

Predictive performance of CHA2DS2-VASc-HS score and Framingham risk scores for coronary disease severity in ischemic heart disease patients with invasive coronary angiography

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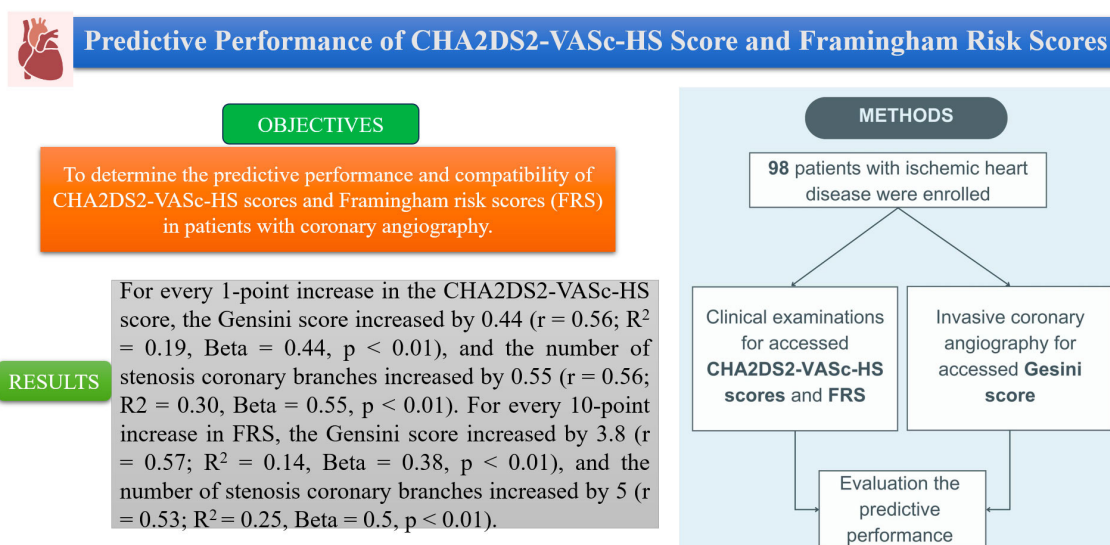
Abstract. – OBJECTIVE: The objective of this study was to determine the predictive performance and compatibility of CHA2DS2-VASc-HS scores and Framingham risk scores (FRS) in patients with coronary angiography.

PATIENTS AND METHODS: This cross-sectional analysis study enrolled 98 patients with ischemic heart disease who were indicated for invasive coronary angiography. Sensitivity and specificity were determined using the cut-off values of the ROC curve. The Gensini score was used to evaluate the correlation.

RESULTS: The cut-off value of the Congestive heart failure, hypertension, age 75 years, diabetes mellitus, stroke, vascular disease, age 65-74 years, sex category – hyperlipidemia, smoking (CHA2DS2-VASc-HS) score was 2.5, and for FRS, it was 14.5. The area under the curve (95% CI) for the

CHA2DS2-VASc-HS score and FRS were 0.76 (0.66, 0.85) and 0.80 (0.71, 0.85), respectively. For every 1-point increase in the CHA2DS2-VASc-HS score, the Gensini score increased by 0.44 ($r = 0.56$; $R^2 = 0.19$, $Beta = 0.44$, $p < 0.01$), and the number of stenosis coronary branches increased by 0.55 ($r = 0.56$; $R^2 = 0.30$, $Beta = 0.55$, $p < 0.01$). For every 10-point increase in FRS, the Gensini score increased by 3.8 ($r = 0.57$; $R^2 = 0.14$, $Beta = 0.38$, $p < 0.01$), and the number of stenosis coronary branches increased by 5 ($r = 0.53$; $R^2 = 0.25$, $Beta = 0.5$, $p < 0.01$).

CONCLUSIONS: Our study demonstrated a high predictive performance of coronary artery injury using the CHA2DS2-VASc-HS score and Framingham risk scores. These scores could be applied in predicting ischemic heart disease in non-symptomatic cases where invasive coronary angiography is not indicated.



Graphical Abstract. Predictive performance of CHA2DS2-VASc-HS score and Framingham risk scores for coronary disease severity in ischemic heart disease patients with invasive coronary angiography.

Key Words:

Scaphoid, Nonunion, ORIF (open reduction and internal fixation), CRIF (closed reduction and internal fixation).

Introduction

In 2019 there were 17.9 million mortalities from cardiovascular diseases (CVDs), accounting for 32% of the total mortality rate worldwide. Of these, more than 75% of deaths occur in low- and middle-income countries¹. Among the top ten common causes of death, coronary artery disease (CAD) was recorded as the leading cause, contributing to 74% of CVD-related deaths². Early screening and prevention of CVDs are crucial¹. While invasive coronary angiography (ICA) remains the gold standard for diagnosing CAD, it has limitations and inconvenience in patients with moderate stenosis and clinical manifestation limitations. Therefore, non-interventional clinical risk stratification models have been employed for early screening of coronary artery injury.

Congestive heart failure, hypertension, age 75 years, diabetes mellitus, stroke, vascular disease, age 65-74 years, sex category-hyperlipidemia, smoking (CHA2DS2-VASc-HS) score has been used to assess ischemic heart disease (IHD) in patients with CAD. The Framingham Risk Score (FRS) is used to predict cardiovascular risk in different age groups and sexes^{3,4}. Cetin et al⁵ examined 407 patients with indications for invasive coronary angiography (ICA). They utilized the CHA2DS2-VASc-HS scale to assess its effectiveness in predicting the severity of coronary heart disease. In conclusion, the findings from Cetin et al's study⁵ suggest that employing the CHA2DS2-VASc-HS scale with a cut-off value of >2 could be valuable in predicting the severity of coronary heart disease in patients undergoing invasive coronary angiography. Günaydim et al⁶ evaluated over 227 patients, and the FRS > 20% for predicting coronary artery damage had AUC = 0.819 (95% CI: 0.757-0.861; $p = 0.881$). According to Katkat et al⁷, patients with higher CHA2DS2-VASc-HS (>3 points) and CHA2DS2-VASc (>2 points) scores exhibited the highest mortality rate in survival analysis. However, it was not comparable to the FRS scale in this regard. However, there have been limited studies using these scores to predict coronary artery injury in the Vietnamese population. To address this gap, our study was conducted to determine the predictive performance and compar-

ability of CHA2DS2-VASc-HS scores and FRS in patients undergoing coronary angiography. Our aim is to increase the accuracy of coronary artery lesion diagnosis using non-interventional clinical risk stratification models.

Patients and Methods

Study Design and Population

The study was a cross-sectional descriptive study conducted with a convenience sample of patients diagnosed with ischemic heart disease and referred for invasive coronary angiography (ICA) at Can Tho University of Medicine and Pharmacy Hospital from February 2019 to May 2020. The study protocol was approved by the Ethics Committee in Biomedical Research of Can Tho University of Medicine and Pharmacy. Prior to their enrollment, all participating patients were provided with an informed consent form and were ensured to receive health benefits from the study. To protect patient privacy, the identities of all participants were kept confidential throughout the study. During the interventions on patients, strict adherence to aseptic techniques and artery anatomical characteristics was maintained. Additionally, the amount of contrast agent used was carefully controlled to prevent the occurrence of acute renal failure, and kidney function was evaluated by measuring plasma creatinine levels after ICA.

Inclusion criteria: patients diagnosed with IHD with 1 of the following criteria⁸: (1) patient clinically presents with angina pectoris suspected of IHD; (2) Patient on electrocardiogram presents with downsloping ST-elevation depression ≥ 0.5 mm in two consecutive precordial leads, or typical necrotic Q waves (≥ 40 milliseconds wide); (3) Echocardiography presents hypodynamics according to coronary subdivision; (4) Positive stress electrocardiogram. The patient was indicated for ICA.

Exclusion criteria: (1) history of coronary intervention, bypass surgery; (2) Patients with acute coronary syndromes; (3) Patients with renal failure; (4) Patients with coagulopathy.

Study Variables

Clinical characteristics were recorded: age, gender, body mass index (BMI) (BMI according to WHO 1998 obesity diagnostic criteria for Asian countries⁹), hypertension [based on diagnostic criteria according to the European Society of Cardiology (ESC) and the European Society of Hyperten-

sion (ESH) 2018¹⁰], smoking (non-smoking when never smoked or quitted ≥ 5 years¹¹); Dyslipidemia [European Society of Cardiology (ESC) and European Atherosclerosis Society (EAS) Guidelines¹²]; Type 2 diabetes mellitus (T2DM) [diagnosis according to American Diabetes Association (ADA) 2020 guideline¹³]. The paraclinical tests were also recorded: electrocardiogram (record pathological waves); echocardiography [ejection Fraction (EF) evaluated by biplane method of disks modified by Simpson method¹⁴]; plasma lipid bilan [triglyceride (TG), low density of lipoprotein cholesterol (LDL-c) values]; ICA was used to determine the degree of stenosis and the number of coronary artery stenosis.

The study population was divided into 3 groups with no coronary artery stenosis on ICA in group 1; stenosis $< 50\%$ of coronary artery diameter in group 2; stenosis $\geq 50\%$ of the arterial diameter in group 3. The FRS assesses the risk of coronary heart disease in 10 years with factors including¹⁵: age, gender, hypertension, T2DM, dyslipidemia, smoking, IHD, and heart failure. The CHA2DS2-VASc-HS Score was used to assess IHD risk in patients with nonvalvular atrial fibrillation, including the following components^{14,16-18}: heart failure, hypertension, age (65-74 or ≥ 75 years), T2DM, IHD, vascular disease, gender, dyslipidemia, smoking. Both these scores were classified into 2 groups: low risk and high risk, based on the cut-off value of the Receiver operating characteristic (ROC) curve.

The severity of coronary artery disease was assessed according to the Gensini scale (GS) based on the degree of narrowing of the coronary lumen diameter during coronary angiography. If the degree of stenosis was 25%, it corresponded to 1 point; 50% corresponded to 2 points; 75% corresponded to 4 points; 90% corresponded to 8 points; 99% corresponded to 16 points, and 100% corresponded to 32 points.

Injury severity = \sum (Number of injuries x the corresponding coefficient).

Data Collection Methods

Enrolled patients received clinical examinations to record clinical characteristics and risk factors. Echocardiography used a 2.5-4 MHz multi-frequency sector probe, and cardiac synchronous evaluation parameters were automatically generated and recorded according to the software of the ultrasound machine. The patient was positioned comfortably and rested while undergoing the procedure. Simpson disk summa-

tion method uses the short-axis cine steady-state free precession images of the left ventricular to obtain left ventricular ejection fraction. During the end-systole and end-diastole phase, short-axis images were obtained. Left ventricular endocardial borders were manually traced on each short-axis image to obtain the ventricular cavity area for each slice¹⁴. ICA (Siemens Axiom Artis, Siemens, Munich, Germany) was performed as follows: (1) Step 1: the imaging catheter and guidewire were cleaned, and the guidewire was inserted into the catheter; (2) Step 2: the contrast line was connected to the manifold, making sure no air existed in the contrast line; (3) Step 3: access was provided to the radial or femoral artery; (4) Step 4: the guidewire and catheter were pushed through the femoral artery to the ascending aorta (First, the guidewire was pushed, followed by the catheter, making sure not to let the guidewire enter the carotid artery); (5) Step 5: the lead was removed and the catheter was successfully preserved. The catheter was connected to the manifold system, and the procedure was performed to ensure no air existed in the catheter and the manifold system. Selective coronary angiography left, and right were performed; (6) Step 6: The coronary artery injury was significant when there were atherosclerotic lesions causing at least $> 70\%$ stenosis of a coronary artery branch or $> 50\%$ stenosis on large branches the left main coronary artery (LM), the left anterior descending artery (LAD), the circumflex artery (LCx), the right coronary artery (RCA).

Bias Controlled Method

All data were collected to ensure information bias control (clear and specific definition of research variables, information on diagnosis and classification according to guidelines, all data collected through a unified medical record form) and selection bias control (following inclusion and exclusions criteria).

Statistical Analysis

Data analysis was processed using SPSS 18.0 software (SPSS Inc., Chicago, IL, USA). Quantitative variables with normal distribution were presented as mean \pm standard deviation (SD), and non-normal distribution variables were described by the maximum, minimum, and interquartile range (IQR). Qualitative variables are presented as frequencies and percentages. Chi-square test (with Fisher's correction) to test the difference between two groups of qualitative

variables. The difference between two normally distributed variables groups was determined by an independent *t*-test, and the Mann-Whitney test for non-normally distributed. If ≥ 3 groups were compared, 1-way ANOVA was used with normal distribution and Kruskal-Wallis' test for non-normal distribution. A *p*-value < 0.05 was statistically significant. For correlation between two quantities, using the correlation coefficient (*r*) with 0.01 to 0.1, the correlation was insignificant; 0.2 to 0.3 there was a low correlation; 0.4 to 0.5 there was the median correlation; 0.6 to 0.7 was highly correlated; 0.8 or higher was a very high correlation. The diagnostic values of the FRS and CHA2DS2-VASc-HS score are determined by sensitivity (Se), specificity (Sp) by ROC curve, and area under the curve (AUC) with AUC > 0.90 was excellent performance; 0.80 to 0.90 was good; 0.70 to 0.80 was fair; 0.60 to 0.70 was poor; 0.50 to 0.60 failed.

Results

Baseline Characteristic of the Study Population

96 patients were enrolled, 27 (28.13%) patients had no stenosis on ICA (Group 1), 30 (31.25%) had stenosis $< 50\%$, and 39 (40.62%) had stenosis $\geq 50\%$. The mean age was high in all 3 groups

Table II. Risk factors and the CHA2DS2-VASc-HS score components.

Variable	n = 96	%
Hypertension (%)	82	85.41
Diabetes (%)	18	18.75
Dyslipidemia (%)	67	69.79
Smoke (%)	47	48.96
Heart failure (%)	11	11.46
Myocardial infarction history (%)	5	5.2
Peripheral artery disease (%)	2	2.08

(58.71 ± 13.13), group 2 (64.67 ± 11.81), group 3 (67.15 ± 10.24), and gradually increased in the stenosis group. Males accounted for a higher proportion (Table I). Hypertension was the highest risk factor for CAD, with 85.41%, followed by dyslipidemia with 69.79%, and smoking with 48.96% (Table II).

Predictive Performance of CHA2DS2-VASc-HS Score and FRS

The ROC curve (Figure 1) showed the predictive performance of the two scores at the stenosis $\geq 50\%$, which were high with AUC $> 70\%$. AUC (95% CI) of CHA2DS2-VASc-HS score and FRS were 0.76 (0.66, 0.85) and 0.80 (0.71, 0.85), respectively. The cut-off value of the

Table I. Baseline characteristics of the study population.

Variable	Group 1, n = 27 58.71 ± 13.13	Group 2, n = 30 64.67 ± 11.81	Group 3, n = 39 67.15 ± 10.24	<i>p</i> 1 ^b	<i>p</i> 2 ^b	<i>p</i> 3 ^b	<i>p</i> ^c
Age (year)	11 (40.7)	8 (26.7)	18 (46.2)	0.13	0.12	0.65	0.02
Female (%)	20.83 ± 0.62	20.61 ± 0.65	20.63 ± 0.54	0.26 ^a	0.66 ^a	0.10 ^a	0.25 ^a
BMI (Kg/m ²)	134.44 ± 11.55	138.67 ± 12.24	142.56 ± 8.80	0.38	0.38	0.99	0.32
SBP (mmHg)	74.44 ± 8.00	78.00 ± 5.51	76.67 ± 5.30	0.46	0.01	0.37	0.01
DBP (mmHg)	70.29 ± 7.49	69.93 ± 8.57	65.15 ± 12.07	0.17	0.51	0.67	0.10 ^d
EF (%)	1.98 ± 1.1	2.12 ± 1.17	1.81 ± 0.83	0.10	0.11	0.17	0.06 ^d
TG (mmol/L)	2.77 ± 0.81	2.70 ± 0.78	2.48 ± 0.86	0.87	0.79	0.44	0.47 ^d
LDL-c (mmol/L)	11.81 ± 4.88	14.27 ± 5.25	18.54 ± 4.25	0.94	0.33	0.51	0.31
FRC	1.89 ± 0.93	2.6 ± 1.10	3.33 ± 1.03	0.13	0.00	0.00	0.00
CHA2DS2-VASc-HS score	0.685 ± 1.48	3.4 ± 2.17	26.29 ± 24.59	0.03	0.00	0.01	0.00
Gensini score	0.68 ± 1.5	3.4 ± 2.2	26.29 ± 24.59	0.00	0.00	0.00	0.00 ^d

Group 1: No stenosis, Group 2: Stenosis $< 50\%$, Group 3: Stenosis $\geq 50\%$, *p*: group 1 vs. group 2 vs. group 3, *p*1: group 1 vs. group 2, *p*2: group 1 vs. group 3, *p*3: group 2 vs. group 3, ^a: Chi-squared test, ^b: One simple *t*-test, ^c: One way ANOVA test, ^d: Kruskal-Wallis' test. BMI: Body mass index, SBP: Systolic blood pressure, DBP: Diastolic blood pressure, EF: Ejection Fraction, TG: Triglyceride, LDL-c: Low density of lipoprotein cholesterol, FRC: Framingham risk score, CHA2DS2-VASc-HS: Congestive heart failure, hypertension, age 75 years, diabetes mellitus, stroke, vascular disease, age 65-74 years, sex category – hyperlipidemia, smoking.

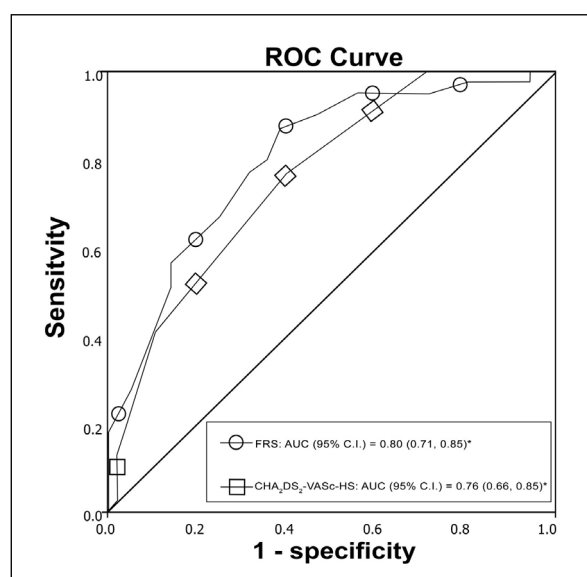


Figure 1. ROC curve of FRS and CHA2DS2-VASc-HS score in predictive coronary artery stenosis (stenosis > 50%). CHA2DS2-VASc-HS: Congestive heart failure, hypertension, age 75 years, diabetes mellitus, stroke, vascular disease, age 65-74 years, sex category – hyperlipidemia, smoking. FRS: Framingham risk score; AUC: area under the curve, CI: Confidence interval, *: $p < 0.001$.

CHA2DS2-VASc-HS score was 2.5, and the FRS was 14.5.

Correlation Between CHA2DS2-VASc-HS Score and FRS with ICA Variables

A significant difference between the CHA2DS2-VASc-HS score and FRS was observed within coronary artery injury branches number. The CHA2DS2-VASc-HS score increased from 2.28 ± 0.88 in 1 branch to 3.69 ± 1.03 in 3 branches ($p < 0.001$). The FRS also increased from 11.87 ± 5.32 to 19.85 ± 3.99 ($p < 0.001$) (Table III), with a standardized coefficient-

ts beta of 0.55 for the CHA2DS2-VASc-HS score and 0.5 for the FRS.

There was a correlation between the Gensini score and both the CHA2DS2-VASc-HS and FRS scores, with a strong correlation coefficient ($r > 0.5$, $p < 0.001$) (see Table IV).

Discussion

Baseline Characteristics of the Study Population

There was no significant difference in age between the groups, where the mean age was relatively high (Table I). The studies by Cetin et al⁵, Yidirim et al¹⁹, Modi et al²⁰, Shi et al²¹, Vyas et al²², Roopali et al²³, Günaydin et al⁶ all have a population of high age (> 60 years old) and the majority were males (> 50%) which is similar to our findings. CAD risk factors recorded that hypertension and dyslipidemia were predominated, which is similar to other studies^{5,19,20,24}.

The CHA2DS2-VASc-HS score, FRS, and GS were all recorded to be higher in the groups with stenosis (groups 2 and 3) and even higher in the groups with severe stenosis (group 3). Other studies showed similar results. In Cetin et al⁵'s study, the CHA2DS2-VASc-HS scores in groups 1, 2, and 3 were: 2.06 ± 0.94 , respectively; 2.49 ± 1.0 ; 3.50 ± 1.2 , and the GS was 0 ± 0 ; 5.6 ± 2.6 ; 40.4 ± 25.7 ; in Yidirim et al¹⁹'s study, the CHA2DS2-VASc-HS score increased by 1.62 ± 0.93 , respectively; 2.01 ± 1.27 ; 3.07 ± 1.32 . In Vyas et al's study²², there was a statistically significant increase in FRS ($p = 0.04$) between the group without CAD compared with the CAD group, 5.22 ± 8.27 and 8.55 ± 8.36 , respectively. Several other studies^{20,21} also reported similar results, indicating that the predicted performance of the score was completely reasonable and had clinical significance.

Table III. Correlation between the CHA2DS2-VASc-HS score and FRS within coronary artery injury branches number.

Score	Coronary artery injury branches number					r	R ²	Beta
	0 branch, n = 23	1 branch, n = 29	2 branches, n = 23	3 branches, n = 13	3 branches + LM n = 8			
CHA2DS2-VASc-HS score								
Mean + SD	1.91 ± 0.95	2.28 ± 0.88	3.13 ± 1.10	3.69 ± 1.03	3.63 ± 1.06	0.56**	0.30**	0.55**
Framingham Risk Score								
Mean + SD	11.87 ± 5.32	13.76 ± 5.39	16.83 ± 4.28	19.85 ± 3.99	19.13 ± 2.80	0.53**	0.25**	0.50**

p: One way ANOVA, r: spearman's correlations, **: Correlation is significant at the 0.01 level (2-tailed), CHA2DS2-VASc-HS: Congestive heart failure, hypertension, age 75 years, diabetes mellitus, stroke, vascular disease, age 65-74 years, sex category – hyperlipidemia, smoking, SD: standard deviation, Beta: Standardized Coefficients Beta, LM: left-main.

Table IV. Correlation between the CHA2DS2-VASc-HS score and FRS within the GS.

Score	Gensini score	r	R2	Beta
CHA2DS2-VASc-HS				
< 2.5 (n = 43), Median ± IQR	2.0 ± 5.0	0.56**	0.19**	0.44**
≥ 2.5 (n = 53), Median ± IQR	6 ± 25.3			
Framingham Risk Score				
< 14.5 (n = 40), Median ± IQR	1.25 ± 2.5	0.57**	0.14**	0.38**
≥ 14.5 (n = 56), Median ± IQR	7.25 ± 23.6			

p: One way ANOVA, *r*: spearman's correlations, **: Correlation is significant at the 0.01 level (2-tailed), CHA2DS2-VASc-HS: Congestive heart failure, hypertension, age 75 years, diabetes mellitus, stroke, vascular disease, age 65-74 years, sex category – hyperlipidemia, smoking, SD: standard deviation, Beta: Standardized Coefficients Beta.

Predictive Performance of CHA2DS2-VASc-HS Score and FRS

Our study revealed a very high predictive performance of the CHA2DS2-VASc-HS score and FRS, with an AUC > 0.7 ($p < 0.01$). These findings are consistent with some previous studies^{5,6,19,22,25} (refer to Table V). Sensitivity was high compared with other studies^{5,6,19,22,25}, with a value of 46.74% for the CHA2DS2-VASc-HS score and from 33.9 to 70.9 for the FRS. The specificity was lower when compared with other studies^{5,6,19,22,25} ranging from 79.9% to 90% common for both scores ($p < 0.01$). The difference was due to the cut-off value of our setup; from the results of the ROC graph, the optimum over the cut-off point (Figure 1) was 2.5 for CHA2DS2-VASc-HS and 14.5 for FRS. The results showed that both of the non-interventional clinical risk stratification models had a high performance when used in predicting coronary artery injury.

Correlation Between CHA2DS2-VASc-HS Score and FRS with ICA Variables

The CHA2DS2-VASc-HS score and FRS were increased and correlated with the number of nar-

rowed arteries (Table III). With the normalization coefficients shown in Table III, an increase of 1 point in CHA2DS2-VASc-HS will increase the number of narrow coronary branches by 0.55 ($p < 0.001$), and an increase of 10 points in FRS will increase the number of narrow coronary branches by 5 branches ($p < 0.001$). The study of Cetin et al⁵ also found the same results, with the CHA2DS2-VASc-HS score increasing from 2.31 ± 1.01 in the non-stenotic group to 4.03 ± 1.14 in the 3-vessel stenosis group ($p < 0.001$). Modi et al²⁰ revealed similar findings, with a statistically significant increase in CHA2DS2-VASc-HSF score ($p < 0.001$).

When evaluating the correlation between non-invasive scores and Gensini, our study showed that in high-risk groups (FRS >14.5 and CHA2DS2-VASc-HS \geq 2.5), the average Gensini value was significantly higher than in the low-risk group. With the standardized coefficients beta shown in Table IV, an increase of 1 point in CHA2DS2-VASc-HS will increase Gensini points by 0.44, and 10 FRS points will increase Gensini points by 3.8 ($p < 0.001$).

Table V. Predictive performance compared with other studies.

Study	Cut-off	n	AUC	95% CI	Se	Sp	<i>p</i>
Cetin et al ⁵ (2014)	CHA2DS2-VASc-HS \geq 2	407	0.76	0.72 - 0.80	–	–	–
Yidirim et al ¹⁹ (2021)	CHA2DS2-VASc-HS > 2	685	0.72	0.68 - 0.75	46.74	83.30	< 0.01
Andrianto et al ²⁵ (2020)	CHA2DS2-VASc-HSF \geq 2.5	210	0.78	0.72 - 0.85	–	–	–
Vyas et al ²² (2022)	FRC > 10%	250	0.64	–	33.9	90.0	0.01
Günaydin et al ⁶ (2016)	FRC > 20%	227	0.72	0.66 - 0.80	70.9	79.9	–
Our study	CHA2DS2-VASc-HS \geq 2.5	96	0.77	0.66 - 0.89	76.9	59.6	< 0.01
	FRS \geq 14.5		0.80	0.63 - 0.85	87.2	61.4	< 0.01

AUC: area under the curve, CHA2DS2-VASc-HS: Congestive heart failure, hypertension, age 75 years, diabetes mellitus, stroke, vascular disease, age 65-74 years, sex category – hyperlipidemia, smoking. FRS: Framingham risk score; AUC: area under the curve, CI: Confidence interval, Se: Sensitivity, Sp: Specificity.

The studies of Cetin et al⁵ and Modi et al²⁰, demonstrated a significant difference in the mean Gensini score between the CHA2DS2-VASc-HS groups with a score < 3 and those with a score of 3 ($p < 0.001$). The correlation coefficient between non-invasive scores and Gensini scores showed a strong correlation. Similar to the study by Andrianto et al²⁵, Spearman's correlation coefficient of CHA2DS2-VASc-HSF score was 0.612 ($p < 0.01$). Several other studies^{6,19} also reported similar results. The results showed that the non-interventional clinical risk stratification models had a high predictive performance in coronary artery injury, which correlated with a strong coefficient of Gensini. Therefore, it could be applied in non-symptom cases where ICA is not indicated.

Limitations and Implementations

Our study compared two non-invasive scores with only the Gensini score, and not with the SYNTAX score to bring higher inference value. However, the comparison with the Gensini score was significant enough to prominently show the predictive performance of the CHA2DS2-VASc-HSF and FRS scores. Our study had a small sample size and was single-center. A multicenter study with a larger sample size or meta-analysis was needed to give a better view of the predictive performance in coronary artery disease. However, our study yielded very positive results in terms of the predictive performance of both scores, which could be the basis for future studies.

Conclusions

Our study found that the predictive performance of coronary artery injury by two non-interventional clinical risk stratification models CHA2DS2-VASc-HS and Framingham risk scores was very high and had a strong correlation coefficient when compared to the invasive score of Gensini in ICA. Therefore, it could be applied in the prediction of ischemic heart disease in non-symptom cases where ICA is not indicated.

Ethics Approval

The study was conducted in accordance with the Declaration of Helsinki and approved by the Ethics Committee of Can Tho University of Medicine and Pharmacy (protocol code 1016/HĐĐD-PCT in 2019).

Acknowledgments

We would like to thank the Rectorate Board of Can Tho University of Medicine and Pharmacy and the Board of Directors of Can Tho University of Medicine and Pharmacy Hospital for creating favorable conditions for this study to be carried out.

Informed Consent

Informed consent was obtained from all relatives of the patients involved in the study.

Data Availability

The datasets generated and/or analyzed during the current study are available from the corresponding author upon reasonable request.

Conflicts of Interest

No conflict of interest.

Funding

None to declare.

Authors' Contributions

Conceptualization; An Viet Tran, Khue Duy Nguyen; Methodology; Toan Hoang Ngo, Khue Duy Nguyen; Software; Bao Lam Thai Tran, Toan Hoang Ngo; formal analysis; Bao Lam Thai Tran, Toan Hoang Ngo; data curation; Bao Lam Thai Tran, Toan Hoang Ngo; writing original draft preparation; Toan Hoang Ngo, An Tuan Huynh, Khue Duy Nguyen; writing review and editing; Toan Hoang Ngo, Bao Lam Thai Tran, An Tuan Huynh, Khue Duy Nguyen, Khuong Duy Nguyen, An Viet Tran. All authors have read and agreed to the published version of the manuscript.

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