ORIGINAL ARTICLE

Risk of left atrial appendage thrombus in patients scheduled for ablation for atrial fibrillation: beyond the CHA_2DS_2VASc score

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KEY WORDS

ablation, atrial fibrillation, left atrial appendage thrombus, risk factors

ABSTRACT

INTRODUCTION Atrial fibrillation (AF) increases the risk of thromboembolic events by promoting clot formation in the left atrial appendage (LAA). Transesophageal echocardiography (TEE) is routinely used to exclude the presence of an LAA thrombus before AF ablation. So far, it has not been established what is the optimal combination of noninvasive parameters for thromboembolic risk stratification in this setting and whether patients at very low risk require TEE.

OBJECTIVES The aim of the study was to assess predisposing factors for an LAA thrombus in patients scheduled for AF ablation and to identify those patients in whom preprocedural TEE is not necessary.

PATIENTS AND METHODS In consecutive 151 patients (107 men; mean age, 57 ±10 years) the type of AF and renal function were assessed in addition to the CHA_2DS_2VASc score to improve thromboembolic risk stratification.

RESULTS An LAA thrombus or dense echo contrast with a strong suspicion of a probable thrombus was detected in 15 patients (10%). Diabetes, age of 65 years or older, persistent AF, and estimated glomerular filtration rate (eGFR) of less than 60 ml/min/1.73 m^2 were predictors of the LAA thrombus. A multivariate logistic regression analysis showed that only persistent AF and an eGFR of less than 60 ml/min/1.73 m^2 were independent predictors of the LAA thrombus. The receiver operating characteristic curves showed that the greatest area under the curve (0.845) was achieved for the CHA_2DS_2VASc-AFR (CHA_2DS_2VASc plus the type of AF and renal function); the difference was not significant. A CHA_2DS_2VASc-AFR score of 2 or greater or a CHA_2DS_2VASc score of 1 or greater identified patients with the LAA thrombus with a sensitivity of 100% (and specificity of 54% and 36%, respectively).

CONCLUSIONS In patients scheduled for AF ablation, an LAA thrombus or dense echo contrast is a relatively common finding despite routine anticoagulant treatment. The addition of AF type and renal function to the CHA_2DS_2VASc score slightly improves thromboembolic risk stratification and may help identify patients who do not need preprocedural TEE.

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INTRODUCTION Atrial fibrillation (AF) increases the risk of thromboembolic events, including ischemic stroke, by promoting clot formation in the left atrial appendage (LAA).[1] The risk of stroke in patients with AF varies widely depending on age, clinical variables, and cardiac structure or function. Accordingly, several stroke risk stratification systems for AF patients have been developed, with the CHA_2DS_2VASc scale being the most widely used and endorsed by international guidelines.[2] In addition, other parameters such as renal impairment or permanent type of AF have been recently proposed as additional thromboembolic risk factors in large cohorts of patients with AF or in patients after AF ablation.[3-5] However, no study has addressed this issue in patients scheduled for ablation for AF.

Catheter ablation for AF has become a well-established method of treatment with high success rates when compared with antiarrhythmic drugs.[2,6] It is mandatory to exclude the presence of a thrombus in the LAA before the procedure. For this purpose, transesophageal echocardiography (TEE) has been used as the gold standard.[2] However, there is no consensus as to whether all patients scheduled for AF ablation should routinely undergo TEE, which is an invasive procedure, carries a risk of complications, is relatively expensive, and can extend the length of hospital stay.[7] This question is especially relevant in patients with a very low risk of thromboembolic events.

The aim of the present study was to assess the predisposing factors for LAA thrombus formation, including those not incorporated in the CHA_2DS_2VASc score, in consecutive patients scheduled for AF ablation in our center. We also aimed to establish the necessity for preprocedural TEE and to answer the question whether there are patients in whom this examination could be safely omitted based on the thromboembolic risk calculation.

PATIENTS AND METHODS

Study population The study group consisted of 161 consecutive patients scheduled for AF ablation from January 2012 to March 2014 in our center. All demographic, clinical, laboratory, and TEE data, as well as information on medications, were retrieved from medical records. We performed a retrospective analysis of prospectively collected data. The anticoagulant therapy before ablation was based on the current guidelines and all patients with a CHA_2DS_2VASc score of 2 or higher were treated with oral anticoagulants. The decision to administer preablation anticoagulation in patients with a CHA_2DS_2VASc score of 0 or 1 was left to the discretion of attending physicians.

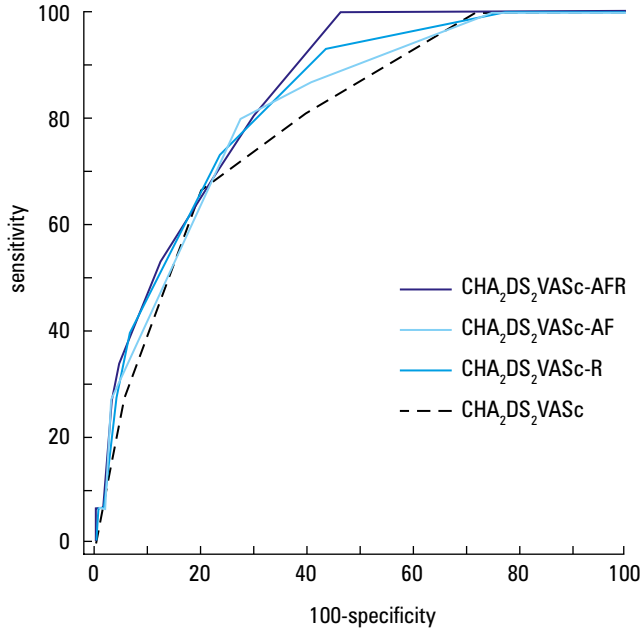
Definitions Patients with hypertension were defined as subjects currently using antihypertensive medication, and those with diabetes—as subjects currently using hypoglycemic agents. Chronic heart failure (CHF) was defined as the presence of signs and symptoms of either right or left ventricular failure or both, confirmed by noninvasive or invasive measurements demonstrating objective evidence of cardiac dysfunction.[8] Vascular disease was defined as the presence of at least one of the following: previous myocardial infarction, angina pectoris, percutaneous coronary intervention or coronary artery bypass surgery, intermittent claudication, previous surgery or percutaneous intervention on the abdominal aorta or the lower extremity vessels, abdominal or thoracic surgery, or arterial and venous thrombosis.[8] Paroxysmal AF was defined as recurrent episodes of AF lasting less than 7 days.[9] Persistent AF was defined as episodes of AF lasting longer than 7 days.[9]

The $CHADS_2$ and CHA_2DS_2VASc scores were calculated according to standard definitions. The R_2CHADS_2 score was computed according to Piccini et al,[10] where R stands for renal impairment (electronically calculated estimated glomerular filtration rate [eGFR] <60 ml/min/1.73 m^2) and 2 points are given for an eGFR of less than 60 ml/min/1.73 m^2. The CHA_2DS_2VASc-AFR is an original score, developed and tested in the present study, and includes the type of AF (1 point for persistent AF) and renal status (1 point for eGFR <60 ml/min/1.73 m^2 according to Roldan et al).[11]

Laboratory data Blood samples were collected on admission. In all patients, serum creatinine levels were measured. Kidney function was assessed using eGFR calculated with the Modification of Diet in Renal Disease formula. Renal impairment was defined as an eGFR of less than 60 ml/min/1.73 m^2.

Echocardiography All patients underwent TEE within 48 hours before the ablation procedure. TEE was performed according to the standard practice guidelines using a commercially available equipment (Vivid 9, GE Vingmed Ultrasound, Horten, Norway, and Vivid S6, GE Healthcare, Israel) with 6T and 6Tc multiplane TEE probes (GE Vingmed Ultrasound).[12,13] Pharyngeal anesthesia was performed with lidocaine spray. Sedation with intravenous midazolam was needed in some patients. The left atrial (LA) and LAA cavities were examined for the presence of a thrombus or spontaneous echocontrast by experienced echocardiographers. Special attention was paid to ensure that the entire LA and LAA were visualized. The LAA emptying velocity was recorded by placing the pulse-wave Doppler gate within 1 cm of the LAA orifice, and emptying velocity of less than 0.4 m/s was considered as decreased. The LA thrombus was defined as an independently mobile round, oval, or irregularly shaped echo-dense structure distinct from the surrounding endocardium or pectinate muscles and detected in more than 1 imaging plane. Dense contrast was defined as dynamic "smoke-like" signal with the characteristic swirling motion, or a dynamic gelatinous, precipitous echo density, without a discrete mass, present throughout the cardiac cycle with appropriate gain settings to distinguish the spontaneous echo contrast from echoes due to excessive gain. Patients with a definite LAA thrombus and with dense contrast with a strong suspicion of a thrombus were classified as the "LAA thrombus" group. In this group, ablation was postponed and a new anticoagulant regimen was initiated.

Statistical analysis The results were presented as mean ± 1 standard deviation or numbers and percentages. Differences between patients with or without the LAA thrombus were examined using the *t* test for numerical variables or the χ^2 or Fisher test for qualitative variables. A univariate analysis was performed using odds ratios and 95% confidence intervals (CIs). To assess which parameter was independently associated with the



Score	AUC	95% CI
CHA_2DS_2VASc-R	0.830	0.761–0.886
CHA_2DS_2VASc-AF	0.814	0.743–0.873
CHA_2DS_2VASc	0.795	0.722–0.856
CHA_2DS_2VASc-AFR	0.845	0.777–0.898

P value for the pairwise comparison of the ROC curves

ROC curves	*P* value
CHA_2DS_2VASc-AFR vs CHA_2DS_2VASc-AF	0.1509
CHA_2DS_2VASc-AFR vs CHA_2DS_2VASc-R	0.5004
CHA_2DS_2VASc-AFR vs CHA_2DS_2VASc	0.0618
CHA_2DS_2VASc-AF vs CHA_2DS_2VASc-R	0.6395
CHA_2DS_2VASc-AF vs CHA_2DS_2VASc	0.3719
CHA_2DS_2VASc-R vs CHA_2DS_2VASc	0.1402

FIGURE 1 Receiver operating characteristic curves and values of the area under the curve for various combinations of the CHA_2DS_2VASc score, type of atrial fibrillation, and renal parameters Abbreviations: AUC, area under the curve; CHA_2DS_2VASc-R, CHA_2DS_2VASc plus renal function; CHA_2DS_2VASc--AF, CHA_2DS_2VASc plus type of AF; CHA_2DS_2VASc-AFR, CHA_2DS_2VASc plus the type of AF and renal function; CI, confidence interval; ROC, receiver operating curve

LAA thrombus, a multivariate logistic regression analysis was performed (with the backward likelihood ratio method and *P* for stepwise removal >0.10). The Hosmer–Lemeshow test was used to assess the goodness of fit of the model. The receiver operator characteristic (ROC) curves were constructed and the area under the curve (AUC) was calculated to compare the sensitivity and specificity of different scores in the identification of patients with or without the LAA thrombus. The pairwise comparison of ROC curves (using the De Long method) was performed using *z* statistics. A *P* value of less than 0.05 was considered significant.

RESULTS Of 161 patients scheduled for AF ablation, 10 patients were excluded from the current analysis. In 8 patients, TEE was not performed (2 patients did not swallow the probe; in 5 patients, the TEE was unavailable at the time of ablation; and 1 patient had esophageal stricture), and in the remaining 2 patients, LAA was not properly visualized. Thus, the analyzed study group consisted of 151 patients (107 men; mean age, 57 ±10 years). Detailed characteristics of the study group are presented in TABLE 1.

The LAA thrombus was detected in 10 patients, and dense echo contrast with high suspicion of thrombus—in 5 patients. Thus, the LAA-thrombus group consisted of 15 patients (10% of the studied population). In the remaining 136 patients, the LAA cavity was clear (123 patients) or only moderate echo contrast without suspicion of a thrombus was detected (13 patients). Compared with patients without the thrombus, patients with the thrombus were significantly older and significantly more often had persistent AF, diabetes, renal impairment, lower LAA emptying velocity, and higher thromboembolic risk scores (TABLE 1).

Of the risk factors that compose the CHA_2DS_2VASc score, only diabetes and age of 65 years or older were predictors of the LAA thrombus in the univariate analysis. Among other clinical factors, persistent AF and eGFR of less than 60 ml/min/1.73 m^2 were also predictors of the LAA thrombus in the univariate analysis (TABLE 2).

The multivariate logistic regression analysis showed that only persistent AF and eGFR of less than 60 ml/min/1.73 m^2 were independent predictors of the LAA thrombus (TABLE 3).

Individual clinical, demographic, and echocardiographic parameters of patients from the LAA--thrombus group are shown in TABLE 4.

FIGURE 1 shows the ROC curves for various combinations of CHA_2DS_2VASc and AF type and renal function, with the corresponding values of the AUC. The ROC curves showed that the CHA_2DS_2VASc score alone or in combination with AF type or renal function (or both) performed well in the identification of patients from the LAA-thrombus group. The greatest AUC (0.845) was achieved for the CHA_2DS_2VASc-AFR score; however, the difference between the AUC for the CHA_2DS_2VASc-AFR (the greatest AUC) and the AUC for the CHA_2DS_2VASc (the lowest AUC) did not reach statistical significance (difference between the areas, 0.0495; standard error, 0.0265; 95% CI, 0.00245–0.101; *z* statistics, 1.868; *P* = 0.0618).

TABLE 1 Clinical, demographic, and echocardiographic characteristics of the whole study group and comparison between patients with and without left atrial appendage thrombus

Parameter	Total (n = 151)	Patients with LAA thrombus (n = 15)	Patients without LAA thrombus (n = 136)	*P* value
age, y	57 ±10	62 ±7	56 ±10	0.0128
female sex	43 (28.5)	7 (47.6)	36 (26.4)	0.1309
persistent AF	34 (22.5)	8 (53.3)	26 (19.1)	0.0060
CHF	4 (3.3)	2 (13.3)	7 (5.1)	0.2203
hypertension	88 (71.5)	12 (80)	76 (55.9)	0.0983
diabetes	24 (15.9)	6 (40)	18 (13.2)	0.0162
previous stroke/TIA	7 (4.6)	3 (20)	8 (5.9)	0.0807
vascular disease	25 (16.6)	4 (26.7)	21 (15.4)	0.2765
VKA	116 (76.8)	12 (80)	104 (76.5)	0.7029
NOAC	21 (13.9)	3 (20)	18 (13.2)	0.7088
creatinine, mg/dl	1.10 ±0.23	1.15 ±0.25	1.10 ±0.23	0.4291
eGFR, ml/min/1.73 m^2	71.93 ±17.30	64.24 ±20.81	72.78 ±16.53	0.1443
eGFR <60 ml/min/1.73 m^2	36 (23.8)	9 (60)	27 (19.9)	0.0017
CHA_2DS_2VASc	1.54 ±1.38	2.93 ±1.44	1.16 ±1.16	0.0010
$CHADS_2$	1.1 ±1.07	2.2 ±1.32	0.98 ±0.92	0.0031
R_2CHADS_2	1.58 ±1.54	3.4 ±1.92	1.38 ±1.07	0.0011
CHA_2DS_2VASc-AFR	2 ±1.69	4.07 ±1.79	1.78 ±1.25	0.0002
LAA emptying velocity, m/s	0.61 ±0.25	0.34 ±0.24	0.61 ±0.25	0.0005

Data are presented as mean ± standard deviation or number (percentage) of patients.

Abbreviations: AF, atrial fibrillation; AFR, atrial fibrillation type and renal function; eGFR, glomerular filtration rate calculated electronically; CHF, chronic heart failure; LAA, left atrial appendage; NOAC, novel oral anticoagulant; TIA, transient ischemic attack; VKA, vitamin K antagonist; others, see FIGURE 1

TABLE 2 Predictors of left atrial appendage thrombus according to a univariate analysis

Variable	OR	95% CI	*P* value
female sex	2.4306	0.8225–7.1828	0.1082
age ≥65 years	4.0833	1.3510–12.3416	0.0127
diabetes	4.3704	1.3895–13.7460	0.0116
stroke/TIA	4	0.9356–17.1018	0.0615
hypertension	3.1579	0.8523–11.6999	0.0853
CHF	2.8352	0.5328–15.0879	0.2218
vascular disease	1.9740	0.5739–6.7903	0.2806
persistent AF	4.8352	1.6083–4.5367	0.0050
eGFR <60 ml/min/1.73 m^2	6.0556	1.9845–18.4785	0.0016
LAA emptying velocity <0.4 m/s	14.7125	4.2575–50.8411	<0.0001

Abbreviations: OR, odds ratio; others, see FIGURE 1 and TABLE 1

TABLE 3 Predictors of left atrial appendage thrombus according to a multivariate logistic regression analysis

Variable	OR	95% CI	*P* value
eGFR <60 ml/min/1.73 m^2	3.6399	1.0853–12.2078	0.0364
age ≥65 years	3.0249	0.8690–10.5288	0.0820
diabetes	3.2886	0.8929–12.1115	0.0735
persistent AF	4.1422	1.2281–13.9712	0.0220

Abbreviations: see TABLE 1, TABLE 2, and FIGURE 1

The examples of sensitivity and specificity values for the identification of patients with the LAA thrombus for different CHA_2DS_2VASc and CHA_2DS_2VASc-AFR scores are presented in TABLE 5. Patients with a CHA_2DS_2VASc score of 0 or a CHA_2DS_2VASc-AFR score of 0 or 1 had no LAA thrombus. For a given value of sensitivity (for example, 100%), the specificity values were

TABLE 4 Demographic, clinical, and thromboembolic risk data in the LAA thrombus group (n = 15)

No.	Age, y	Sex	CHA_2DS_2VASc	CHA_2DS_2VASc-AFR	Persistent AF	Definite thrombus	LAA emptying velocity, m/s	Anticoagulant	Creatinine, mg/dl	eGFR, ml/min/1.73 m^2
1	60	F	1	2	no	yes	0.5	rivaroxaban	1.23	47
2	44	M	1	2	yes	yes	0.35	rivaroxaban	1.12	75.7
3	58	M	1	2	yes	no	0.2	VKA	0.94	87.6
4	50	M	2	4	yes	yes	0.28	VKA	1.53	51.5
5	62	F	2	3	no	yes	0.2	VKA	1.13	51.9
6	68	M	3	4	yes	yes	0.3	VKA	1.07	73
7	59	F	3	4	no	no	0.7	VKA	1.29	45
8	65	M	3	3	no	yes	0.3	VKA	0.83	99
9	61	M	3	5	yes	no	0.1	VKA	1.38	55.7
10	72	M	3	3	no	yes	1	VKA	0.87	91.7
11	60	F	3	3	no	no	0.2	VKA	0.67	95.4
12	67	M	4	6	yes	yes	0.15	VKA	1.42	52.9
13	70	F	4	6	yes	yes	0.25	VKA	1.35	41.2
14	67	F	5	6	no	yes	0.2	VKA	1.04	56.2
15	65	F	6	8	yes	no	0.4	rivaroxaban	1.41	39.8

Abbreviations: F, female, M, male; others, see **FIGURE 1** and **TABLE 1**

TABLE 5 Sensitivity and specificity values for various CHA_2DS_2VASc and CHA_2DS_2VASc -AFR scores for identification of patients with left atrial appendage thrombus

Score	Points	Sensitivity, %	Specificity, %
CHA_2DS_2VASc	≥1	100	36
	≥2	80	66
	≥3	67	80
CHA_2DS_2VASc-AFR	≥2	100	54
	≥3	80	71
	≥4	53	88

Abbreviations: see **FIGURE 1**

higher when using the CHA_2DS_2VASc-AFR than when using the CHA_2DS_2VASc score.

DISCUSSION The present study showed that in patients scheduled for AF ablation a thrombus or dense echo contrast in the LAA (which precludes AF ablation) may be observed in up to 10% of patients despite routine and effectively managed anticoagulation. In addition, the study showed that the absence of an LAA thrombus may be predicted by calculating the thromboembolic risk score. Finally, by adding 2 variables such as persistent AF and renal impairment to the standard CHA_2DS_2VASc score, a marginal improvement in the identification of patients who may not require preprocedural TEE is obtained.

The LAA thrombus may be detected in a small but clinically significant proportion of patients with AF despite routine anticoagulation. The incidence of the thrombus varies widely in the available studies and ranges from 1.5%–2.0% to 7%.[14-16] This may be due to several reasons such as inadequate doses of anticoagulants (especially vitamin K antagonists), missing doses in the case of non-vitamin K oral anticoagulants, predisposing anatomical factors such as LAA morphology, or undetected prothrombotic state in a small group of patients. Another reason may be false-positive results of TEE. It has been shown that intracardiac echocardiography may exclude a thrombus in some patients with positive TEE results; however, the opposite can also occur.[17] Nevertheless, TEE remains the gold standard for the detection of LAA and LA thrombus and the decision whether it is safe to proceed with AF ablation. In our study, TEE allowed to identify the presence of a definite LAA thrombus in 6.6% of the patients and a high probability of a thrombus based on dense echo contrast in 10% of the patients, which is in line with literature data.

As expected, we found several significant differences between patients with or without an LAA thrombus in our study. These included well-established factors such as more advanced age, diabetes, and decreased LAA emptying velocity; however, we found 2 factors not included in the CHA_2DS_2VASc score that occurred to be independent predictors of the LAA thrombus, namely, persistent AF and renal impairment.[18,19] These 2 factors have been shown to independently increase thromboembolic risk in patients with AF, although in different patient populations than our cohort.[3,5,20,21]

Although the AF type is not included in the risk scores, numerous studies have shown that persistent AF carries a higher risk of stroke than paroxysmal AF.[5,22] The minimum duration of AF that increases the risk of stroke has not been established; however, in the ASSERT study, as short as >6-minute episodes of AF were associated with an increased risk of stroke.[22] The mechanisms by

which permanent AF carries a higher thromboembolic risk than paroxysmal AF may be multifactorial and include longer periods of LAA/LA stunning, changes in the left atrial wall structure (especially in patients with a long history of persistent AF) or other cardiovascular abnormalities promoting thromboembolism, which are more common in patients with persistent AF.

Renal impairment has been consistently shown to increase thromboembolic risk, including stroke, but the additive value of this parameter in risk stratification scores is debatable.[3] Banerjee et al[23] in a large real-world cohort of patients with nonvalvular AF showed that renal dysfunction was not independently associated with thromboembolic risk and did not improve the predictive power of $CHADS_2$ and CHA_2DS_2VASc scores.[23] However, the population in that study was different from our patients scheduled for AF ablation (more advanced age, more patients with chronic kidney disease, and higher proportion of persistent AF). Also Kornej et al[24] and Chao et al[4] studied patients after AF ablation and suggested that the inclusion of renal function in the risk stratification scores adds little to the existing scores. More positive results were obtained by the ATRIA investigators who showed that adding proteinuria, eGFR of less than 30 ml/min/1.73 m^2, or end-stage renal disease significantly improved thromboembolic risk stratification.[21] Finally, the most recent meta-analysis showed that renal impairment is an independent risk factor for thromboembolic events (relative risk of 1.62) and postulated that it should be added to the existing risk scores.[25] Thus, it may be speculated that in some subgroups of patients with AF adding renal function to the existing risk scores may improve the identification of patients at increased risk of stroke. In addition, as a cardiovascular risk factor, renal impairment improves risk stratification based on the CHA_2DS_2VASc scale not only in patients with AF but also in other conditions such as acute coronary syndrome.[26]

Out of other parameters examined in our study, the history of stroke—a very potent thromboembolic risk factor—did not show a significant difference between patients with or without the LAA thrombus. This may be explained by a low prevalence of these complications in our population. In general, the thromboembolic risk of our patients was quite low (mean CHA_2DS_2VASc, 1.54 ±1.38), as is often observed in patients who are offered AF ablation.[27]

The question of whether some patients may not require preprocedural TEE because the risk of an LAA thrombus is very low still remains unanswered. Data from literature are conflicting. Puwananat et al[14] suggested that in patients with a $CHADS_2$ of 0 who have paroxysmal AF and are treated with anticoagulants, preprocedural TEE may be omitted. Our findings are also similar to those of Calco et al[15] who suggested that preprocedural TEE may be omitted in patients who have paroxysmal AF and no LA dilation or structural heart disease. However, 1 study showed that in unselected patients scheduled for cardioversion or catheter ablation as many as 11% of the subjects with an LAA thrombus had a CHA_2DS_2VASc score of 0 or 1.[20]

Our study showed that patients with a CHA_2DS-$_2VASc$ score of 0 or a CHA_2DS_2VASc-AFR score of 0 or 1 had no LAA thrombus. Much larger prospective studies are needed to assess whether this criterion may be introduced into clinical practice. The CHA_2DS_2VASc-AFR score only slightly improved the identification of patients with almost no risk of a thrombus. The reason why the type of AF and renal function only marginally improved thromboembolic risk stratification may be explained by the fact that both parameters may reflect cardiovascular impairment already expressed by the components of the CHA_2DS_2VASc score, and, therefore, there is little new information on future risk.

Patients scheduled for AF ablation often routinely undergo other imaging tests capable of detecting an LAA thrombus such as computed tomography, cardiac magnetic resonance, or intracardiac echocardiography. This may be another reason why a no-TEE approach could find its way into clinical practice in the very near future. It may be speculated that adding a thromboembolic risk score including AF type and renal function to the results of new imaging tests would improve differentiation between patients with an LAA thrombus and those with a clear LAA; however, this needs to be examined in prospective studies.

Limitations Owing to the small size of the study group, all our findings are hypothesis-generating. The retrospective nature of the study also precludes firm conclusions; however, all data were collected prospectively at the time of hospitalization for ablation and TEE.

Patients with a definite LAA thrombus and patients with dense echo contrast and hence a strong suspicion of a thrombus were classified as the LAA-thrombus group because, in such patients, ablation is usually postponed. On the other hand, in patients with minor or even moderate echo contrast but without the suspicion of a thrombus, ablation can be safely performed. It has been shown that very dense echo contrast is associated with an increased risk of thromboembolism.[19]

Although TEE was performed and analyzed by experienced echocardiographers, there is always a possibility of misinterpretation. TEE has been shown to provide both false negative and positive results; however, it still remains the gold standard for the detection of an LAA thrombus.

The eGFR was calculated using the Modification of Diet in Renal Disease formula, which has some limitations. We used only 1 cut-off value for eGFR (<60 ml/min/1.73 m^2), and the vast majority of our patients had normal or only slightly decreased eGFR (only 1 patient had an eGFR of less than 30 ml/min/1.73 m^2) Thus, our results may

not be applicable to patients with more severe renal impairment than those in our study.

Although patients taking non-vitamin K oral anticoagulants were instructed to use a drug according to a prescribed schedule, it is possible that some patients might not have fully complied, which might have predisposed them to the formation of an LAA thrombus. However, with these new agents, it is difficult to assess adherence because there are no routine blood tests assessing the anticoagulation status.[28] Also patients treated with vitamin K antagonists might have had periods of ineffective anticoagulation. Although they were instructed to keep an international normalized ratio between 2.0 and 3.0, it is well known that in clinical practice, time in the therapeutic range rarely exceeds 60%.[29]

Another limitation of our study is the lack of LA dimensions in predicting models. This was due to the fact that preprocedural transthoracic echocardiography was performed at various time intervals before ablation and usually in other centers; therefore, it was difficult to fully rely on the LA diameter measurements.

In conclusion, the present study showed that patients scheduled for AF ablation quite often have an LAA thrombus despite adequate anticoagulation. Thromboembolic risk stratification using the CHA_2DS_2VASc score, with the addition of data on the type of AF and renal function, may accurately identify low-risk patients who do not require preprocedural TEE; however, this has to be tested in larger prospective trials.

Contribution statement PK and AS were responsible for the concept and design of the study. PK, AS, and JB contributed to the design of the research. All authors were involved in data collection. AS, PK, and EP analyzed the data. AS and PK were responsible for statistical analysis. All authors edited and approved the final version of the manuscript.

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ARTYKUŁ ORYGINALNY

Ocena ryzyka wystąpienia skrzepliny w uszku lewego przedsionka u pacjentów zakwalifikowanych do zabiegu ablacji migotania przedsionków – nie tylko skala CHA_2DS_2VASc

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SŁOWA KLUCZOWE

ablacja, czynniki ryzyka, migotanie przedsionków, skrzeplina w uszku lewego przedsionka

STRESZCZENIE

WPROWADZENIE Migotanie przedsionków (*atrial fibrillation* – AF) zwiększa ryzyko powikłań zakrzepowo-zatorowych, sprzyjając tworzeniu się skrzeplin w uszku lewego przedsionka (*left atrial appendage* – LAA). W celu wykluczenia skrzepliny w LAA przed zabiegiem ablacji AF rutynowo wykonuje się echokardiografię przezprzełykową (*transesophageal echocardiography* – TEE). Dotychczas nie ustalono jaka jest optymalna kombinacja nieinwazyjnych parametrów w stratyfikacji ryzyka zakrzepowo-zatorowego u takich chorych oraz czy u chorych z bardzo małym ryzykiem konieczne jest wykonywanie TEE.

CELE Celem badania była identyfikacja czynników sprzyjających tworzeniu się skrzeplin w LAA u pacjentów kwalifikowanych do ablacji AF oraz identyfikacja pacjentów, u których można zrezygnować z przedzabiegowego TEE.

PACJENCI I METODY W celu lepszej identyfikacji pacjentów z wysokim ryzykiem zakrzepowo-zatorowym, w grupie kolejnych 151 pacjentów (107 mężczyzn, średni wiek 57 ±10 lat) oprócz skali CHA_2DS_2VASc oceniono rodzaj AF oraz wydolność nerek.

WYNIKI Skrzeplinę w LAA lub gęsty echokontrast z silnym podejrzeniem skrzepliny stwierdzono u 15 (10%) chorych. W analizie jednoczynnikowej cukrzyca, wiek ≥65 lat, przetrwałe AF oraz oszacowana wielkość przesączania kłębuszkowego (*estimated glomerular filtration rate* [eGFR]) <60 ml/min/1,73 m^2 były predyktorami wystąpienia skrzepliny w LAA. W wieloczynnikowej analizie regresji tylko przetrwałe AF i eGFR <60 ml/min/1,73 m^2 były niezależnymi czynnikami ryzyka wystąpienia skrzepliny w LAA. Krzywe ROC pokazały, że największe AUC (0,845) uzyskano dla skali CHA2DS2VASc-AFR (CHA2DS2VASc + rodzaj AF + parametry nerkowe); różnice nie były istotne statystycznie. Wynik CHA_2DS_2VASc-AFR ≥2 lub CHA_2DS_2VASc ≥1 ze 100% czułością (i swoistością odpowiednio 54% i 36%) identyfikował pacjentów ze skrzeplina w LAA.

WNIOSKI Pomimo rutynowego leczenia przeciwzakrzepowego skrzeplina w LAA jest stosunkowo często stwierdzana u pacjentów kwalifikowanych do zabiegu ablacji. Dodanie typu AF i wydolności nerek nieznacznie poprawia stratyfikację ryzyka oraz być może pozwoli na identyfikację pacjentów bardzo niskiego ryzyka, u których można zrezygnować z przedzabiegowego TEE.

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