Original Research Article

CHA_2DS_2-VASc-HSF Score as a Predictor of Severity of Coronary Artery Disease in Patients Undergoing Coronary Angiography

Abstract:

Background: Cardiovascular atherosclerosis, particularly coronary artery disease (CAD), represents the main reason for death prematurely over the world. Risk stratification and prevention by risk factor modification are crucial aspects of CAD therapy. The CHADS2 and CHA2DS2-VASc scores are effective in determining the risk of thrombosis in non-valvular atrial fibrillation (AF). The current research aimed to determine the CHA_2 DS_2-VASc-HSF score as a predictor for CAD severity in CAD patients after coronary angiography.

Methods: This cross-sectional study was assessed on 100 patients who attended the coronary care unit and underwent coronary angiography. They were categorised into three groups: Group I: Low syntax scores (2-13), Group II: Intermediate syntax score (14-20), and Group III: High syntax score (21-40).

Results: Our study showed that the SYNTAX score revealed a statistically significant relation with patient's age, gender, and presentation. Regarding the medical history of the studied participant in relation to SYNTAX score, most patients reported a history of HTN, DM, Dyslipidemia, CHF, and previous history of vascular disease showed intermediate and high SYNTAX score in comparison to those with normal blood pressure, glucose level, lipid profile, no CHF history and those no previous history. SYNTAX score showed significant relation with ejection fraction and CHA2 DS2-VASc-

HSF score of the patient. Significant low ejection fraction in high SYNTAX score patients compared to low SYNTAX score patients. Significant high average of CHA2 DS2-VASc-HSF score among those with high and intermediate SYNTAX score compared to those with low SYNTAX score.

Conclusions: CHA2DS2-VASc-HSF should be constituted as the ideal scoring scheme for predicting the severity of CAD. Risk scoring systems may be effective as predictors due to their simplicity and easy employment by physicians in ordinary practice without incurring additional costs.

Keywords: CHA2DS2-VASc-HSF score, coronary artery disease, coronary angiography.

Introduction

Coronary artery disease (CAD) remains the most common reason of death worldwide[1], smoking, hyperlipidemia, hypertension, and diabetes mellitus (DM) are the majority of established risk factors for CAD that could be reduced through lifestyle changes and medication use [2]. However, prospective risk stratification is critical for estimating initial hospital outcomes, determining patient prognosis, and guiding clinical and therapy decisions [3]. Current risk stratification guidelines suggest using the thrombolysis in myocardial infarction (TIMI) risk score or the Global Registry for Acute Coronary Events (GRACE) [4].

The syntax score (SS), an angiographic measure for classifying the complication of CAD, is estimated based on the coronary anatomy and lesion characteristics [5]. Clinical investigations have demonstrated that SS is an important prognostic factor in CAD and affords critical evidence for revascularization strategy selection [6].

The CHA_2DS_2 and CHA_2DS_2-VASc scores (C for congestive heart failure, H for hypertension, A_2 for age more than 75 years, D for diabetes mellitus, S_2 for the previous stroke, V for vascular disease, A for age from 65 years to 74 years, Sc for female sex) traditionally have been used to stratify individuals with atrial fibrillation for embolic risk. The most recognized risk factors in stroke and severe cardiac events are age, diabetes, and heart failure [7, 8]. The CHADS scores are extensively employed in clinical practice and incorporate comparable risk factors for CAD progress [9]. Recently, Cetin et al., 2014 [10] reported that the CHADS2 and CHA2DS2-VASc scores, in addition to the recently improved CHA2DS2-VASc-HS scores, could predict the CAD severity in patients undergoing diagnostic coronary angiography. The factors comprising the newly developed CHA2 DS2-VASc-HSF score

are known to promote atherosclerosis and are linked with CAD severity [2, 11]. However, information about the use of the CHA_2 DS_2-VASc-HSF score to predict CAD severity is still limited [12, 13].

Patients and Methods

This cross-sectional study comprised 100 patients attended to the coronary care unit at Tanta university hospitals from May 2020 to November 2020 for coronary angiography. After approval of the health committee in the department of cardiology Tanta university hospital, written and verbal informed consent was obtained from each candidate after explanation. Patient's data Were presented in code numbers for the reason of privacy and confidentiality.

According to their syntax score, the patients were distributed to three groups: group I: low syntax scores (2-13), group Il: intermediate syntax score (14-20), and group Ill: high syntax score (21-40). The inclusion criteria: patients undergoing coronary angiography either elective or primary intervention. The exclusion criteria: patients were excluded if they have one of the parameters that may affect our results: Stage 4-5 chronic renal failure, patients with acute inflammation, severe trauma, liver failure, neoplasm, hematological disorders, and patients who underwent coronary artery bypass graft surgery.

All patients underwent: a detailed history was with an emphasis on demographic parameters such as age, gender, and weight. A complete medical and cardiac history, including cardiovascular disease risk factors: Smoking history: patients were classified into smokers (current smokers) and ex-smokers (former smokers) who stopped smoking for one year or more [14](Ritchie et al., 2015b, Ritchie et al., 2015a)[15], Hypertension is diagnosed and/or treated with drugs, a healthy diet, and/or exercise. Hypertension was

described when the systolic blood pressure was more than 140 mmHg and/or a diastolic blood pressure equal to or higher than 90 mmHg [16], diabetes Mellitus: DM was diagnosed on basis of the history of diabetes treated medically or non-medically or on basis listed by [17, 18] ADA [19] as:-Fasting blood sugar126 mg% or 2 hours postprandial blood sugar ≥ 200 mg%, dyslipidemia and family history of ischemic heart disease or sudden cardiac death. Physical Examination: A thorough clinical examination is performed, which includes: Pulse and blood pressure- Neck veins - Lower limb edema - Chest and abdominal investigations- Cardiac examination (inspection, palpation, and auscultation)- Killip classification [20]: Class 1 There are no rales and no third heart sound. Class 2 Rales in <1⁄2 lung field or the presence of a third heart sound. Class 3 Rales in >1⁄2 lung field–pulmonary edema. Class 4 Cardiogenic shock–determined clinically). [21]

Electrocardiography: On admission, an ECG was performed at a paper speed of 25mm/s and amplification of 10mm/mv. The ECG changes depicted were either: greater than 1 mm ST-segment elevation in two anatomically contiguous leads, ST-segment depression T wave inversion, Pathological Q waves, and normal ECG (no ST deviation).

Transthoracic Echo Doppler study: Detailed transthoracic echocardiography was performed on all patients using GE Vivid 9.

The conventional echocardiography was implemented by a qualified echocardiographer in collaboration with the American Society of Echocardiography's (ASE) and European Association of Echocardiography's (EAE) recommendations. The mean of three measurements was used in the analysis [22]. The patient was asked to breathe quietly and lie in the left lateral posture during the echocardiography.

Left ventricular dimensions: From the parasternal long-axis view, we assessed the linear measurement of LV at the level of mitral valve tip or immediately below it perpendicular line taken left parasternal long-axis view that view Internal dimensions were calculated by (2DE) guided M-mode approach [14, 23].

These measurements included the following: Inter-ventricular septum thickness (IVST)- left ventricular posterior wall thickness (LVPWT)- LV end-diastolic diameter (LVEDD)- LV end-systolic diameter (LVESD)- LV ejection fraction (EF) by M-Mode calculated through this equation: EF= (EDV – ESV) /(EDV)* 100.

To assess LV filling, the pulsed-wave (PW) Doppler in the apical 4-chamber view was performed to obtain mitral inflow velocities [24].

Laboratory investigations include a Kidney Function test using Beckman Coulter AU840 biochemical analyzer. All measurements were performed for all patients in a single hospital-based laboratory, and laboratory staff was unaware of the protocol or serum samples. complete blood cell count using Sysmex S. F3000 automated analyzer, Random blood sugar level, and lipid profile: This included total cholesterol, LDL, HDL, and triglycerides using Beckman Coulter AU840 biochemical analyzer.

$CHA_2DS_2VASCHSF$ Score Calculation. Table 1

Table 1: CHA2DSVASCHSF score components

C	**CONGESTIVE HEART FAILURE**	**1 POINT**
H	HYPERTENSION	1 POINT
A_2	AG E>75 YEARS	2 POINTS
D	DIABETES MELLITUS	1 POINT
S_2	PREVIOUS STROKE or TIA	2 POINTS
V	VASCULAR DISEASE	1 POINT
A	AGE: 65-74 YEARS	1 POINT
Sc	SEX CATEGORY(MALE)	1 POINT
H	HYPERLIPIDEMIA	1 POINT
S	SMOKER	1 POINT
F	FAMILY HISTORY	1 POINT

Coronary intervention: Invasive coronary angiography was done. Left and right guiding catheters are introduced into the right femoral artery via the sheath (trans-femoral approach). Assessment of lesions in 2 orthogonal views. Syntax score calculation: The syntax score is the summation of the points provided to each lesion discovered in the coronary tree with a diameter narrowing greater than 50% in arteries larger than 1.5mm in diameter. The AHA classifies the coronary tree as sixteen segments.

Each segment is assigned a score of 1 or 2 depending on the existence of the disease and then weighted according to a chart, ranging from 3.5 for the proximal left anterior descending artery (LAD) to 5.0 for the left main, and 0.5 for minor branches. In the case of total occlusion, the following points will be added: (age greater than 3 months or unknown, a blunt stump, a bridging collateral image, and a side branch >1.5 diameters) all deserve one point. Three points are awarded for a single diseased segment, four points for two diseased segments, five points for three diseased segments, and six points for four diseased segments.

One point is assigned to bifurcation lesions of types A, B, and C; two points are assigned to lesions of types D, E, F, and G; and one point is

assigned to lesions of an angulation more than 70 degrees. Aorto-ostial lesions are also worth one point, significant vascular tortuosity deserves two points, lesion length longer than 20 mm deserves one point, heavy calcification deserves two points, the thrombus is worth one point, and widespread disease or involvement of a minor vessel is worth one point per segment. Several lesions separated by less than three reference vessel diameters are considered a single lesion. These are considered independent lesions if they are separated by more than three-vessel diameters.

Statistical analysis

The present study was statistically presented and analysed utilising the mean, standard deviation, unpaired student t-test, Paired t-test, Logistic Regression, and chi-square tests by (IBM SPSS Statistics for Windows, Version 24.0. Armonk, NY: IBM Corp.).

Results:

Demographic data for all participants. Table 2

Table 2: Demographic data and presentation and medical history of the study participants.

		Total (n=100)	
		N	**%**
Age	Min – Max	42 – 80	
	Mean ± SD	58.69 ± 11.78	
Gender	Male	80	80.0
	Female	20	20.0
Presentation	ACS	56	56.0
	Elective	44	44.0
Medical and family history	Smoking	66	66.0
	HTN	64	64.0

	DM	54	54.0
	CHF	37	37.0
	Previous vascular disease	18	18.0
	Previous stroke	10	10.0
	Dyslipidemia	76	76.0
	Family history of CAD	12	12.0

Investigation of the study participants. Table 3

Table 3: Investigation of the study participants

		Total (n=100)
Urea	Min – Max	22 – 81
	Mean ± SD	34.4 ± 15.76
Creatinine	Min – Max	0.7 – 1.6
	Mean ± SD	0.96 ± 0.16
LDL	Min – Max	70 – 244
	Mean ± SD	121.95 ± 42.63
Ejection fraction	Min – Max	25 – 76
	Mean ± SD	53.35 ± 10.49

CHA2DS2-VASC-HSF score and SYNTAX score of the study participants. Table 4

Table 4: CHA2DS2-VASC-HSF score and SYNTAX score of the study participants

		Total (n=100)	
		N	**%**
CHA2DS2-VASC-HSF score	Min – Max	1 – 11	
	Mean ± SD	5.03 ± 2.21	
SYNTAX score	Low	31	31.0

	Intermediate	46	46.0
	High	23	23.0
	Min – Max	6 – 40	
	Mean ± SD	17.01 ± 8.5	

Relation between SYNTAX score and characteristics of the studied participants. Table 5

Table 5: Relation between SYNTAX score and characteristics of the studied participants

	SYNTAX category						**Test of significance (P-value)**
	Low (n= 31)		Intermediate (n= 46)		High (n= 23)		
Age (years)							ANOVA = 15.799 (P<0.01)
Min-Max	47 – 80		42 – 67		45 – 79		
Mean ± SD	60.35 ± 12.1		53.09 ± 9.4		67.65 ± 9.52		
Presentation	N	%	N	%	N	%	X^2 = 27.893 (P< 0.01)
ACS (n= 56)	7	12.5	38	67.9	11	19.6	
Elective (n= 44)	24	54.5	8	18.2	12	27.3	
Gender	N	%	N	%	N	%	X^2 = 8.363 (P= 0.015)
Female (n= 20)	11	55.0	4	20.0	5	25.0	
Male (n= 80)	20	25.0	42	52.5	18	22.5	
Smoking	N	%	N	%	N	%	X^2 = 2.676 (P= 0.262)
No (n= 34)	10	29.4	19	55.9	5	14.7	
Yes (n= 66)	21	31.8	27	40.9	18	27.3	

Regarding Relation between the SYNTAX score and the characteristics of the studied participants, the SYNTAX score showed

significant relation with age, gender, and presentation of the patient. Smoking status showed no significant connection with the SYNTAX score. Table 5

Relation between SYNTAX score and medical history of the studied participants. Table 6

Table 6: Relation between SYNTAX score and medical history of the studied participants

	SYNTAX category						**X^2 (P-value)**
	Low (n= 31)		Intermediate (n= 46)		High (n= 23)		
HTN	N	%	N	%	N	%	16.862 (P< 0.01)
No (n= 36)	15	41.7	21	58.3	0	0.0	
Yes (n= 64)	16	25.0	25	39.1	23	35.9	
DM							20.727 (P< 0.01)
No (n= 46)	22	47.8	22	47.8	2	4.4	
Yes (n= 54)	9	16.7	24	44.4	21	38.9	
Dyslipidemia							15.007 (P< 0.01)
No (n= 24)	15	62.5	7	29.2	2	8.3	
Yes (n= 76)	16	21.1	39	51.3	21	27.6	
CHF							26.51 (P< 0.01)
No (n= 63)	31	49.2	22	34.9	10	15.9	
Yes (n= 37)	0	0.0	24	64.9	13	35.1	
Previous vascular disease							13.83 (P< 0.01)
No (n= 82)	31	37.8	37	45.1	14	17.1	
Yes (n= 18)	0	0.0	9	50.0	9	50.0	
Previous stroke							12.015

No (n= 90)	27	30.0	46	51.1	17	18.9	(P< 0.01)
Yes (n= 10)	4	40.0	0	0.0	6	60.0	

Regarding the medical history of the studied participant in relation to SYNTAX score, most patients reported a history of HTN, DM, Dyslipidemia, CHF, and previous history of vascular disease showed intermediate and high SYNTAX score in comparison to those with normal blood pressure, glucose level, lipid profile, no CHF history and those no previous history. Table 6

Relation between SYNTAX score and investigation and CHA2 DS2-VASc-HSF score of the studied participants. Table 7

Table 7: Relation between SYNTAX score and investigation and CHA2 DS2-VASc-HSF score of the studied participants

	SYNTAX category			**ANOVA (P-value)**
	Low (n= 31)	Intermediate (n= 46)	High (n= 23)	
Ejection fraction				5.192 (P< 0.01)
Min-Max	45 – 70	35 –76	25 – 66	
Mean ± SD	58.19 ± 7.45	51.22 ± 10.71	51.09 ± 11.72	
LDL				0.685 (P= 0.507)
Min-Max	70 – 244	70 – 160	70 – 240	
Mean ± SD	128.39 ± 48.81	121.22 ± 35.51	114.74 ± 47.28	
CHA2DS2-VASC-HSF				44.011 (P<0.01)
Min-Max	1 – 8	1 – 6	4 – 11	
Mean ± SD	3.55 ± 1.997	4.72 ± 1.24	7.65 ± 1.72	

SYNTAX score showed significant relation with ejection fraction and CHA2DS2-VASC-HSF score of the patient. LDL showed no significant connection with the SYNTAX score. Table 6

Correlation between SYNTAX and CHA2DS2-VASC-HSF. Figure 1

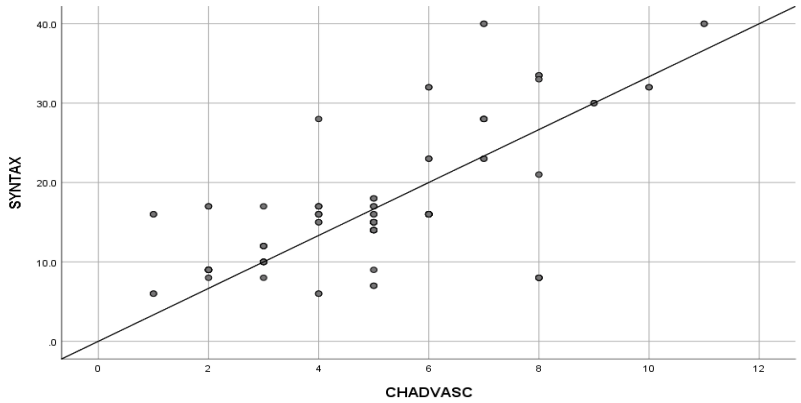

Figure 1: Correlation between SYNTAX and CHA2DS2-VASC-HSF

there is a significant positive moderate correlation between the SYNTAX and CHA2 DS2-VASc-HSF scores. Figure 1

Discussion

In the present world, coronary artery disease (CAD) is the major reason for illness and mortality. Assessment of risk factors, prevention, and treatment of CAD are critical factors of contemporary research [25].

The syntax score (SS), is an angiographic method for measuring the difficulty of CAD. Clinical investigations have demonstrated that SS is prognostic in CAD and gives critical evidence for revascularization strategy selection [26]. The CHADS2-VASc score could be effective for assessing stroke risk in non-valvular atrial fibrillation patients. Collectively, these scores are considered to be effective predictors of thromboembolism risk in non-valvular atrial fibrillation patients [27].

A higher score is an indicator of a higher risk of stroke. The score aids in planning the patient's subsequent management of non-valvular atrial fibrillation, including the use of anticoagulants or antiplatelets. Recently, the CHA2DS2-VASc score has replaced the old score due to its superior stratification in low-risk patients.

A new formulated score CHA2DS2-VASc-HSF was improved to incorporate additional variables such as hyperlipidemia (H), smoking (S), and family history of coronary artery disease (F) to evaluate the CAD risk. These scores were utilised as multivariable evaluation methods in all patients having coronary angiography(CAG) to estimate the CAD severity [28].

This is agreed with Modi et al., 2019 [28] who studied the CHA2DS2-VASc-HSF score as a new predictor of the CAD severity in 2976 patients and classified them into three categories regarding the CAD. 2976 patients

were included, 2204 males and 772 females. Most patients ranged from 51 and 60 years, with hypertension as the most prevalent risk factor, followed by diabetes. A small percentage of patients with previous vascular disease or stroke.

In accordance with Andrianto et al., 2020 [29] who examined a novel CHA2DS2-VASc-HSF score and discovered that it was superior to the CHADS2 and CHA2DS2-VASc scores in predicting the risk of CAD severity. Also, comes in the same line with Andrianto et al., 2020 [29] who exposed that the majority of the 210 participants had an intermediate syntax score.

Cetin et al., 2014 [30] examined the prediction of CAD severity by CHADS2 and CHA2DS2-VASc scores, as well as the new CHA2DS2-VASc-HS Score. They divided 407 consecutive patients into three groups and discovered that (mean age was 61±10 years) and the study included 113 women [28%]. The demographics and characteristics comparison of all groups revealed a significant age difference (p-value 0.013) that comes in agreement with our result.

Our results were against Cetin et al., 2014 [30] and his colleagues who discovered that smoking was most prevalent in group 3 and differed significantly between the groups (p-value = 0.014).

Incompatible with Ciftci et al ., 2019 [31] who evaluated the novel CHA2DS2-VASC-FSH score for predicting the CAD severity in atrial fibrillation and unstable symptoms patients on coronary angiography. The comparison of groups with and without severe CAD revealed that the group with severe CAD had significantly elevated rates of hypertension, diabetes, and dyslipidemia ($p<0.05$).

In agreement with a study conducted in 2020 by Zhang, Ma, & Sun et al., 2020 [32] revealed that the new CHA2DS2-VASc-HSF score accurately predicts the severity of CAD and the no-reflow phenomenon following PCI in STEMI patients, and observed that a history of stroke/TIA and vascular disease was statistically significant with a p-value ($P < 0.001$) for both. Zhang et al., 2020 [32] also found statistically significantly different with a p-value of 0.005 (Significant low average of ejection fraction among those with high coronary lesion score).

While against Al-Shorbagy & Al-Cekelly et al.,2018 [33] who explained a statistically significant negative correlation between the CHA2DS2-VASc-HSF score and EF% ($r = -0.3072$, $P < 0.05$).

Our results are comparable with Uysal OK et al., 2016 [34] who investigated the prediction ability of the new CHA2 DS2-VASc-HSF score for CAD severity in STEMI The study included 454 consecutive STEMI patients (79 % of were male, mean age 57.3 ±12.9 years) who underwent PCI. The patients were classified into three groups depending on the SYNTAX grades: low SYNTAX group (SYNTAX < 14; 151 patients), intermediate SYNTAX group (SYNTAX 14–20; 152 patients), and high SYNTAX group (SYNTAX ≥ 21; 151 patients), After multivariate analysis, it was determined that a high CHA2 DS2-VASc-HSF score was related with a high SYNTAX score, along with age and LVEF.

Also in agreement with Al-Shorbagy & Al-Cekelly et al.,2018 [33] who examined the new CHA2DS2-VASC-HSF score as a predictor for CAD severity in non-STEMI patients and indicated a statistically highly significant positive correlation between the CHA2DS2-VASC-HSF score and the Syntax score.

Also in agreement with Ciftci et al .,2019 [31] who demonstrated that the severity of the coronary lesions was correlated to the CHA2DS2-VASc score ($p<0.05$), CHA2DS2-VASc-FSH score ($p<0.05$), left ventricular hypertrophy ($p<0.05$), history of CAD ($p<0.05$), chronic severe renal disease ($p<0.05$), HT ($p<0.05$) while the CHA2DS2-VASC-FSH score (OR=3.03 [95% CI 1.19–7.63]; $p<0.05$) remained the only significant predictor of severe CAD.

Also, in the line with Modi, R et al.,2017 [35] who showed in a study involving 2976 consecutive coronary angiography patients, the presence of > 50% stenosis in a coronary artery was evaluated as significant CAD. The patients were classified as follows: Group 1 consisted of 804 patients who had normal coronary angiograms. 2172 patients with coronary stenosis were divided into two groups depending on the incidence of CAD with stenosis < 50% or > 50%: 834 patients with mild CAD as group 2 and 1338 patients with severe CAD as group 3. The scores were considerably different amongst the three groups. For all patients, CHADS2, CHA2DS2-VASc, and CHA2DS2-VASc-HSFscores were determined. The values for each grading system increased as the number of diseased vessels increase. The CHA2DS2-VASc-HSF score is considered the most accurate score scheme for predicting the severity of coronary artery disease with a statistically highly significant value (p-value <0.001).

Limitations: A small and brief study. The outcome was obtained from a single centre. Recommendations: Additional trials with a larger sample size are recommended to confirm our findings. This study used data from a single centre. As a result, selection bias may occur. We encourage the inclusion of additional cardiac centers and stratifying the sample according to several

aspects as race and socioeconomic status to confirm the score's validity across a range of demographic characteristics.

Conclusion

CHA2DS2-VASc-HSF should be the optimal scoring scheme for predicting the severity of coronary artery disease. Risk scoring systems may be useful as predictive methods due to their simplicity and easy application by physicians in routine practice without incurring additional costs.

COMPETING INTERESTS DISCLAIMER:

Authors have declared that no competing interests exist. The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

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