Long-Term Outcomes of Catheter Ablation in Atrial Fibrillation Patients With Complete Left Bundle Branch Block

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Abstract

Background: CLBBB and AF are not uncommon coexisted. The impact of CLBBB on long-term prognosis of catheter ablation of AF has not been well determined. **Objectives:** This study aims to explore the long-term outcomes of patients with atrial fibrillation (AF) and complete left bundle branch block (CLBBB) after catheter ablation. **Methods:** Forty-two patients with CLBBB of the 11,752 patients who underwent catheter ablation of AF from 2011 to 2020 were enrolled as CLBBB group. After propensity score matching in a 1:4 ratio, 168 AF patients without CLBBB were enrolled as Non-CLBBB group. The primary endpoint was a composite of stroke, all-cause mortality, and cardiovascular hospitalization. The secondary endpoint was AF recurrence after single ablation. **Results:** The incidence of the primary endpoint in the CLBBB group was significantly higher than in the Non-CLBBB group (21.4% vs. 6.5%, HR 3.98, 95%CI 1.64-9.64, P = 0.002). The recurrence rates in the CLBBB group and the Non-CLBBB group were 54.8% and 31.5% (HR 1.71, 95%CI 1.04-2.79, P = 0.034), respectively. Multivariate analysis showed that CLBBB was an independent risk factor for both primary endpoint (HR 2.92, 95%CI 1.17-3.34, P = 0.022) and secondary endpoint (HR 2.19, 95%CI 1.09-4.40, P = 0.031) in patients with AF after catheter ablation. **Conclusions:** CLBBB significantly increased the risk of a composite endpoint of stroke, all-cause mortality, and cardiovascular hospitalization after catheter ablation in patients with AF. CLBBB also independently predicted recurrence in these patients.

Title Page

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Short title: Ablation in Complete Left Bundle Branch Block and Atrial Fibrillation

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Abstract

Background: CLBBB and AF are not uncommon coexisted. The impact of CLBBB on long-term prognosis of catheter ablation of AF has not been well determined.

Objectives: This study aims to explore the long-term outcomes of patients with atrial fibrillation (AF) and complete left bundle branch block (CLBBB) after catheter ablation.

Methods: Forty-two patients with CLBBB of the 11,752 patients who underwent catheter ablation of AF from 2011 to 2020 were enrolled as CLBBB group. After propensity score matching in a 1:4 ratio, 168 AF patients without CLBBB were enrolled as Non-CLBBB group. The primary endpoint was a composite of stroke, all-cause mortality, and cardiovascular hospitalization. The secondary endpoint was AF recurrence after single ablation.

Results: The incidence of the primary endpoint in the CLBBB group was significantly higher than in the Non-CLBBB group (21.4% vs. 6.5%, HR 3.98, 95%CI 1.64-9.64, P = 0.002). The recurrence rates in the CLBBB group and the Non-CLBBB group were 54.8% and 31.5% (HR 1.71, 95%CI 1.04-2.79, P = 0.034), respectively. Multivariate analysis showed that CLBBB was an independent risk factor for both primary endpoint (HR 2.92, 95%CI 1.17-3.34, P = 0.022) and secondary endpoint (HR 2.19, 95%CI 1.09-4.40, P = 0.031) in patients with AF after catheter ablation.

Conclusions: CLBBB significantly increased the risk of a composite endpoint of stroke, all-cause mortality, and cardiovascular hospitalization after catheter ablation in patients with AF. CLBBB also independently predicted recurrence in these patients.

Key Words: atrial fibrillation, complete left bundle branch block, catheter ablation

Introduction

Complete left bundle branch block (CLBBB) is a severe cardiac conduction disorder associated with hospitalization and cardiovascular death.[1] Atrial fibrillation (AF) is the most common sustained tachyarrhythmia in clinical practice, which is associated with an increased rate of stroke and heart failure.[2]CLBBB and AF are not uncommon coexisted. It was found that the prevalence of left bundle branch block (LBBB) in patients with AF was 1.7% and the prevalence of AF in the LBBB population was 30.5%.[3] Whether CLBBB and AF have a synergistic effect on mortality and morbidity of the patients has not been well determined.

Catheter ablation is a well-established therapy for patients with symptomatic AF who were failed or intolerant to antiarrhythmic drugs.[4] It has been proved to be an effective option to maintain sinus rhythm and improve the quality of life in patients with AF.[5] In a small sample size study, it was found that LBBB was associated with very late recurrence in patients underwent cryoballoon ablation of AF.[6] However, the effect of LBBB on long-term outcomes of catheter ablation of AF remains to be further studied. This study aimed to explore the long-term prognosis of patients with CLBBB who underwent catheter ablation of AF.

Methods

Study population

Patient data in this study were obtained from the Chinese Atrial Fibrillation Registry (CARF), which is a prospective, multicenter, ongoing registry study.[7] In CARF, consecutive patients referring to Beijing

Anzhen Hospital for catheter ablation of AF were retrospectively enrolled in this study if meeting all the inclusion criteria: (1) age[?]18 years old; (2) AF (confirmed by 12-lead ECG or 24-hour Holter monitoring); (3) CLBBB. Exclusion criteria include: (1) valvular AF; (2) hypertrophic cardiomyopathy; (3) a history of catheter or surgery ablation of AF; (4) other wide QRS morphologies (right bundle branch block, ventricular pacing, unclassified intraventricular conduction disturbances). A total of 11,752 patients who underwent catheter ablation of AF from 2011 to 2020 were screened. Forty-two cases of AF combined with CLBBB were enrolled as CLBBB group. After propensity score matching in a 1:4 ratio, 168 AF patients without CLBBB were enrolled in the study as Non-CLBBB group.

CLBBB was defined according to the American Heart Association/American College of Cardiology Foundation/Heart Rhythm Society recommendations: native QRS duration >120 ms; broad R waves in leads I, aVL, V5, or V6; absent q waves in leads I, V5, and V6; R peak time > 60 ms in leads V5 and V6 but normal in leads V1, V2, and V3, when small initial r waves can be discerned in the above leads.[8] This study was approved by the ethics committee.

Ablation procedure

AF ablation strategy of our center has been described previously.[9-10] Briefly, all patients underwent transesophageal echocardiography to exclude left atrial thrombosis. All antiarrhythmic drugs except amiodarone were stopped for at least five half-lives before the procedure. The procedures were guided by CARTO system under conscious sedation. A continuous irrigated radiofrequency ablation (Navi-Star Thermocool, or Thermocool-Smart-touch Biosenes Webster, USA) was performed along each pulmonary vein antrum in order to encircle the ipsilateral pulmonary veins (maximum power: 35 W, infusion rate: 17 ml/min). Procedural end-points were electrical isolation of all pulmonary veins in the patients with paroxysmal AF. In the patients with persistent AF, left atrial roofline, mitral isthmus and cavotricuspid isthmus were routinely targeted. Cardioversion was performed if sinus rhythm was not achieved after circle and line ablation. Additional ablation was applied, if needed, to achieve pulmonary veins isolation and linear block in sinus rhythm.

In repeat procedure, pulmonary veins isolation was achieved again if recovered pulmonary veins conduction gaps existed. Conduction recovery across ablation line was also ablated to achieve line block in those who received linear ablation. Entrainment mapping and 3D activation mapping were applied to identify the mechanism of organized atrial tachycardia. The earliest activation site was ablated for focal atrial tachycardia and the critical isthmus was ablated for macro-reentry atrial tachycardia, respectively. Additional ablation of superior vena cava, complex fractionated atrial electrograms were performed as the operator's discretion. The endpoints of the repeat procedure included pulmonary veins isolation, bidirectional linear block if targeted and non-inducibility of atrial tachyarrhythmias by burst pacing at minimum interval with1:1 atrial capture.

Outcomes

The primary endpoint was a composite of stroke, all-cause mortality, and cardiovascular hospitalization. The secondary endpoint was AF recurrence after single ablation. Stroke was defined as sudden neurologic dysfunction caused by brain ischemia attack. Cardiovascular hospitalization was defined as hospitalization caused by heart failure, AF, and other cardiovascular conditions. However, scheduled admission for a redo procedure was not included. The recurrence of AF was defined as any symptomatic or asymptomatic documented atrial tachyarrhythmia (AF, atrial tachycardia, atrial flutter) lasting for >30 seconds after a 3-month blanking period of the ablation.

Data collection and follow-up

Baseline characteristics were recorded when patients were enrolled in CARF. The demographic characteristics included age, gender, and body mass index. The clinical characteristics included type of AF, AF duration, alanine transaminase, creatinine, hemoglobin, QRS duration, echocardiography information, concomitant diseases, and medications.

Oral anticoagulants (warfarin or non-vitamin K antagonists) were prescribed for at least 2 months after ablation. International normalized ratio (INR) should be maintained between 2.0 to 3.0 in patients taking warfarin. The patients with high risk of stroke were encouraged to continue taking anticoagulation drugs. When to stop anticoagulation therapy was according to the patients' embolism and bleeding risk and the patients' intention. Antiarrhythmic drugs were taken after ablation for 3 months if there were no contraindications.

The patients were followed up at 3, 6, and 12 months after enrollment and every 6 months thereafter by professionally trained staff affiliated with CARF. Follow-up was conducted by telephone or outpatient clinic interview to learn about the patients' clinical events and current situation. 24h-Holter was performed monthly in the first 3 months, which was followed by an ECG and/ or 24h-Holter every 6 months. If patients had clinical symptoms of heart rhythm disorders, the arrhythmias should be confirmed by ECG or Holter.

Statistical analysis

Propensity score matching was performed to reduce confounding in the comparison of the two groups. Age, gender, diabetes mellitus, hypertension, coronary artery disease, chronic obstructive pulmonary disease, previous stroke, congestive heart failure, left ventricular ejection fraction, left atrial diameter, procedure date, and CHA_2DS_2-VASc score were matched between the two groups. Matching was performed using the nearest neighbor matching protocol (matching ratio of 1 to 4 without replacement) and a caliper width of 0.2.

Descriptive statistics were presented as means and standard deviation (SD) for continuous variables. Categorical variables were presented as numbers and proportions. Continuous variables in normal distribution were compared with Student's t-test or Wilcoxon test if not in normal distribution. The Kaplan-Meier method was used to derive the event rate and plot the time-survival curve. The unadjusted and adjusted Cox proportional hazards models were used to assess the association between CLBBB and clinical outcomes. All P values were 2-sided with a significance threshold of <0.05. All statistical analysis was performed using R Software version 4.1.0 (R Foundation for Statistical Computing, Vienna, Austria).

Results

Patients' characteristics

A total of 42 patients in the CLBBB group and 168 patients in the Non-CLBBB group were included in the study. The baseline characteristics were listed in Table 1. QRS duration were 157.0 (122.0-200.0) ms and 90.0 (68.0-118.0) ms in the two groups, respectively ($P < 0.001$). All the other baseline characteristics were not significantly different between the two groups.

Three months after the procedure, the proportion of antiarrhythmic drugs (include I, III and IV class AADs) in the two groups was 23.8% in the CLBBB group versus 26.8% in the Non-CLBBB group (P=0.695). The proportion of the patients on ACEI/ARBs, statins, and β-blockers was comparable between the two groups. During follow-up, there were no significant differences in anticoagulation and antiplatelet medication between the CLBBB group and the Non-CLBBB group (19.0% vs. 16.7%, P=0.714; 7.1% vs. 2.4%, P=0.290).

Primary endpoint

After a median duration of 49.0 (30.33-75.1) and 48.2(23.9-78.5) months' follow-up in the CLBBB group and in the Non-CLBBB group, the incidence of the composite primary endpoint in the CLBBB group was significantly higher than the Non-CLBBB group (21.4% vs. 6.5%, HR 3.98, 95%CI 1.64-9.64, P = 0.002) (Figure 1). As a component of the composite primary endpoint, cardiovascular hospitalization was significantly higher in the CLBBB group (14.3% vs.3.6%, HR 4.83, 95%CI 1.55-15.07, P = 0.007). There were no significant differences in stroke and all-cause mortality between the two groups (Table 2). All the death cases in the two groups were due to cardiovascular causes.

In univariate regression analysis, QRS duration, heart failure, previous stroke, COPD, and CLBBB were significantly associated with the occurrence of the primary endpoint. After adjusting for these variations, CLBBB (HR 2.92, 95%CI 1.17-1.34 P = 0.022) was the only independent risk factor for the primary endpoint (Table 3).

Characteristics of catheter ablation

The average procedure time was 151.8±4.6 mins in the CLBBB group and 156.7±10.5 mins in the Non-CLBBB group (P=0.651). The fluoroscopy time was 6.2±0.4 and 5.7±0.6 mins in the two groups, respectively. Pulmonary veins isolation was achieved in all the patients in the two groups. Superior vena cava isolation was achieved in 10 patients (23.8%) in the CLBBB group and 37 patients (22.0%) in the Non-CLBBB group (P=0.084). Besides pulmonary veins, the proportion of additional ablation target did not differ between the CLBBB and Non-CLBBB groups including left atrial roof line ablation (42.9% vs. 41.7%, P=0.889), mitral isthmus line ablation (42.9% vs. 41.7%, P=0.889), left atrial complex fractionated atrial electrograms (33.3% vs.23.2%, P=0.164), and cavotricuspid isthmus line ablation (52.4%vs.44.6%, P=0.368). Conduction blocks were obtained in all the left roof line and cavotricuspid isthmus line ablation. There was no significant difference in conduction block across the mitral isthmus line between the two groups (83.3% vs. 85.7%, P=0.724). There was one patient had pseudoaneurysms after procedure in the CLBBB group (2.4%), and two patients with inguinal hematomas in the Non-CLBBB group (2.4% vs 1.2%, P=0.561).

Secondary endpoint

After single ablation, the recurrence rate in the CLBBB group was significantly higher than that in the Non-CLBBB group (54.8% vs. 31.5%, HR 1.71, 95% CI 1.04-2.79, P=0.034) (Figure 2). In univariate analysis, QRS duration, heart failure, CHA_2DS_2-VASc score, and CLBBB were associated with recurrence. In multivariate analysis, it was shown that heart failure (HR 1.82, 95% CI 1.14-2.91, P=0.010), CHA_2DS_2-VASc score (HR 1.21, 95% CI 1.03-1.43, P=0.022), and CLBBB (HR 2.19, 95% CI 1.09-4.40, P=0.031) were independent risk factors of recurrence after catheter ablation of AF (Table 4).

Fourteen patients (33.3%) in the CLBBB group and 37 (22.0%) patients in the Non-CLBBB group underwent redo procedures. In redo procedures, pulmonary vein reconnections occurred in 12 (85.7%) patients with CLBBB and 30 (81.0%) patients without CLBBB (P=0.121). After the last procedure, the recurrence rate was significantly higher in the CLBBB group than the Non-CLBBB group (35.7% vs. 16.1% P=0.004).

Discussion

To the best of our knowledge, this was the largest study to explore the long-term outcome in patients with CLBBB underwent catheter ablation of AF. This study found that CLBBB was associated with a higher risk of a composite endpoint of stroke, all-cause mortality, and cardiovascular hospitalization in the patients underwent catheter ablation of AF. CLBBB was also an independent risk factor for recurrence of catheter ablation of AF.

AF was the most common tachyarrhythmias, which was an important contributor to population morbidity and mortality. CLBBB and QRS prolongation were also known risk factors for poor cardiovascular prognosis. AF combined with CLBBB was an important clinical situation and was not rarely coexisted. There were several studies exploring the relationship between CLBBB and AF. In the National Inpatient Sample database, 1,420,585 hospitalizations (0.7% of the total sample size) had LBBB. The patients in the LBBB group had a significantly higher prevalence of AF than the Non-LBBB group (30.5% vs. 11.9%). In multiple regression analysis, AF was independently associated with LBBB (odds ratio 1.17, 95%CI 1.16-1.18).[3] In another study, 25,268 patients from 106 centers in the United States with LV dysfunction were enrolled. After adjusting for potential AF risk factors, QRS duration remained independently associated with AF (odds ratio: 1.20, 95% CI: 1.14-1.25).[11] In a large population-based study, QRS duration was an independent predictor of incident AF among women.[12] It was also found that AF was an independent risk factor for bundle branch block (odds ratio: 1.15, 95% CI 1.01-1.31, P = 0.036) in Candesartan in Heart failure Assessment of Reduction in Mortality and morbidity (CHARM) program.[13] However, the study did not classify the subtype of bundle branch block.

Whether AF and CLBBB had a synergistic effect on cardiovascular prognosis remained controversial. In Italian Network on congestive heart failure (IN-CHF) Registry, 185 of 5,517 (3.3%) patients with heart failure had CLBBB and AF. The patients with CLBBB and AF had significantly higher all-cause mortality (HR 1.88, 95%CI 1.37-2.57) and 1-year hospitalization (HR 1.83, 95% CI 1.26-2.67) than the patients without CLBBB and AF, and those with CLBBB or AF alone.[14] In a case report, it was also shown that AF alone (lasting for 6 years) or isolated CLBBB (lasting for 18 months after AF ablation) did not induce cardiomyopathy. However, a combination of AF and CLBBB induced heart failure within 6 months was observed.[15] In order to exclude the influence of LBBB on heart failure which leads to poor outcomes, Rodríguez-Mañero M et al found that the mortality rate of LBBB without cardiac dysfunction population was similar to that of without LBBB group in the Atrial Fibrillation in the BARbanza area (AFBAR) study. In multivariate analysis, LBBB had no significant correlation with all-cause death, all-cause hospitalization, and cardiovascular hospitalization.[16]

The effect of catheter ablation of AF on prognosis remained controversial. To our knowledge, there were no published data on the long-term outcome of the patients with CLBBB and AF who underwent catheter ablation of AF. This study found that CLBBB was an independent risk factor of the composite primary endpoint of stroke, all-cause mortality, and cardiovascular hospitalization. With regard to the component of the primary endpoint, CLBBB significantly increased cardiovascular hospitalization. This finding emphasized the poor prognosis of CLBBB even in those underwent catheter ablation of AF. We all knew that maintenance of sinus rhythm after AF ablation improved prognosis. Catheter ablation still had positive significance for the prevention of heart failure in AF patients combined with CLBBB.[15] However, this study failed to find an association between sinus rhythm and the endpoint events. It suggested that the presence of CLBBB caused an adverse effect on long-term prognosis, which might alleviate the benefits of sinus rhythm.

There were only a few studies discussed the impact of CLBBB on AF recurrence after catheter ablation. In Mujovic's study, bundle branch block was a predictor of very late recurrence after catheter ablation of AF. However, only 5 patients with bundle branch block (3 LBBB and 2 RBBB) were enrolled. Whether LBBB was a predictor of very late recurrence could not be determined for the small sample size.[17] In a retrospective analysis of 674 patients who underwent cryoballoon ablation, the prevalence of LBBB was significantly higher in the very late recurrence group than in those without very late recurrence. That study revealed that CLBBB was an independent predictor of recurrence after long term follow-up. However, only 13 patients with LBBB were enrolled in the study. Whether LBBB was an independent predictor of very late recurrence in multivariate analysis was not shown in the study.[6] This study found that CLBBB was an independent risk factor for recurrence of AF. The baseline characteristics and the ablation strategy of the CLBBB group and the Non-CLBBB group were comparable. However, the mechanism of how CLBBB increased the recurrence of catheter ablation of AF was not well depicted in this study. Pulmonary vein reconnection was a key mechanism of recurrence. In redo procedures, the rate of pulmonary vein reconnection was comparable between the two groups in this study. Previous studies showed that conduction abnormalities such as BBB may develop degeneration/fibrosis of the myocardium, adverse ventricular remodeling, or ischemia.[18-19] Ventricular and atrial fibrosis share some common mechanisms. Diffuse ventricular fibrosis indexed by ventricular T1 relaxation time was independently associated with a higher recurrence rate of catheter ablation of AF.[20]

This study had several limitations. Firstly, this was a retrospective analysis based on a prospective cohort. There may be selection bias due to the inherent deficiency of retrospective study. We tried to reduce bias by propensity-score match and adjusting for possible confounders by multivariate analysis. Secondly, there were only 42 cases of AF combined with CLBBB. However, the natural incidence of CLBBB was low. This study was already the largest study of patients with AF and CLBBB who underwent catheter ablation of AF up to now. Thirdly, the recurrence of AF was detected by symptom and intermittent 12-lead ECG or 24-hour Holter. The recurrence rate may be underestimated, especially with asymptomatic attacks. Finally, the patients with AF and CLBBB who did not undergo catheter ablation were not enrolled in this study. This study was unable to evaluate whether catheter ablation could improve the prognosis of the patients with AF and CLBBB.

Conclusion

This study revealed that CLBBB was associated with a higher incidence of a composite primary endpoint of stroke, all-cause mortality, and cardiovascular hospitalization in the patients who underwent catheter ablation of AF. CLBBB was also an independent risk factor for recurrence of AF after catheter ablation.

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Disclosures

The authors have reported that they have no relationships relevant to the contents of this paper to disclose.

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Tables Table 1: Baseline characteristics**Table 2:** Clinical outcomes in patients with and without CLBBB**Table 3:** Predictors of primary endpoint**Table 4:** Predictors of AF recurrence

Figure titles and legends Figure 1. Kaplan-Meier estimates of primary endpoint Kaplan-Meier analysis demonstrated better survival in the Non-CLBBB group than in the CLBBB group after catheter ablation.**Figure 2.Kaplan-Meier estimates of secondary endpoint**Kaplan-Meier analysis demonstrated that the recurrence-free survival after catheter ablation of AF was significantly lower in the CLBBB group than in the Non-CLBBB group.

Table 1 Baseline characteristics

	CLBBB n=42	Non-CLBBB n=168	P-value
Age, years	65.3±8.7	64.3±9.5	0.557
Female, n(%)	17(40.5)	67(39.9)	0.944
BMI, kg/m^2	23.7±2.8	23.8±3.1	0.910
Persistent AF, n(%)	18(42.9)	66(39.3)	0.805
AF duration, years [M(P_{25}, P_{75})]	1.1(0.2-5.2)	1.1(0.1-5.0)	0.666
ALT, U/L [M(P_{25}, P_{75})]	21.5(17.0-31.8)	21.0(14.0-31.0)	0.441
Cr, umol/L [M(P_{25}, P_{75})]	78.7(70.6-87.6)	77.8(65.4-89.8)	0.747
Hemoglobin, g/L	140.6±17.4	142.5±18.2	0.549
QRS duration, ms [M(P_{25}, P_{75})]	157.0(122.0- 200.0)	90.0(68.0-118.0)	<0.001
Echocardiography			
LAD, mm (x±s)	39.7±5.1	39.3±5.7	0.711
LVEF, % (x±s)	50.9±12.9	51.4±12.7	0.793
LVEDD, mm (x±s)	52.3±5.5	52.3±6.6	0.997
Concomitant disease			
Heart failure, n(%)	8(19.0)	32(19.0)	1.000
Coronary artery disease, n(%)	16(38.1)	57(33.9)	0.744
Hypertension, n(%)	20(47.6)	81(48.2)	1.000
Diabetes Mellitus, n(%)	8(19.0)	30(17.9)	1.000
Ischemic stroke, n(%)	2(4.8)	5(3.0)	0.923
COPD, n(%)	3(7.1)	5(3.0)	0.417
Medication			
ACEI/ARBs, n (%)	15(35.7)	57(33.9)	0.827
Statins, n (%)	10(23.8)	46(27.4)	0.640
β-blockers, n (%)	17(40.5)	49(29.2)	0.158
CHA_2DS_2-VASc score	2.3±1.6	2.2±1.5	0.779

CLBBB: complete left bundle branch block group, Non-CLBBB: non complete left bundle branch block group; BMI: body mass index, AF: atrial fibrillation, ALT: alanine transaminase, Cr: creatinine, LAD: left atrial diameter, LVEF: left ventricular ejection fraction, LVEDD: left ventricular end-diastolic diameter, COPD: chronic obstructive pulmonary disease.

Table 2 Clinical outcomes in patients with and without CLBBB

	CLBBB n=42	Non-CLBBB n=168	HR (95%CI)	P-value
Primary endpoint, n(%)	9 (21.4)	11 (6.5)	3.98 (1.64-9.64)	0.002

	CLBBB n=42	Non-CLBBB n=168	HR (95%CI)	P-value
Stroke	2 (4.8)	4 (2.4)	0.43 (0.08-2.36)	0.333
Cardiovascular hospitalization	6 (14.3)	6 (3.6)	4.83 (1.55-15.07)	0.007
All-cause mortality	2 (4.8)	1 (0.6)	0.11 (0.01-1.21)	0.071
Secondary endpoint Recurrence	23 (54.8)	53 (31.5)	1.71 (1.04-2.79)	0.034

CLBBB: complete left bundle branch block group, Non-CLBBB: non complete left bundle branch block group; HR: hazard ratio, CI: confidence interval

Table 3 Predictors of primary endpoint

Variable	Univariate Analysis	Univariate Analysis	Multivariate Analysis	Multivariate Analysis
	HR (95% CI)	*P* value	HR (95% CI)	P-value
Age	0.99(0.95-1.04)	0.718	-	-
Female	0.60(0.23-1.58)	0.303	-	-
BMI	0.99(0.85-1.14)	0.847	-	-
Persistent AF	0.94(0.36-2.48)	0.900	-	-
AF duration	1.02(0.96-1.09)	0.575	-	-
ALT	1.01(0.99-1.02)	0.321	-	-
Cr	1.00(0.99-1.01)	0.956	-	-
Hemoglobin	1.00(0.98-1.03)	0.807	-	-
QRS duration	1.02(1.01-1.03)	0.001	1.01(0.99-1.04)	0.239
Echocardiography				
LAD	1.03(0.96-1.11)	0.420	-	-
LVEF	0.97(0.94-1.01)	0.127	-	-
LVEDD	1.02(0.95-1.09)	0.624	-	-
Concomitant disease				
Heart failure	2.86 (1.16-7.09)	0.023	1.21(0.30-4.89)	0.789
Coronary artery disease	1.98(0.79-4.96)	0.145	-	-
Hypertension	0.63(0.25-1.58)	0.322	-	-
Diabetes Mellitus	1.45(0.48-4.33)	0.511	-	-
Stroke	6.42(1.45-28.45)	0.014	2.18(0.84-5.63)	0.107
COPD	5.27(1.52-18.29)	0.009	2.19(0.44-10.76)	0.337
CHA_2DS_2-VASc score	1.05(0.77-1.44)	0.742	-	-
CLBBB	3.98(1.64-9.64)	0.002	2.92(1.17-1.34)	0.022
Anticoagulation	1.64(0.22-12.23)	0.632	-	-
Antiplatelet	1.33(0.44-3.98)	0.613	-	-
Recurrence	1.08(0.44-2.64)	0.872	-	-

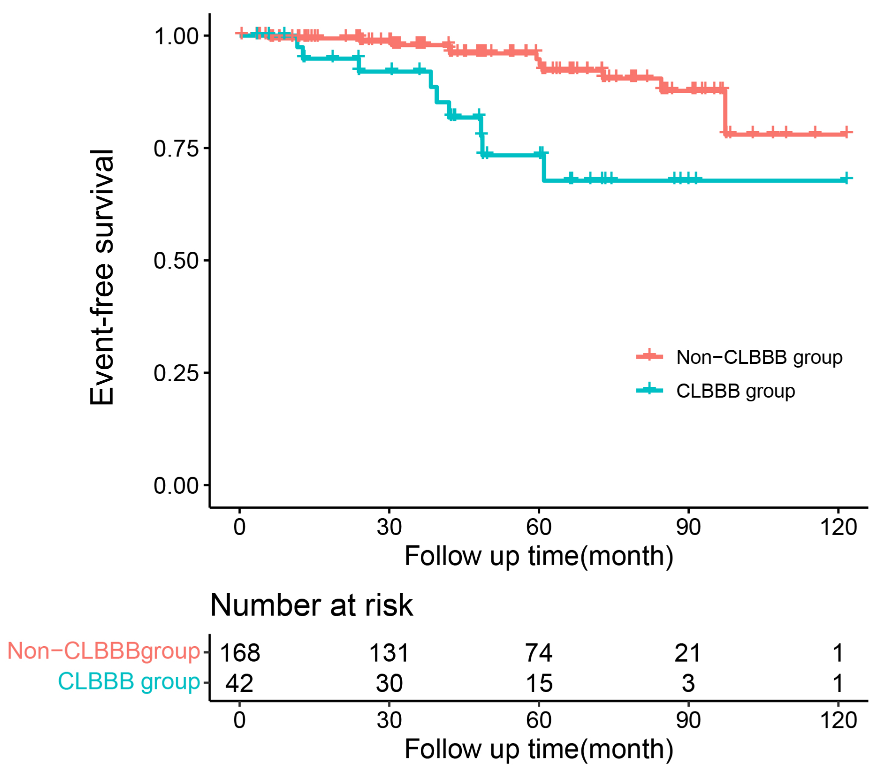
HR: hazard ratio, CI: confidence interval. Other abbreviations were as Table 1.

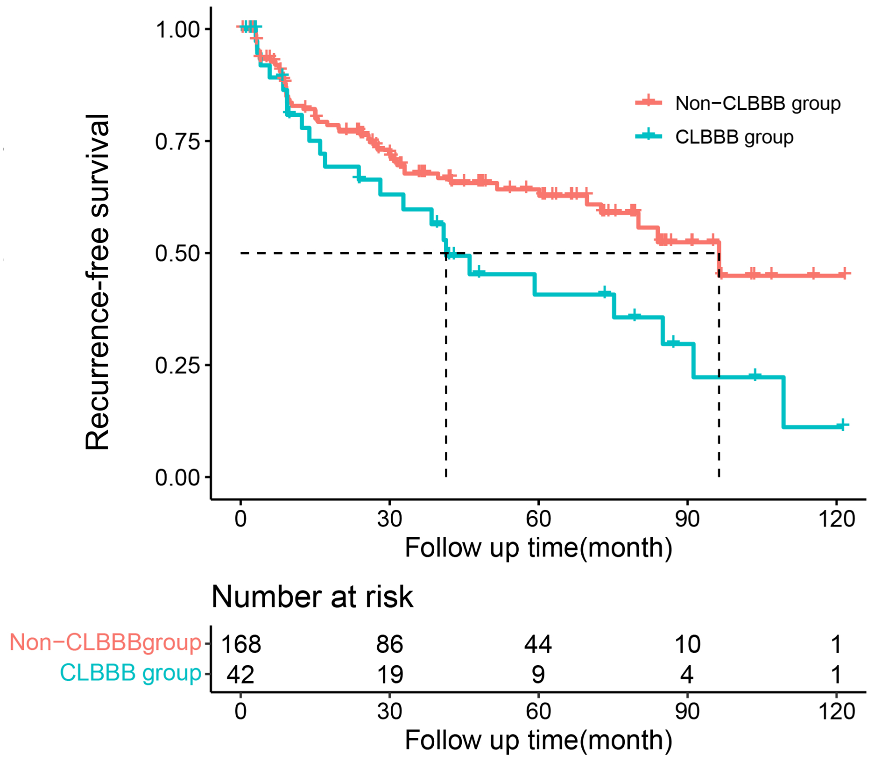
Table 4 Predictors of AF recurrence

Variable	Univariate Analysis	Univariate Analysis	Multivariate Analysis	Multivariate Analysis
	HR (95% CI)	*P* value	HR (95% CI)	P-value
Age	1.02(0.99-1.04)	0.186	-	-

Variable	Univariate Analysis	Univariate Analysis	Multivariate Analysis	Multivariate Analysis
Female	0.74(0.46-1.19)	0.217	-	-
BMI	0.97(0.90-1.04)	0.384	-	-
Persistent AF	1.11(0.70-1.76)	0.652	-	-
AF duration	1.02(0.99-1.05)	0.198	-	-
ALT	0.99(0.98-1.00)	0.404	-	-
Cr	0.99(0.98-1.01)	0.533	-	-
Hemoglobin	0.99(0.97-1.00)	0.852	-	-
QRS duration	1.01(1.00-1.02)	0.041	1.01(0.99-1.04)	0.240
Echocardiography				
LAD	1.03(0.99-1.08)	0.169	-	-
LVEF	0.99(0.97-1.01)	0.264	-	-
LVEDD	1.01(0.98-1.05)	0.471	-	-
Concomitant disease				
Heart failure	1.90(1.10-3.28)	0.021	1.82(1.14-2.91)	0.010
Coronary artery disease	1.06(0.65-1.74)	0.810	-	-
Hypertension	1.28(0.81-2.01)	0.286	-	-
Diabetes Mellitus	1.48(0.85-2.57)	0.171	-	-
Ischemic stroke	1.01 (0.25-4.11)	0.995	-	-
COPD	1.17(0.37-3.71)	0.794	-	-
CHA_2DS_2-VASc score	1.25(1.07-1.46)	0.005	1.21(1.03-1.43)	0.022
CLBBB	2.29(1.23-4.28)	0.012	2.19(1.09-4.40)	0.031

HR: hazard ratio, CI: confidence interval. Other abbreviations were as Table 1.




Recurrence-free survival
1.00
0.75
0.50
0.25
0.00
Non−CLBBB group
CLBBB group
0
30
60
90
120
Follow up time(month)
Number at risk
Non−CLBBBgroup 168 86 44 10 1
CLBBB group 42 19 9 4 1
0
30
60
90
120
Follow up time(month)