc-HSF, and Syntax score ($P<0.001$). Conversely, the ejection fraction showed a significant negative correlation ($r=-0.329$, $P<0.001$). Regarding the novel risk marker, Age, cholesterol, triglycerides, LDL, HbA1C, CHADS2, and syntax score ($P<0.001$) were all significantly positively correlated with CHADS2-VASc-HSF. Conversely, there was a noteworthy inverse relationship with ejection fraction ($r=-0.403$, $P<0.001$) and HDL ($r=-0.289$, $P<0.001$).

Abd-Alkhaleq et al.[6]revealed that the CHADS2 and CHA2DS2-VASc scores had a strong correlation with severe CAD in logistic regression models. Consistent with these findings, another study by Al-Farabi et al.[9]identified CHADS2, CHA2DS2-VASc, and CHA2DS2-VASc-HSF scores as significant predictors for severe CAD assessed by SYNTAX score.

When Liu et al.[16]using logistic regression models to examine the risk factors associated with ACS and discovered that, in comparison to the control group, the ACS group had significantly higher scores for CHADS2, CHA2DS2-VASc, and CHA2DS2-VASc-HSF. An independent risk factor for ACS was shown to be an elevated CHA2DS2-VASc-HSF score, suggesting that this factor might predict the severity of ACS. Al-Shorbagy et al.[13]discovered that, in individuals with non-ST segment elevation myocardial infarction, the CHA2DS2-VASc-HSF score had a stronger connection with the Syntax Score than the CHADS2 and CHA2DS2-VASc scores (NSTEMI).

CHA2DS2-VASc-HSF can be used as an independent factor for predicting high Syntax score with a more significant p value than CHA2DS2-VASc score after using logistic regression analysis for predictors of high Syntax score (>22) (P=0.006 vs P=0.02).

Modi et al. [17]reported that the old scoring systems have similar drawbacks regarding difficulty to use in daily practice, variability with race and that they were studied only for short-term prognosis.

The CHA2DS2-VASc-HSF score, which takes smoking, hyperlipidemia, and family history into account, was developed in 2019 by Ciftci et al. [18]It was demonstrated to be a reliable indicator of severe CAD. On the other hand, in univariate analysis, the CHA2DS2-VASc score was solely associated with severe CAD; in multivariate analysis, it did not independently predict it.

The transition from CHADS2 to CHA2DS2-VASc and further refinement into CHA2DS2-VASc-HSF demonstrated improved predictive power for severe CAD assessed by SYNTAX score, suggesting that the addition of these factors enhances the prediction of CAD risk [19].

CONCLUSIONS

According to the results of our investigation, the CHA2DS2-VASc-HSF score is a better predictor of CAD severity than CHADS2 and CHA2DS2-VASc. It is also simple to use in day-to-day activities.

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Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interest.

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Citation

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