

The Predictive Value of CHA2DS2–VASc Score as a Predictor for Left Ventricular Thrombus After Acute Anterior ST-Elevation Myocardial Infarction: A Case-Control Retrospective Analysis

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Research article

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Abstract

Objective: To determine the predictive value of CHA₂DS₂-VASc score as a predictor for left ventricular thrombus after acute anterior ST-elevation myocardial infarction (STEMI).

Methods: We performed a case-control retrospective study of 30 patients with left ventricular thrombus (median age: 60.6 years, range: 38–75 years old; 26 males, 74 females) and 60 age- and sex-matched controls without left ventricular thrombus. Correlation analysis was performed and receiver operating characteristic (ROC) curve was used to evaluate the predictive value of CHA₂DS₂-VASc score in detecting left ventricular thrombus.

Result: Patients with left ventricular thrombus after acute anterior STEMI had higher CHA₂DS₂-VASc scores than controls ($P < 0.001$). Correlation analysis revealed that CHA₂DS₂-VASc scores were positively correlated with left ventricular thrombus after acute anterior STEMI ($r = 0.413$; $P < 0.001$). Multiple logistic regression analyses indicated that CHA₂DS₂-VASc scores ($P = 0.001$) and [heart failure](#) ($P = 0.023$) were risk factors of left ventricular thrombus. The ROC curve of CHA₂DS₂-VASc scores revealed that area under curve was 0.746 (95% confidence interval: 0.638–0.853, $P < 0.001$), sensibility was 86.7%, and specificity was 50.0%.

Conclusion: Patients with [heart failure](#) have a high incidence of left ventricular thrombus after acute anterior STEMI. CHA₂DS₂-VASc scores [contribute to](#) the prediction for left ventricular thrombus after acute anterior STEMI.

Introduction

Despite widespread uptake of primary percutaneous coronary intervention and improved overall periprocedural care, left ventricular thrombus remains a complication of acute anterior ST-elevation myocardial infarction (STEMI) and is associated with a high thromboembolic risk.^{1–3} Previous studies reported that the incidence of left ventricular thrombus in patients presenting with acute anterior STEMI ranges from 2.1–12.3%.^{4,5} Moreover, the detection, prevention, and treatment of this condition is replete with distinct challenges.⁶

Transesophageal echocardiography is considered the gold standard technique for left ventricular thrombus detection.^{7–9} However, it is time-consuming, expensive, and not readily available in all centers, especially when repeated examinations are necessary. Accumulating evidence illustrates the meaningful clinical information of CHA₂DS₂-VASc score in coronary heart and thrombotic diseases (whether diagnostic information or prognostic information). However, data regarding the role of the CHA₂DS₂-VASc score in left ventricular thrombus after acute anterior STEMI are lacking. Thus, we performed this retrospective study to determine the predictive value of the CHA₂DS₂-VASc score as a predictor for left ventricular thrombus after acute anterior STEMI.

Methods

Ethics and consent

This study was approved by the Medical Ethics Committee of Cangzhou Central Hospital (No. 2020-170-01) and conducted in accordance with the Declaration of Helsinki. Informed consent was waived given the retrospective nature of this study. Patient information was anonymized prior to analysis.

Patients

We performed a case-control retrospective study of 30 patients with left ventricular thrombus (median age: 60.6 years, range: 38–75 years old; 26 males, 74 females) and 60 age- and sex-matched controls without left ventricular thrombus. The inclusion criteria were as follows: (1) aged > 18 years old, (2) with acute anterior STEMI diagnosed via coronary angiography and subsequently underwent revascularization, and (3) had complete medical data. Patients with any of the following criteria were excluded: (1) hypertrophic cardiomyopathy, (2) congenital heart disease, (3) organic valvular heart diseases, (4) history of any cardiac surgery and/or cardiac device insertion, and (5) significant associated systemic illness.

Acute left ventricular thrombus was defined as the presence of an echo dense mass seen in the left ventricular cavity on transthoracic echocardiogram within 7 days from acute anterior STEMI.^{10,11} STEMI was defined according to the WHO criteria as revised in 2000.¹² Each patient received standard pharmacologic treatment according to AMI treatment guidelines.¹³

Clinical Data

Clinical baseline characteristics, including age, gender, body mass index, echocardiographic data, and medical history, were collected from medical record and analyzed. CHA₂DS₂-VASc score was calculated with 1 point assigned for a history of congestive heart failure, hypertension, 74 years ≥ age ≥ 65 years, female, diabetes mellitus, and vascular disease and 2 points assigned for age ≥ 75 years and a history of stroke or transient ischemic attacks. The maximum score is 9. The CHA₂DS₂-VASc score was calculated by the researcher without knowledge of the transthoracic echocardiogram result.

Statistical analysis

All statistical analyses were performed by SPSS for Windows version 13.0 (SPSS Inc., Chicago, IL). Two-sample *t* test was used to compare continuous variables with normal distribution and presented as mean ± standard deviation, whereas nonparametric tests were utilized to compare continuous variables with abnormal distribution and presented as median (interquartile range). Chi-squared two-group proportion test was employed to compare categorical data. Correlation analyses using the Spearman method were

conducted to test the relationship between CHA₂DS₂-VASc score and left ventricular thrombus. In univariate logistic analysis, when $P < 0.10$, significant correlation factors were included in a forward stepwise multivariate logistic regression. The predictive value of CHA₂DS₂-VASc scores was evaluated by receiver operating characteristic (ROC) curve analyses, and their specificity and sensitivity in detecting left ventricular thrombus were analyzed. All tests were two-sided, and a P value < 0.05 was considered statistically significant.

Results

Patient characteristics

All patient characteristics are summarized in Table 1. The CHA₂DS₂-VASc scores of the patients ranged from 0 to 6, and the mean score was 1.98. The patients with left ventricular thrombus were characterized by heart failure, stroke, vascular disease, and high CHA₂DS₂-VASc scores.

Table 1
General characteristics of the patients

	Without left ventricular thrombus ($n = 30$)	With left ventricular thrombus ($n = 60$)	P value
Age (years)	63.00 (16.00)	62.50 (14.00)	0.901
Gender (male/female)	4/26	8/52	1.000
hypertension (Yes/no)	27/33	19/11	0.101
Diabetes mellitus (Yes/no)	16/44	8/22	1.000
Heart failure (Yes/no)	8/52	14/16	0.001
Stroke (Yes/no)	3/57	8/22	0.003
Vascular disease (Yes/no)	5/55	7/23	0.048
body mass index (kg/m ²)	25.05 ± 3.04	24.50 ± 3.67	0.453
CHA ₂ DS ₂ -VASc score	1.50 (1.00)	3.00 (2.00)	< 0.001
Data are reported as mean ± standard deviation, median (interquartile range) or numbers.			

Correlation Analysis

Correlation analysis revealed that CHA₂DS₂-VASc scores were related to left ventricular thrombus in patients with this condition ($r = 0.413$; $P < 0.001$).

Multiple logistic regression analyses of factors associated with left ventricular thrombus

Multiple logistic regression analyses indicated that CHA₂DS₂-VASc scores ($P= 0.001$) and heart failure ($P= 0.023$) were significant risk factors of left ventricular thrombus (Table 2). In addition, the incidence of left ventricular thrombus increased with higher CHA₂DS₂-VASc scores (Fig. 1).

Table 2
Multiple logistic regression analyses of factors associated with left ventricular thrombus.

	B coefficient	Standard error	Beta	P value	95% confidence Interval for B
Univariate logistic analysis					
Age	0.000	0.005	0.009	0.933	-0.010–0.011
Gender	0.000	0.148	0.000	1.000	-0.294–0.294
hypertension	0.163	0.099	0.173	0.103	-0.034–0.360
Diabetes mellitus	0.000	0.114	0.000	1.000	-0.226–0.226
Heart failure	0.401	0.109	0.366	< 0.001	0.185–0.617
Stroke	0.224	0.073	0.312	0.003	0.080–0.369
Vascular disease	0.288	0.145	0.208	0.049	0.001–0.576
Body mass index	-0.012	0.015	-0.080	0.453	- 0.042–0.019
Ventricular aneurysm	6.38	0.145	0.425	< 0.001	0.350–0.925
CHA ₂ DS ₂ -VASc score	0.162	0.036	0.428	< 0.001	0.090–0.234
Multivariate logistic analysis					
CHA ₂ DS ₂ -VASc scores	0.128	0.038	0.338	0.001	0.051–0.204
Heart failure	0.259	0.112	0.236	0.023	0.037– 0.481

Roc Curve Analysis For Left Ventricular Thrombus

The ROC curve of CHA₂DS₂-VASc scores showed an area under curve (AUC) of 0.746 (95% confidence interval: 0.638–0.853, $P< 0.001$; Fig. 2), with a sensibility of 86.7%, a specificity of 50.0%, and a cut-off of 1.5, suggesting that the CHA₂DS₂-VASc scores contributed to the prediction for left ventricular thrombus after acute anterior STEMI.

Discussion

This study provided further evidence of the predictive value of CHA₂DS₂-VASc score as a predictor for left ventricular thrombus after acute anterior STEMI. Our results showed that the AUC of CHA₂DS₂-VASc score was 0.746, sensibility was 86.7%, and specificity was 50.0%, suggesting that CHA₂DS₂-VASc score was a predictor for left ventricular thrombus after acute anterior STEMI. Moreover, our results showed patients with heart failure had a high incidence of left ventricular thrombus after acute anterior STEMI.

Although our research showed that CHA₂DS₂-VASc score was related to left ventricular thrombus after acute anterior STEMI, the precise mechanism remains unknown; a study suggested that the possible mechanism is platelet activity. Asher et al.¹⁴ reported that in patients with acute coronary syndrome treated with clopidogrel following PCI, high CHA₂DS₂-VASc scores correlated with high on-treatment platelet reactivity, whereas low scores correlated with optimal platelet reactivity. Another study¹⁵ showed that CHA₂DS₂-VASc score is linearly correlated with residual platelet reactivity ($R = 0.77$; $P < 0.001$). Multivariable analysis demonstrated that CHA₂DS₂-VASc score is an independent predictor of high residual platelet reactivity.

Another finding of the present study was that patients with heart failure had a higher incidence of left ventricular thrombus after acute anterior STEMI. A previous meta-analysis¹⁶ showed that the incidence of left ventricular thrombus in patients with acute anterior STEMI was 6.3%; however, the incidence was 19.2% when only acute anterior STEMI with LVEF < 50% was considered. This observation is pathophysiologically plausible because the larger the areas of damage, the larger the probability of regional wall motion disturbances, or even aneurysm formation, will be, leading to a reduced blood flow, ultimately resulting in thrombus formation.^{17,18}

The present study has several limitations. First, the sample size of this study was relatively small. Second, the findings were restricted to a yellow race cohort and may not be generalized to other ethnic cohorts. Third, although these findings are important, the retrospective nature of this study limits its generalizability. Fourth, the results were influenced by variabilities among intra- and intersonographers, thereby introducing a significant bias and affecting the measured outcomes.

In conclusion, patients with heart failure have a high incidence of left ventricular thrombus after STEMI. CHA₂DS₂-VASc score contribute to the prediction for left ventricular thrombus after acute anterior STEMI. Further clinical studies with a better research design are warranted to evaluate and establish the direct cause and effect relationships between CHA₂DS₂-VASc score and left ventricular thrombus after acute anterior STEMI.

Abbreviations

STEMI; ST-elevation myocardial infarction, ROC = receiver operating characteristic, AUC = area under curve

Declarations

Ethics approval and consent to participate

This study was approved by the Medical Ethics Committee of Cangzhou Central Hospital (No. 2020-170-01) and conducted in accordance with the Declaration of Helsinki. Informed consent was waived given the retrospective nature of this study.

Consent for publication

Not applicable.

Availability of data and materials

The datasets generated and/or analysed during the current study are not publicly available due to privacy or ethical restrictions, but are available from the corresponding author on reasonable request.

Conflict of interest

The authors declare no conflict of interest.

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Author Contributions

NZ and JZ contribute to study design and literature search.

NZ contribute to data collection, interpretation, and analysis.

NZ and JZ contribute to manuscript writing/revisions.

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Figures

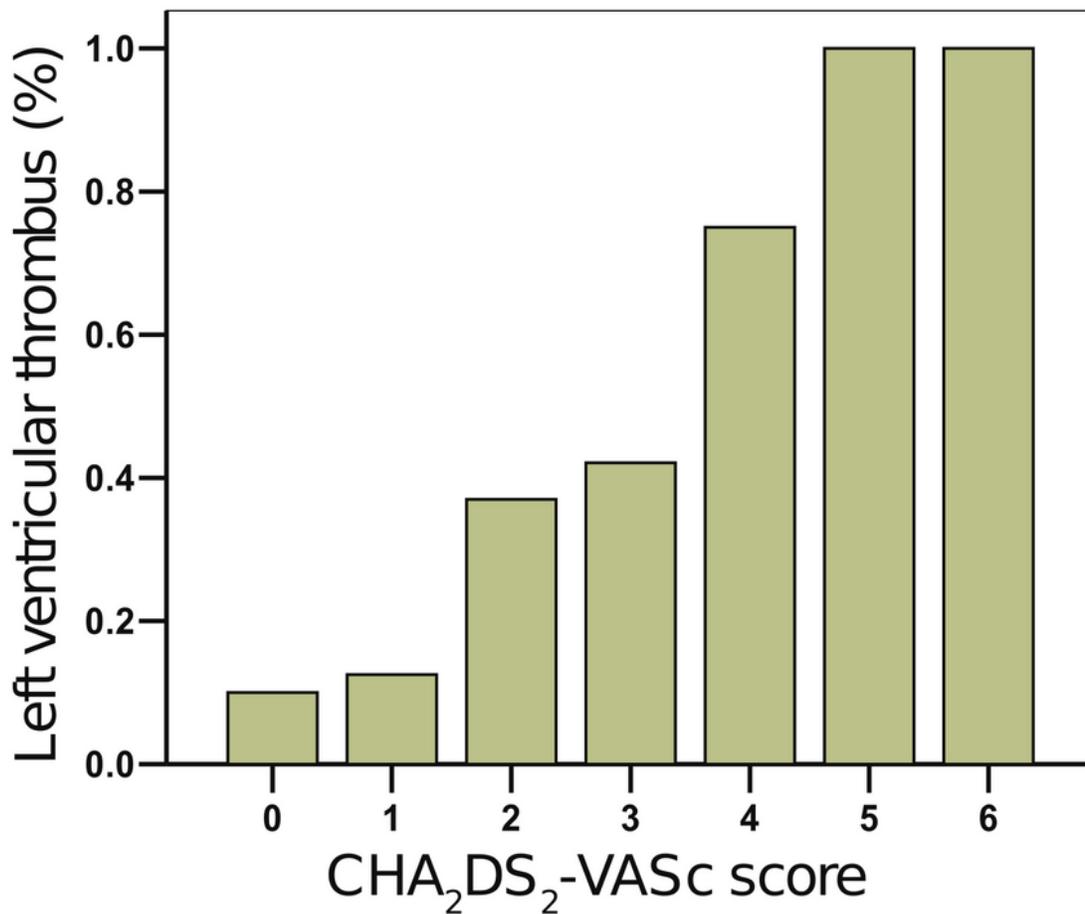


Figure 1

The incidence of left ventricular thrombus according to CHA2DS2-VASc scores

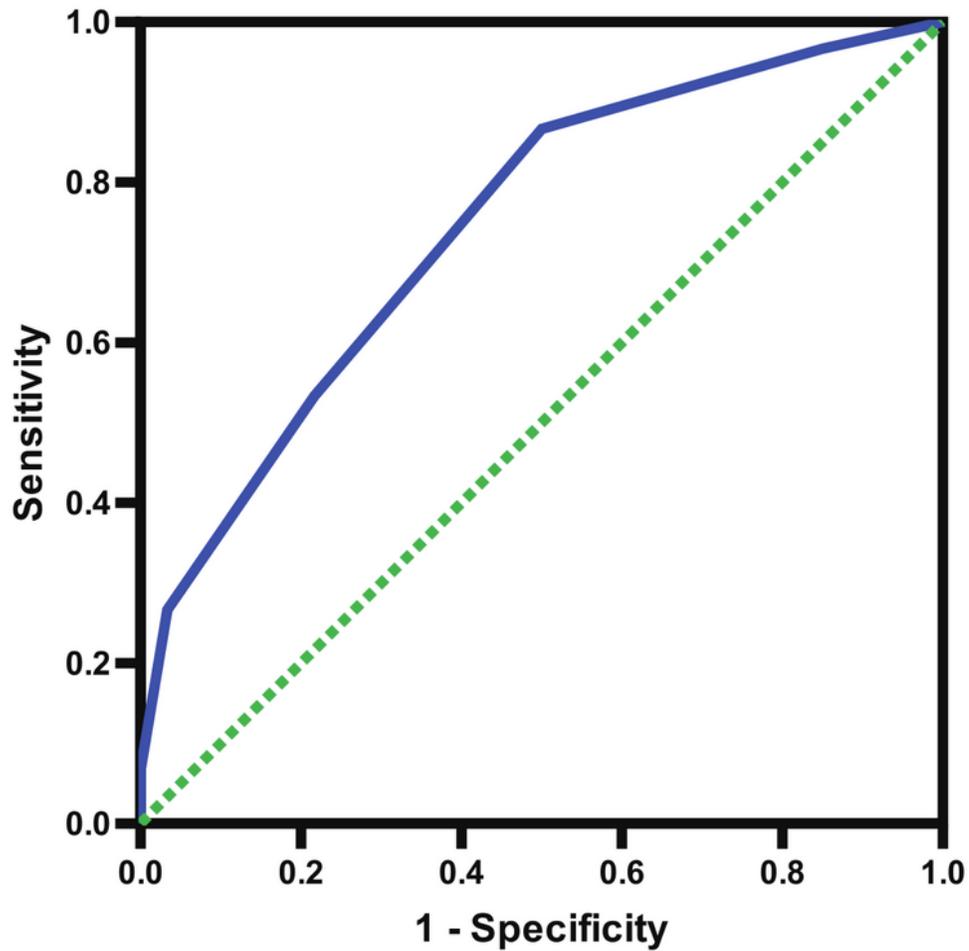


Figure 2

Area under the receiver operating characteristic curve analysis