The Value of the $CHADS_2$ and CHA_2DS_2-VASc Score for Predicting the Prognosis in Lacunar Stroke with or without Atrial Fibrillation Patients

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Background: The $CHADS_2$ and CHA_2DS_2-VASc scoring systems have been proved efficacy to stratify stroke and thromboembolism risk in patients with atrial fibrillation (AF). Whether $CHADS_2$ and CHA_2DS_2-VASc score has predictive value for the prognosis in lacunar stroke (LS) patients remains unclear. *Methods*: A total of 763 consecutive patients with LS (mean age: 66 ± 12 years; 464 male) were enrolled in this study between January 2013 and December 2014. Patients were divided into LS without AF (LS; n = 679) and LS with AF (LS-AF; n = 84) groups. Measures of performance for the risk scores were evaluated at predicting mortality and restroke in LS-AF and LS without AF patients. All patients were evaluated with respect to clinical features and in-hospital clinical results. *Results*: During the mean follow-up period of 20 ± 5.8 months, 29 patients (3.8%) experienced all-cause death, 105 patients (13.8%) experienced recurrence of ischemic stroke. Multivariate analysis revealed that $CHADS_2$ and CHA_2DS_2-VASc score were independently associated with all-cause death (all $P < .05$). On receiver operating characteristic curve analysis, area under the curve (AUC) for CHADS2 score was .942 with a similar accuracy of the CHA2DS2-VASc score (AUC: .908) in predicting mortality in LS-AF patients. Kaplan-Meier curves were conducted according to the cut-off value of CHA_2DS_2-VASc score. When $CHADS_2$ score greater than or equal to 4 point or CHA_2DS_2-VASc score greater than or equal to 5 point, the mortality in LS-AF patients was significantly higher compared with those $CHADS_2$ score less than 4 point or CHA_2DS_2-VASc score less than 5 point. However, after adjusting for clinical covariates, $CHADS_2$ and CHA_2DS_2-VASc score could not predict both mortality and restroke in LS without AF patients. *Conclusions*: The $CHADS_2$ and CHA_2DS_2-VASc score have excellent predictive value for mortality in LS-AF patients but could not predict both mortality and restroke in LS without AF patients.

Key Words: Atrial fibrillation—lacunar stroke—predict—prognosis

Introduction

Atrial fibrillation (AF) is a key risk factor for cardioembolic stroke and is associated with a high mortality and disability rate.[1,2] AF is often associated with large, cortically based infarcts, which have a 30-day mortality rate as high as 24% among patients not taking any antithrombotic therapy.[1] Lacunar stroke (LS) is a small (<2cm) infarction that accounts for approximately 25% of ischemic strokes.[3] In terms of disease progression and prognosis, LS patients have slightly lower rates of stroke recurrence and mortality in the short term (1-2 years) compared to those with non-LS.[4] Several studies have reported higher case fatality and morbidity after an acute ischemic stroke among AF patients compared with

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patients in sinus rhythm.[5,6] Both mortality and recurrence rate of acute ischemic stroke with AF patients are higher than that of ischemic stroke without AF.[7] Risk stratification in ischemic stroke with AF patients of high risk of mortality and recurrence is necessary.

Various clinical scoring systems have been developed for the risk stratification in cardiovascular and stroke diseases. The $CHADS_2$ and CHA_2DS_2-VASc scores are the widely recommended clinical risk prediction tools used to evaluate the risk of thromboembolism, as well as in the decision to use preventive antithrombotic agents in patients with nonvalvular AF (NVAF) because of their simplicity.[8] $CHADS_2$ and CHA_2DS_2-VASc scores have also been reported to have a predictive role for cardiovascular and cerebrovascular outcomes.[9-11] However, there is little information available regarding the predictive value of the $CHADS_2$ and CHA_2DS_2-VASc scores for mortality in LS with or without AF patients.

The aim of this study was to evaluate the value of the $CHADS_2$ and CHA_2DS_2-VASc score for predicting the prognosis in LS with or without AF patients.

Methods

Study Population

This was a retrospective study based on electronic hospital databases of our hospital. Eligible patients diagnosed with LS at Renmin Hospital of Wuhan University between January 2014 and December 2015 were enrolled in this study. The exclusion criteria were as follows: (1) nonischemic stroke (ie, hemorrhagic stroke); (2) non-LS; (3) lost to follow-up. From the baseline clinical characteristics of each patient, the CHADS2 and CHA2DS2-VASc scores were calculated according to the ESC guidelines for the management of AF.[12] The present study was conducted in accordance with the Declaration of Helsinki and was approved by the ethical committee of our hospital.

Electrocardiogram

Twelve-lead ECG (paper speed 25 mm/s; amplitude 1.0 mV/10 mm) was recorded in all patients soon after their admission to the hospital. Heart rate, QRS complex duration, and QT interval were recorded automatically by the ECG machine. The corrected QT (QTc) was adjusted for the RR interval, using the Bazett formula ($QTc = QT/\sqrt{RR}$).

Blood Test

Blood test was performed before discharge from the hospital. The blood test included B-type natriuretic peptide (BNP), MB isoenzyme of creatine kinase (CKMB), troponin I (cTnI), homocysteine (Hcy), uric acid (UA), total glyceride (TG), total cholesterol (Tch), and low-density lipoprotein cholesterol (LDL) levels.

Definitions

The definition of AF was in accordance with 2014 AHA/ACC/HRS guideline for the management of patients with AF.[13] The definition of LS was in accordance with 2018 AHA/ASA guideline.[14] The definition of heart failure was in accordance with 2013 ACCF/AHA guideline for the management of heart failure.[15] Hypertension was defined as a systolic blood pressure greater than or equal to 140 mm Hg, diastolic blood pressure greater than or equal to 90 mm Hg, or treatment with antihypertensive drugs. Diabetes mellitus was considered to be present in patients with diabetes controlled by diet, oral hypoglycemic agents, or insulin, as well as in cases discharged from the hospital with a diagnosis of diabetes mellitus and/or prescription of hypoglycemic agents. In the present study, coronary heart disease included ischemic heart disease that had been diagnosed as acute myocardial infarction (MI), coronary stenosis detected by coronary angiography and treated by percutaneous coronary revascularization, and/or coronary artery bypass grafting, ischemic stroke, hemorrhagic stroke, peripheral artery disease, and history of macrovascular surgery. Hyperlipidemia was defined as the use of lipid-lowering agents, a total serum cholesterol level greater than 240 mg/dL, or a serum triglyceride level greater than 200 mg/dL. LS was classified according to the TOAST system.[16]

Follow-Up and End Points

The subjects were followed up until May 31, 2018. Research coordinators and physicians recorded baseline data of all patients at the time of enrollment, including patient demographics, past medical conditions, and current medication. The primary end point of the study was all-cause death. The causes of death were determined from medical records or by direct communication with patients' general practitioners or families. The secondary end point was unplanned rehospitalization for recurrence of ischemic stroke. The secondary end point was determined from medical records.

Statistical Analysis

Data are expressed as the mean ± SD or percentages. For variables that showed skewed distributions, descriptive statistics are presented as medians with interquartile ranges. Comparisons of continuous variables were performed using the unpaired *t* test. Comparisons of categorical variables were analyzed by the chi-square test. Receiver operating characteristic (ROC) curve analysis was used to identify the value of $CHADS_2$ and CHA_2DS_2-VASc score predictive of prognosis in LS-AF patients. Area under the curve (AUC) is a rough guide for quantifying the discriminatory capacity of a diagnostic test ranked as: excellent (.9-1), good (.8-.89), fair (.7-.79), poor (.6-.69).[17] The Kaplan-Meier method was used to estimate primary and secondary end point-free

survival, and the differences between the curves were compared using the log-rank test. The prognostic value of each factor was first evaluated by univariate Cox proportional hazard regression analysis. The factors that had P values <.05 in the univariate analysis were entered into a multivariate Cox proportional hazards model to identify the independent predictors. Assessing value of $CHADS_2$ and CHA_2DS_2-VASc scores in prediction all cause death using the AUC, whether AUC were statistically significant was analyzed using the Z test. $P < .05$ was considered to be statistically significant. All statistical analyses were performed using SPSS for Windows version 20 (IBM, New York, NY).

Results

Comparison of Clinical and Laboratory Characteristics in the LS Groups with or without AF

A total of 763 LS patients (464 male and 299 female, mean age 66 ± 12 years) were enrolled in this study. Among the 763 LS patients, 679 patients (89%) were without AF and 84 (11%) with AF. Table 1 lists the baseline characteristics of patients. Significant differences were noted between the 2 groups in terms of age, percentage of congestive heart failure, coronary heart diseases and diabetes mellitus, heart rate, and TG. LS-AF patients were older, had a higher percentage of congestive heart failure, coronary heart diseases and diabetes mellitus, faster heart rate, and lower TG (all $P < .05$). Compared with LS without AF group, anticoagulation drugs use in LS-AF group were higher ($P < .05$). No significant differences were found between the 2 groups in regard to percentage of female, hypertension, hyperlipidemia, QRS duration, QTc duration, and serum CKMB, UA, cTnI, BNP, Tch, LDL, Hcy levels, and use of statins and antiplatelets.

No significant differences in the NIH Stroke Scale (NIHSS) score were found between the 2 groups ($P > .05$, Table 1). The $CHADS_2$ score and CHA_2DS_2-VASc score in LS-AF group were significantly higher than LS group ($P < .05$, respectively).

Table 1. *Baseline characteristics*

Variable	Total (n = 763)	LS (n = 679)	LS-AF (n = 84)	*P* Valve
Age, years	66.1 ± 12.2	65.4 ± 12.3	71.4 ± 9.7	<.001
Female, n (%)	299 (39.2)	261 (38.4)	38 (45.2)	.229
Congestive heart failure, n (%)	37 (4.8)	24 (3.5)	13 (15.5)	<.001
Coronary heart diseases, n (%)	134 (17.6)	100 (14.7)	34 (40.5)	<.001
Hypertension, n (%)	492 (64.5)	442 (65.1)	50 (59.5)	.314
Diabetes mellitus, n (%)	171 (22.4)	163 (24.0)	8 (9.5)	.003
Hyperlipidemia, n (%)	130 (17.0)	120 (17.7)	10 (11.9)	.185
ECG data				
Heart rate, beat/min	77.1 ± 21.6	75.2 ± 19.3	95.0 ± 31.7	<.001
QRS duration, ms	97.5 ± 20.8	97.1 ± 18.1	100.7 ± 36.8	.150
QTc	433.5 ± 49.0	433.5 ± 46.7	433.2 ± 66.2	.962
Laboratory data				
BNP, pg/mL	369 (103, 1545)	232 (73, 915)	1733 (681, 3645)	.750
cTnI, ng/mL	.02 (.01, .05)	.02 (.01, .05)	.02 (.01, .10)	.509
CKMB, ng/mL	1.29 (.58, 2.42)	1.09 (.54, 2.25)	1.96 (1.20, 2.71)	.485
UA, mmol/L	351.3 ± 113.2	350.6 ± 112.9	356.8 ± 116.3	.642
Tch, mmol/L	4.1 ± 1.0	4.2 ± 1.0	4.0 ± 1.2	.291
TG, mmol/L	1.5 ± .9	1.6 ± 1.0	1.3 ± .7	.018
LDL, mmol/L	2.3 ± 1.1	2.3 ± 1.4	2.3 ± 1.1	.778
Hcy, ng/mL	16.8 ± 8.9	17.0 ± 9.3	15.4 ± 5.9	.257
Medications use				
Statin, n (%)	555 (72.7)	490 (72.2)	65 (77.4)	.311
antiplatelets, n (%)	366 (48.0)	326 (48.0)	40 (47.6)	.946
Anticoagulation, n (%)	136 (23.3)	101 (14.9)	70 (83.3)	<.001
Baseline NIHSS score	3.0 ± 1.0	2.9 ± .9	3.1 ± 1.0	.110
CHADS2 score	3.2 ± .9	3.2 ± .8	3.4 ± 1.0	.039
CHA2DS2-VASc score	4.1 ± 1.2	4.1 ± 1.2	4.4 ± 1.2	.010
All-cause death, n (%)	29 (3.8)	22 (3.2)	7 (8.3)	.021
Cardiovascular death, n (%)	11 (1.4)	7 (1.0)	4 (3.6)	.007

Abbreviations: AF, atrial fibrillation; BNP, B-type natriuretic peptide; CKMB, creatine kinase MB; cTnI, troponin I; HCY, homocysteine; LDL, low-density lipoprotein cholesterol; LS, lacunar stroke; NIHSS score, NIH Stroke Scale score; QTc, rate-corrected QT; Tch, total cholesterol; TG, total glyceride; UA, uric acid.

Data are presented as n (%), median (interquartile range), or mean ± standard deviation.

Table 2. *Multivariate predictors of primary end event and secondary end event in AIS-AF patients*

Variable	Mortality		Restroke	
	HR (95% CI)	*P* Valve	HR (95% CI)	*P* Valve
Age	1.013 (.884, 1.161)	.850	-	-
History of congestive heart failure	-	-	2.711 (.730, 10.076)	.136
History of coronary heart diseases	-	-	-	-
History of diabetes mellitus	-	-	-	-
Heart rate	-	-	-	-
TG	1.332 (.799, 2.219)	.272	1.332 (.799, 2.219)	.272
CHADS2 score	3.601 (1.314, 9.870)	.013	-	-
CHA_2DS_2-VASc score	2.880 (1.115, 7.440)	.029	1.451 (.917, 2.297)	.112

Abbreviations: CI, confidence interval; HR, hazard ratio; TG, total glyceride.
Parameters with a *P* value < .05 were entered in the multivariate analysis.

Compared with LS without AF group, LS-AF group had higher all-cause death rate (8.3% versus 3.2%, $P < .05$) and cardiovascular death rate (3.6% versus 1.0%, $P < .05$).

Survival Analysis

During the mean follow-up period of 20.0 ± 5.8 months, 29 patients (3.8%) experienced all-cause death. In addition, 105 patients (13.8%) had a recurrence of ischemic stroke, the secondary end point.

Predictors of Prognosis in LS-AF Patients

Table 2 summarizes the factors predicting all-cause death and restroke. Age, TG, $CHADS_2$ score, and CHA_2DS_2-VASc score were identified as significant predictors of all-cause death. Multivariate Cox regression analysis revealed that $CHADS_2$ score (hazard ratio: 3.601, 95% confidence interval [CI]: 1.314-9.870) and CHA_2DS_2-VASc score (hazard ratio: 2.880, 95% CI: 1.115-7.440) were independent predictors of all-cause death in LS-AF patients.

Table 2 also summarizes the factors predicting recurrence of ischemic stroke. History of congestive heart failure, CHA_2DS_2-VASc score were significantly associated with recurrence of ischemic stroke. However, according to multivariate Cox regression analysis, only CHA_2DS_2-VASc score was independent predictor of recurrence of LS in LS-AF patients.

As seen in Figure 1A, both mortality and ischemic stroke recurrence rate continuously increased as the scores became higher. $CHADS_2$ score and CHA_2DS_2-VASc score were independent predictors of all-cause death but not recurrence of ischemic stroke in LS-AF patients. So we utilize ROC curve analysis to find the optimal cut-off value of $CHADS_2$ score and CHA_2DS_2-VASc score to predict the death in LS-AF patients. On ROC curve analysis, the optimal cut-off value of $CHADS_2$ score for predicting death was 4 (AUC .942, 95% CI: .87-.98) with a sensitivity of 82.7% and specificity of 92.3% (Fig 2A). The optimal

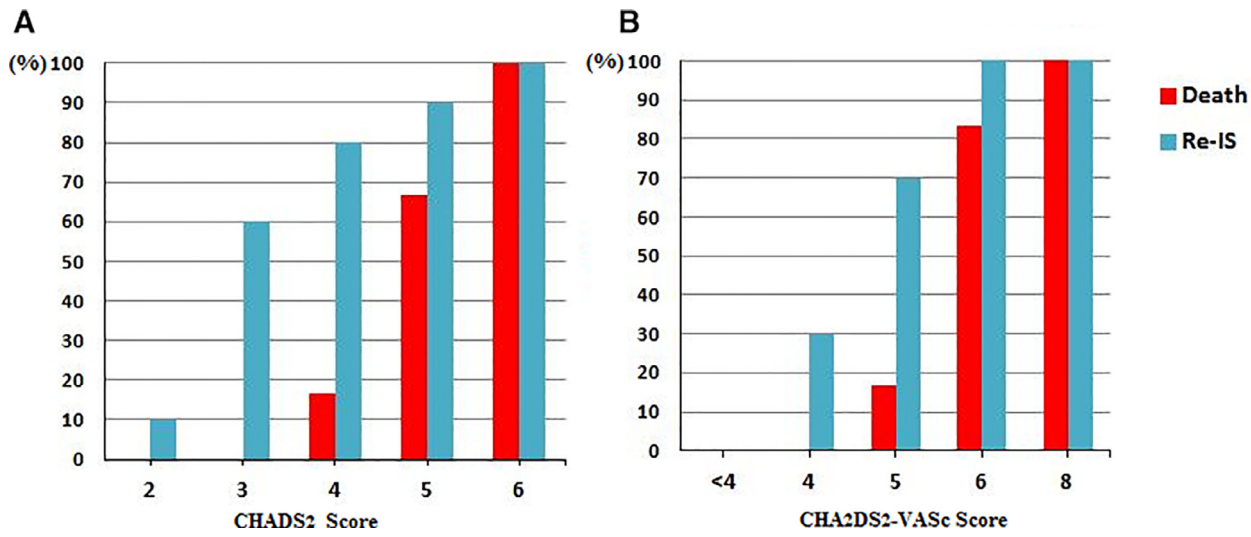

Figure 1. *(A) The relation between mortality, recurrence rate of ischemic stroke (Re-IS), and $CHADS_2$ score in LS-AF patients; (B) the relation between mortality, recurrence rate of stroke (Re-IS), and CHA_2DS_2-VASc score in LS-AF patients.*

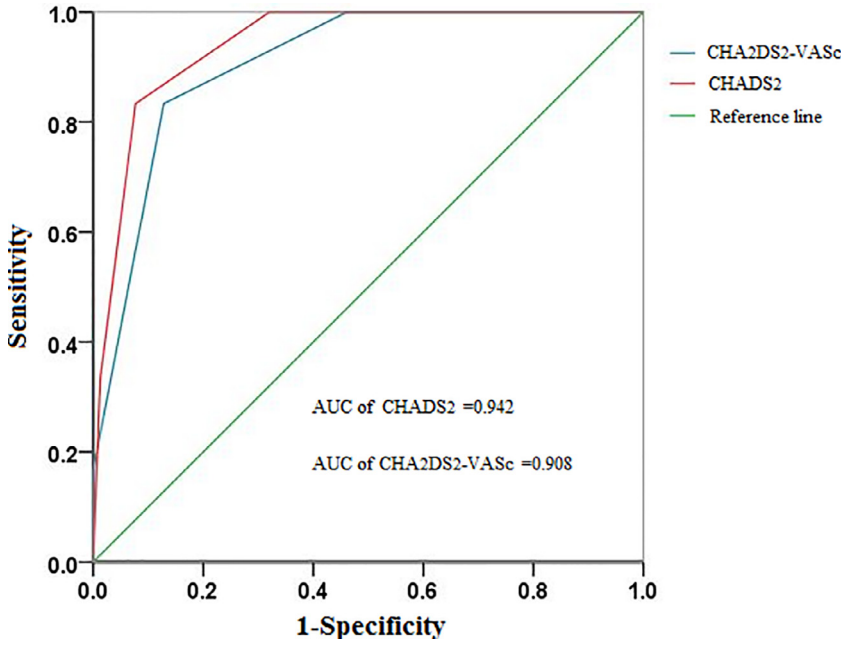

Figure 2. *Receiver operating characteristic curves (ROC) for CHADS2 and CHA2DS2-VASc scores for prediction of all-cause death in LS-AF patients.*

cut-off value of CHA_2DS_2-VASc score for predicting death was 5 (AUC .908, 95% CI: .81-.98) with a sensitivity of 83.3% and specificity of 87.2% (Fig 2B). The difference between the 2 areas under the curves was not significant ($Z = .695$, $P > .05$).

The predictive role of $CHADS_2$ and CHA_2DS_2-VASc score in the prognosis of LS-AF patients were further confirmed when Kaplan-Meier curves were conducted according to the cut-off value of $CHADS_2$ and CHA_2DS_2-VASc score. When $CHADS_2$ score greater than or equal to 4 point, the mortality in LS-AF patients was significantly higher compared with those $CHADS_2$ score less than 4 point (Fig 3A), when CHA_2DS_2-VASc score greater than or equal to 5 point, the mortality in LS-AF patients was significantly higher compared with those CHA_2DS_2-VASc score less than 5 point (Fig 3B). However, CHA_2DS_2-VASc score could not predict the LS recurrence in LS-AF patients, which was consistent with previous results.

Predictors of Prognosis in LS without AF Patients

Table 3 summarizes the results of multivariate Cox analysis of factors predicting all-cause death and recurrence of ischemic stroke. Age and history of coronary heart diseases were significantly associated with all-cause death. Furthermore, history of congestive heart failure, history of coronary heart diseases, and heart rate were significantly predictors of restroke. However, both $CHADS_2$ score and CHA_2DS_2-VASc score were not independent predictors of all-cause death and recurrence of LS in LS without AF patients.

Discussion

In the present study, we investigated the value of the $CHADS_2$ and CHA_2DS_2-VASc score for predicting the prognosis in LS with or without AF patients. The main findings are as follows: (1) the $CHADS_2$ and CHA_2DS_2-VASc score are independent predictors of all-cause death and might be useful for predicting the prognosis in LS-AF patients; (2) the cut-off value of $CHADS_2$ score for predicting death was 4 with a sensitivity of 82.7% and specificity of 92.3%, CHA_2DS_2-VASc score was 5 with a sensitivity of 85.7% and specificity of 73.4%; and (3) when $CHADS_2$ score greater than or equal to 4 point, the mortality in LS-AF patients was significantly higher compared with those $CHADS_2$ score less than 4 point, when CHA_2DS_2-VASc score greater than or equal to 5 point, the mortality in LS-AF patients was significantly higher compared with those CHA_2DS_2-VASc score less than 5 point; (4) both $CHADS_2$ score and CHA_2DS_2-VASc score were not independent predictors of all-cause death and restroke in LS without AF patients.

AF and ischemic stroke are closely associated. AF is found in 6%-20% of patients with IS.[18,19] In the present study, AF is found in 11% of the LS patients. LS patients with AF have more risk factors and comorbidities than patients without AF. The data from our study demonstrate that the prevalence of congestive heart failure, coronary heart diseases, and diabetes mellitus among LS patients with AF was higher than patients without AF. Increased risk of stroke and other thromboembolic events related to stroke complicating AF results in significant

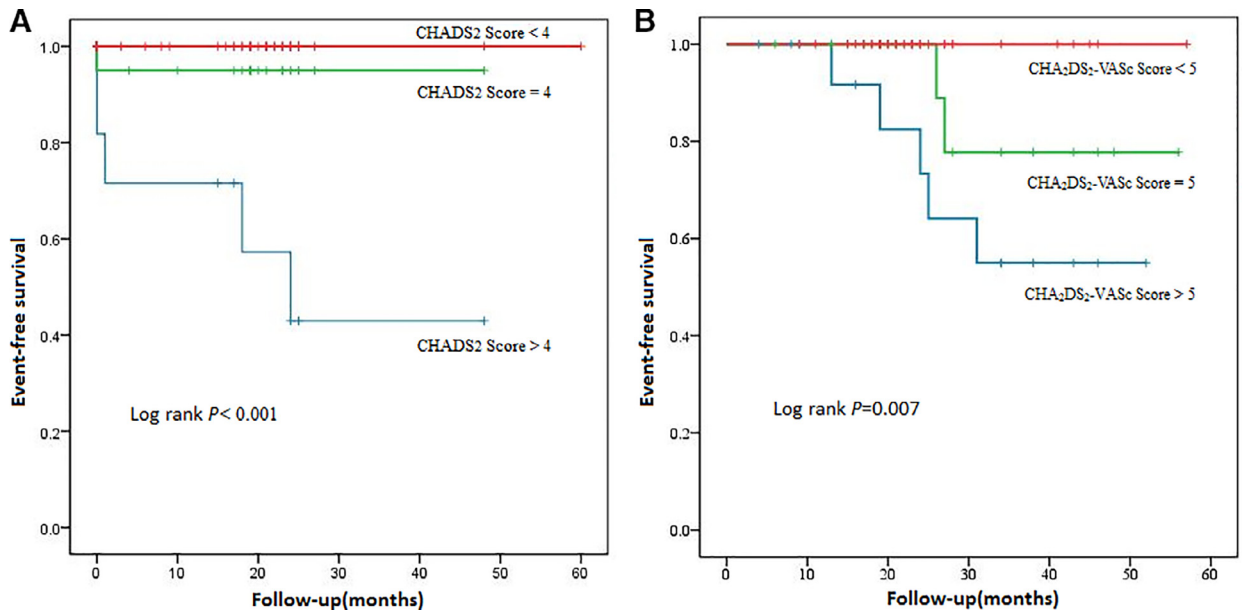

Figure 3. *(A) Comparison of the Kaplan-Meier curve of all-cause death-free survival in LS-AF patients among the 3 groups according to cut-off $CHADS_2$ score value; (B) comparison of the Kaplan-Meier curve of all-cause death-free survival in LS-AF patients among the 3 groups according to cut-off CHA_2DS_2-VASc score value.*

degraded quality of life and long-term death. Saxena et al reported that stroke patients with AF have more risk of short-term and long-term recurrence stroke and death.[7] In the present study, LS patients with AF had a higher risk of LS recurrence and mortality than patients without AF during the mean follow-up period of 20.0 ± 5.8 months ($P < .05$, respectively), indicated that the presence of AF was independent risk factor for recurrence of LS and death in LS patients, which consent with Steger et al reported.[20]

Clinical scores may help the physicians to identify patients at higher risk of unfavorable events, to establish closer monitoring programs in order to prevent disease progression and negative outcomes; their usefulness will be greater the more they include simply assessable parameters which can be easily combined $CHADS_2$ and CHA_2DS_2-VASc scales are simple instruments which are able to identify patients at low, medium, and high risk to develop cardioembolic stroke.[21] $CHADS_2$ score was developed to identify AF patients at risk for stroke or thromboembolic event and thus to guide anticoagulation therapy.[22] However, patients with an intermediate risk presented a challenge in everyday practice because some of them were at low-intermediate risk and others were at high-intermediate risk. Consequently, CHA_2DS_2-VASc score was introduced to improve predictive value for thromboembolic events in patients at low and intermediate risk. The utility of the score goes beyond the benefits of risk stratification for thromboembolic events.[23] Except for preventing stroke in AF patients, several studies recently have reported that the $CHADS_2$ and CHA_2DS_2-VASc scores can also predict severity and outcomes of stroke and thromboembolic events in patients with AF and those without AF. Chen et al reported that $CHADS_2$, CHA_2DS_2-VASc, and R_2CHADS_2 can be used to predict 1-year all-cause mortality in systolic heart failure patients with or without AF.[24] In patients with interatrial block without a history of AF, $CHADS_2$ and CHA_2DS_2-VASc scores can predict the risk of ischemic stroke or transient

Table 3. *Multivariate predictors of primary end event and secondary end event in AIS-without AF patients*

Variable	Mortality		Restroke	
	HR (95% CI)	*P* Valve	HR (95% CI)	*P* Valve
Age	1.042 (1.003, 1.083)	.035	-	-
History of congestive heart failure	-	-	.468 (.357, .614)	<.001
History of coronary heart diseases	3.354 (1.437, 7.831)	.005	1.897 (1.166, 3.086)	.010
Heart rate	-	-	1.016 (1.006, 1.027)	.002
CHADS2 score	1.262 (.800, 1.991)	.316	1.189 (.970, 1.456)	.095
CHA_2DS_2-VASc Score	1.321 (.891, 1.959)	.166	1.017 (.850, 1.216)	.855

Abbreviation: CI, confidence interval; HR, hazard ratio.
Parameters with a *P* value < .05 were entered in the multivariate analysis.

ischemic attack outcomes.[25] In a meta-analysis included 8 cohort studies, $CHADS_2$ score was associated with increased mortality and stroke/TIA incidence in patients without AF.[26]

In the present study, we sought to investigate the role of the $CHADS_2$ and CHA_2DS_2-VASc scores in predicting prognosis in LS with or without AF patients. The ROC curve analysis showed that both $CHADS_2$ and CHA_2DS_2-VASc scores were predictive of death in LS-AF patients, and multivariate analysis showed that $CHADS_2$ and CHA_2DS_2-VASc were independently associated with death. The $CHADS_2$ and CHA_2DS_2-VASc scoring systems comprise a cluster of common cardiovascular risk factors such as age,[27] diabetes,[28] and heart failure[29] associated with thromboembolism. So it is reasonable it may identify underlying conditions that may lead to stroke, or death during follow-up. The CHA_2DS_2-VASc scoring system has been proved to be more sensible than the $CHADS_2$ scale in discriminating between patients really at low risk of cardioembolic events and is indicated,[30] in the ESC Guidelines as the preferred instrument to guide the choice of anticoagulant treatment.[12] However, in the present study, we found the AUC for $CHADS_2$ score was .942 with a similar accuracy of the CHA_2DS_2-VASc score (AUC .908) in predicting death in high-risk LS-AF patients. Both $CHADS_2$ and CHA_2DS_2-VASc scores showed excellent predictive accuracy (AUC .9-1.0). When $CHADS_2$ score greater than or equal to 4 and CHA_2DS_2-VASc score greater than or equal to 5 were chosen as the optimal predictive cut-off values, the 2 clinical-based risk scores significantly improved risk classification for death. Taken together, these findings further support the potential role of $CHADS_2$ and CHA_2DS_2-VASc score in identifying high-risk LS-AF patients. More aggressive therapeutic management and frequent clinical follow-up may be indicated for these patients.

However, when evaluating the potential role of $CHADS_2$ and CHA_2DS_2-VASc score in LS without AF patients, we found that both $CHADS_2$ score and CHA_2DS_2-VASc score were not independent predictors of all-cause death and restroke in LS without AF patients. Recently, a study reported that the $CHADS_2$ and CHA_2DS_2-VASc scores could predict 5-year recurrent stroke and death in non-AF stroke patients,[11] which was inconsistent with our results. It was possible that the follow-up period (20.0 ± 5.8 months) in this study is shorter than Ntaios et al reported (5 years). Furthermore, this study focuses on LS, which accounts for only 25% of ischemic strokes, this subtype of stroke has slightly lower rates of stroke recurrence and mortality in the short term (1-2 years) compared to other subtype strokes, so the 2 risk scores may have no predictive role on the prognosis in LS without AF patients. This result needs to be confirmed in the future.

Our study has several limitations. First, our study is a retrospective study, as such, potentially affected by collection and entry bias, and possible residual confounding. Second, the study population in this study is LS patients the exclusion of patients with other subtype strokes potentially associated with a higher mortality, which may also add bias to obtained results. Third, the mortality of patients with LS is influenced by multiple risk factors; therefore, a comprehensive evaluation, rather than single measurements of $CHADS_2$ or CHA_2DS_2-VASc score, is necessary to assess an increased mortality risk, making $CHADS_2$ or CHA_2DS_2-VASc score a useful predictor of clinical events in LS-AF patients. Fourth, short-term follow-ups of this study have been performed. A longer follow-up period may have provided additional data.

Conclusions

In conclusion, both $CHADS_2$ and CHA_2DS_2-VASc may be predictors of the death in LS with AF but not LS without AF patients and can serve as additive tools in identifying high-risk LS with AF patients that require aggressive management.

Conflicts of Interest

All authors declare no conflicts of interest.

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