Incidence of Late Thromboembolic Events After Catheter Ablation of Atrial Fibrillation

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Background: A low incidence of thromboembolic events after successful catheter ablation of atrial fibrillation (AF) during a mid-term follow-up period was recently reported. However, because the incidence of such events over the long term is unknown, we investigated the late incidence of thromboembolic events after catheter ablation.

Methods and Results: Patients with paroxysmal and persistent AF undergoing catheter ablation and being followed up for at least 24 months formed the study group ($n=524$); 82 patients (16%) had CHADS₂ scores of at least 2. Mean follow-up was 44 ± 13 months. Warfarin was discontinued in 400 (93%) of 429 patients (82% of 524 patients) without AF recurrence. None of the patients without AF recurrence suffered thromboembolic events, whereas 3 of 95 patients (3%) with AF recurrence did ($P<0.001$). One of the 3 was a late AF recurrence occurring >12 months after catheter ablation. There were 2 nonfatal major hemorrhagic events in patients with AF recurrence who continued on warfarin, but no hemorrhagic events were observed in patients free from AF ($P=0.002$).

Conclusions: Maintenance of sinus rhythm after catheter ablation of AF was associated with a lower incidence of thromboembolic events during long-term follow-up >3 years. This result suggests that catheter ablation reduces thromboembolic events if patients continue anticoagulation regardless of the ablation outcome. (*Circ J* 2011; **75**: 2343–2349)

Key Words: Atrial fibrillation; Catheter ablation; Thromboembolic events

Thromboembolic events are a serious complication of atrial fibrillation (AF) and their prevention is a major goal for the management of patient with AF.¹ The AFFIRM study demonstrated the necessity of continued anticoagulation therapy even in AF patients in whom sinus rhythm was maintained by antiarrhythmic drugs.² Catheter ablation has emerged in recent years as a therapeutic option for rhythm control of drug-refractory AF. It is conceivable that rhythm control of AF achieved by catheter ablation might have an outcome different from that achieved by antiarrhythmic drugs with respect to the risk for stroke. Indeed, a recent multicenter cohort study that followed patients for a maximum of 28 months suggested that successful AF ablation abbreviated the necessity of anticoagulation.³ Considering the progressive nature of AF, longer-term follow-up data may provide additional information. In the present study, patients who had undergone AF ablation were followed for a minimum of 2 years, and we report the rate of thromboembolic and hemorrhagic events during the follow-up period.

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Methods

Study Subjects

The patients considered for inclusion in the present study were 659 patients with drug-refractory paroxysmal or persistent symptomatic AF who underwent catheter ablation at Yokosuka Kyosai Hospital from January 2003 to October 2006. The present study group comprised of 524 (80%) of those patients whom we were able to follow for a minimum of 24 months. The patient characteristics were as follows: AF type: paroxysmal 362 (69%), persistent 162; structural heart disease present in 86 (16%); CHADS₂ score ≥ 2 in 82 (16%), of whom 34 (6% of 524) had a history of thromboembolic events; mean age 60 ± 10 years (range 20–80); sex: males 427 (81%), females 97; mean left atrial (LA) diameter 40 ± 6 mm; mean left ventricular ejection fraction 0.64 ± 0.10 .

Received January 24, 2011; revised manuscript received May 15, 2011; accepted May 26, 2011; released online July 21, 2011 Time for primary review: 8 days

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ISSN-1346-9843 doi:10.1253/circj.CJ-11-0065

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Table 1. Baseline Patient Clinical Characteristics

	Patients free from AF (n=429)	Patients with AF recurrence (n=95)	P value
Male, n (%)	352 (82.1)	75 (79.0)	0.469
Age (years)	60.0±10.0	59.3±10.8	0.378
Hypertension, n (%)	170 (39.7)	39 (41.1)	0.818
Diabetes mellitus, n (%)	38 (8.9)	9 (9.5)	0.844
HF, n (%)	31 (7.3)	11 (11.6)	0.208
Structural heart disease, n (%)			
Hypertrophic cardiomyopathy, n (%)	7 (1.6)	2 (2.1)	0.670
DCM, n (%)	14 (3.3)	5 (5.3)	0.363
Valvular heart disease, n (%)	20 (4.7)	6 (6.3)	0.445
Coronary heart disease, n (%)	21 (4.9)	11 (11.6)	0.029
Prior history of cerebral vascular disease, n (%)	28 (6.5)	6 (6.3)	1.000
CHADS ₂ score ≥2, n (%)	65 (15.2)	17 (17.9)	0.755
Persistent AF, n (%)	122 (28.4)	40 (42.1)	0.014
Echocardiography			
Ejection fraction (%)	64.5±9.8	64.5±8.5	0.978
LA size (mm)	39.5±6.0	40.0±7.1	0.503
LA appendage flow velocity (cm/s)	55.5±25.6	52.2±24.0	0.280

AF, atrial fibrillation; HF, heart failure; DCM, dilated cardiomyopathy; LA, left atrium.

Radiofrequency Catheter Ablation

Radiofrequency catheter ablation was performed after discontinuation of antiarrhythmic drugs for ≥5 half-lives. Transesophageal echocardiography was performed in all patients within the 24h before the procedure. Details of the ablation technique have been described previously.^{4,5} In brief, radiofrequency energy was delivered using an 8-mm tip electrode ablation catheter. Pulmonary vein isolation and cavotricuspid isthmus ablation were performed in all patients. In patients with persistent AF, electrogram-based ablation in the LA or coronary sinus, linear ablation at the LA roof and/or mitral isthmus, and superior vena cava isolation were additionally performed at the

discretion of the operator.⁶

Anticoagulation Protocol

All patients were treated with warfarin for at least 1 month before catheter ablation. Warfarin was discontinued 3 days before the procedure, after which heparin was administered intravenously until the procedure. During the procedure, 2 boluses of intravenous heparin (50IU/kg) were administered, 1 prior to the transseptal puncture, and then another immediately following the transseptal puncture. The activated clotting time was evaluated every 30min and maintained at ≥300s during the procedure with a continuous infusion of heparin (1,000IU/h). At the

Table 2. Medication After Catheter Ablation

	Patients free from AF (n=429)	Patients with AF recurrence (n=95)	P value
Warfarin, n (%)	29 (6.8%)	62 (65.3%)	<0.001
Aspirin, n (%)	65 (15.2%)	20 (21.1%)	0.167
ACEI/ARB, n (%)	108 (25.2%)	29 (30.5%)	0.303
β -blocker, n (%)	69 (16.1%)	25 (26.3%)	0.026
Antiarrhythmic drug, n (%)	29 (6.7%)	50 (52.6%)	<0.001
Statin, n (%)	56 (13.1%)	11 (11.6%)	0.865

ACEI, angiotensin-converting enzyme inhibitor; ARB, angiotensin receptor blocker. Other abbreviation see in Table 1.

Figure 2. (a) Kaplan-Meier estimates of the freedom from thromboembolic events. Freedom from atrial fibrillation (AF; Red line) vs. AF recurrence (Green line). Thromboembolic events were significantly lower in patients free from AF. (b) Kaplan-Meier estimates of the freedom from hemorrhagic events. Freedom from AF (Red line) vs. AF recurrence (Green line). Hemorrhagic events were significantly lower in patients free from AF. (c) Kaplan-Meier estimates of the freedom from thromboembolic and hemorrhagic events. Freedom from AF (Red line) vs. AF recurrence (Green line). Thromboembolic and hemorrhagic events were significantly lower in patients free from AF. (d) Kaplan-Meier estimates of the mortality rate. Freedom from AF (Red line) vs. AF recurrence (Green line). The mortality rate was lower in patients free from AF.

end of the procedure, heparin was discontinued and protamine was administered prior to femoral venous sheath removal. Warfarin was re-initiated on the day of the procedure and continued for at least 3 months to keep the international normalized ratio (INR) between 2 and 3. Continuation of warfarin beyond 3 months was determined at the discretion of the physician.

Post-Ablation Follow-up

Patients were followed up in an outpatient clinic at 1, 3 and

6 months after the procedure, then followed up either in an outpatient clinic or contacted by telephone every 12 months. AF recurrence was assessed by patient symptoms in conjunction with serial electrocardiograms performed during every outpatient clinic visit and 24-h Holter monitor recordings performed at 3, 6 and 12 months. Discovery of persistent or paroxysmal episode of AF/AT continuous for ≥ 30 s after the 2-month blanking period was regarded as a recurrence of tachyarrhythmia, and a repeat procedure was performed. Freedom from AF

Table 3. Patients With Thromboembolic Events

Patient no.	Age/sex	Type of AF	Underlying disease	CHADS ₂ score	Time to event after ablation (months)	INR
1	74/F	Paroxysmal	HF	3	24	1.02
2	62/F	Paroxysmal	Prior stroke	2	26	1.38
3	59/M	Paroxysmal	Hypertension, chronic kidney disease	1	50	Not available (warfarin was discontinued)

INR, international normalized ratio. Other abbreviations see in Table 1.

Table 4. Comparison of Clinical Characteristics of Patients With and Without Late Thromboembolic Events

	Patients with thromboembolic events (n=3)	Patients without thromboembolic events (n=521)	P value
Male, n (%)	1 (33.3)	426 (81.7)	0.090
Age (years)	59.8±10.1	65.0±7.9	0.378
Hypertension, n (%)	1 (33.3)	208 (40.0)	1.000
Diabetes mellitus, n (%)	1 (33.3)	46 (8.9)	0.247
HF, n (%)	1 (33.3)	41 (7.9)	0.223
Structural heart disease, n (%)			
Hypertrophic cardiomyopathy, n (%)	0 (0)	9 (1.7)	1.000
DCM, n (%)	0 (0)	19 (3.7)	1.000
Valvular heart disease, n (%)	2 (66.7)	24 (4.6)	0.007
Coronary heart disease, n (%)	1 (33.3)	31 (6.0)	0.729
Prior history of cerebral vascular disease, n (%)	1 (33.3)	33 (6.3)	0.183
CHADS ₂ score ≥2, n (%)	2 (66.7)	80 (15.4)	0.065
Persistent AF, n (%)	0 (0)	162 (31.1)	0.556
AF recurrence	3 (100)	92 (17.6)	0.006
Warfarin, n (%)	2 (67)	89 (17.1)	0.080
Echocardiography			
Ejection fraction (%)	71.7±1.8	64.4±96	0.286
LA size (mm)	36.2±3.1	39.6±6.2	0.441
LA appendage flow velocity (cm/s)	88.3±15.2	54.7±25.3	0.061

Abbreviations see in Table 1.

was defined as no detectable AF episode by using these modalities after the final procedure. AF recurrence >12 months after catheter ablation was defined as late AF recurrence. Thromboembolic events, especially cerebrovascular events including transient ischemic events and ischemic stroke, were defined as the abrupt onset of focal neurological deficit.⁷ Thromboembolic events occurring ≥1 month after the procedure were defined as late thromboembolic events. The end-points of the study were late thromboembolic events, hemorrhagic events and mortality.

Statistical Analysis

Continuous variables are expressed as mean ± 1 standard deviation. Comparison between groups was performed with Student's t-test or the Wilcoxon rank-sum test, as appropriate. For categorical data, Fisher's exact test was applied. A P value <0.05 (2-tailed) was considered to indicate statistical significance. Kaplan-Meier analysis was performed to assess differences in the incidence of late thromboembolic events, hemorrhagic events and mortality rate between patients with and without AF recurrence. All statistical analyses were performed using commercially available computer software (JMP version 6, SAS Institute, Tokyo, Japan).

Results

Among the 524 patients, 429 (82%) maintained sinus rhythm after catheter ablation. Mean follow-up duration was 44±13 months. The proportion of patients with persistent AF (42.1%) was significantly higher in patients with AF recurrence compared with those without (28.4%, $P=0.014$, [Table 1](#)). Persistent AF was the sole independent predictor for AF recurrence in multivariable analysis (odds ratio 2.00; 95% confidence interval 1.23–3.11; $P=0.004$). CHADS₂ score was similar between patients with and without AF recurrence ([Figure 1](#)). Among the 95 patients with AF recurrence, late AF recurrence was observed in 3 patients. Time from the catheter ablation to these late AF recurrences was 25, 31 and 40 months, respectively.

Anticoagulation Status

Warfarin was discontinued in 432 (82%) of 524 patients after the procedure. Of the 429 patients who remained free from AF throughout the follow-up period, only 29 (7%) were continued on warfarin, whereas 63 of the 95 patients (66%) in whom AF recurred were continued on warfarin ([Table 2](#)). The reason for warfarin discontinuation in the 32 patients with AF recurrence was a CHADS₂ score of 0 in 26 patients, and drug intolerance in the remaining 6 patients even though their CHADS₂ score

Table 5. Cause of Death of Individual Patients

Patient no.	Age/sex	Underlying disease	Final rhythm	Anticoagulation therapy	Cause of death	Follow-up (months)
1	74/F	Valvular heart disease	AF	Warfarin	HF	24
2	60/F	CAD	AF	None	Interstitial pneumonia	28
3	55/M	DCM	SR	Warfarin	Sudden death	30
4	67/F	DCM	AF	Warfarin	Interstitial pneumonia	30
5	76/M	Hypertension, CAD	SR	None	Gastric cancer	36
6	64/M	None	AF	None	Lung cancer	47
7	64/M	Valvular heart disease	SR	None	Sepsis	55
8	71/M	Hypertrophic cardiomyopathy	SR	None	Sepsis	61
9	53/M	Hypertension	SR	None	Pancreatic cancer	64
10	69/M	None	AF	Warfarin	Pneumonia	67

CAD, coronary artery disease; SR, sinus rhythm. Other abbreviations see in Table 1.

was ≥ 2 . There were 82 patients with CHADS₂ score ≥ 2 , 65 (79% of 82) of whom were without AF recurrence. Warfarin was discontinued in 53 patients (82%) of the latter group.

Late Thromboembolic Events

None of the 429 patients without AF recurrence had thromboembolic events, whereas 3 of 95 patients with AF recurrence had thromboembolic events. Kaplan-Meier estimate of freedom from thromboembolic events at 5 years was 100% in patients free from AF, whereas the rate was 94% in patients with AF recurrence (log-rank test: $P < 0.001$, [Figure 2a](#)). The clinical characteristics of the 3 patients who had thromboembolic events are shown in [Table 3](#). The first was a 74-year-old woman with a CHADS₂ score of 3 (hypertension, diabetes and heart failure) who had a cerebral infarction of the right hemisphere 24 months after catheter ablation. At the time of the infarction, she had been on warfarin since confirmation of AF recurrence at the 3-month follow-up visit. However, the INR was 1.02. The second case was a 62-year-old woman with a CHADS₂ score of 2 (history of prior stroke) who suffered cerebral infarction of the left hemisphere 26 months after catheter ablation. She also was on warfarin, which had been resumed when AF recurrence was confirmed by Holter monitor recording 10 months after catheter ablation. The INR was 1.38 at the time of infarction. The third was a 59-year-old man with a CHADS₂ score of 1 (hypertension) and history of endstage renal disease because of chronic glomerular nephritis. He had a transient ischemic attack 50 months after the catheter ablation. Although late AF recurrence was confirmed by patient symptoms and electrocardiogram 40 months after the ablation, warfarin was not reinitiated. [Table 4](#) summarizes the comparisons of baseline patient characteristics in patients with and without thromboembolic events. The prevalence of valvular heart disease and the incidence of AF recurrence were significantly higher in patients with thromboembolic events compared with those without thromboembolic events. However, neither was an independent predictor of late thromboembolic events in the multivariable analysis.

Hemorrhagic Events

Non-fatal hemorrhagic events occurred in 2 of 95 patients with AF recurrence, both of whom were on warfarin, whereas no hemorrhagic events occurred in patients free from AF. The 2 events were intramuscular bleeding of a left lower extremity 47 months after catheter ablation and gastrointestinal bleeding 35 months after catheter ablation. The INR at the time was 1.83 and 2.83, respectively. The HAS-BLED bleeding risk

score was similar between patients with and without hemorrhagic events (0.50 ± 0.71 vs. 0.78 ± 0.79). Kaplan-Meier estimates of freedom from hemorrhagic events at 5 years were 100% in patients free from AF, and 95% in patients with AF recurrence (log-rank test: $P = 0.002$, [Figure 2b](#)). The event-free survival estimates for freedom from thromboembolic and hemorrhagic events were significantly different between the 2 groups ([Figure 2c](#)).

Mortality Rate

There were 10 deaths ([Table 5](#)), 5 among the 429 patients maintaining sinus rhythm (1 sudden death, 4 non-cardiac deaths), and 5 among the 95 patients with AF recurrence (1 CHF, 4 non-cardiac deaths). Kaplan-Meier estimates of freedom from death at 5 years were 95% in patients free from AF, and 94% in patients with AF recurrence (log-rank test: $P = 0.027$, [Figure 2d](#)). Although the all-cause mortality rate was significantly different between the 2 groups, the cardiac death rate was not different between them (0.2% vs. 0.9%; $P = 0.21$).

Discussion

The main findings of the present study are: (1) freedom from AF was associated with low incidence of thromboembolic events during long-term follow-up > 3 years after catheter ablation despite discontinuation of anticoagulants in 90% of the patients; (2) hemorrhagic events occurred only in patients who continued on warfarin; and (3) late AF recurrence with subsequent thromboembolic events was observed.

Thromboembolic Events During Long-Term Follow up After Catheter Ablation

There have been several studies showing that maintenance of sinus rhythm is associated with low incidence of thromboembolic events after catheter ablation.^{3,8,9} Among them, the longest mean follow-up period was 28 months and thromboembolic events were lower in patients free from atrial tachyarrhythmia, compared with those without, after catheter ablation of AF (0.07% vs. 0.45%).³ The present study extended the mean follow-up period to greater than 3 years and demonstrated a similar trend (ie, elimination of atrial arrhythmias by catheter ablation was found to attenuate risk of thromboembolism in patients with AF). In our univariable analysis, both the incidence of AF recurrence and the prevalence of valvular heart disease were high in patients with thromboembolic events compared with patients without. However, they were not independent predic-

tors in the multivariable analysis, perhaps because of the small number of thromboembolic events in the present study.

Antithromboembolic Therapy After Catheter Ablation

In this study, warfarin was discontinued in >90% of patients without AF recurrence. In particular, approximately 80% of the 82 patients with CHADS₂ score ≥ 2 did not have AF recurrence and none suffered thromboembolic consequences despite termination of warfarin. According to the HRS/EHRA/ECAS Expert Consensus Statement,¹⁰ discontinuation of warfarin therapy post ablation is not generally recommended in patients who have a CHADS₂ score ≥ 2 because of limited data regarding the safety of treatment cessation. There is another report advocating the need for continued warfarin after catheter ablation in patients with thromboembolic risk.¹¹ Because we had enrolled patients with CHADS₂ score ≥ 2 who underwent catheter ablation before the publication of those reports, warfarin was discontinued in patients with thromboembolic risk in the same manner as in patients without thromboembolic risk. Considering that all thromboembolic events observed in our study occurred in patients with thromboembolic risk, warfarin should be continued in high-risk patients, regardless of their rhythm status after catheter ablation. However, in their report Themistoclakis et al emphasized the benefit of discontinuing warfarin even in high-risk patients for thromboembolic events if the patient was free from AF, because of the increased risk of a major hemorrhage compared with the low thromboembolic event rate (2% vs. 0.04%).³ In the present study, there were 2 hemorrhagic events that occurred in patients who had AF recurrence and continued to be on warfarin, whereas no thromboembolic or hemorrhagic events occurred in AF-free patients who discontinued warfarin. Obviously, a prospective study with a large number of high-risk patients will be necessary to investigate the incidence of stroke and bleeding after catheter ablation. If warfarin is discontinued after successful ablation, it should be reinstated once AF recurrence is confirmed in high-risk patients for thromboembolic events, regardless of the type of AF. A previous study demonstrated the presence of hypercoagulability in the LA of patients with paroxysmal AF and thromboembolic risk, even in the non-paroxysmal period, suggesting that patients with paroxysmal AF are at high risk for developing cerebral thromboembolism even during sinus rhythm.¹² Another study demonstrated that stroke rates in patients with paroxysmal AF were similar to those in patients with persistent AF and similar stroke risk factors,¹³ and that advanced age and structural heart disease were independent predictors for thrombus formation in the LA.¹⁴ Therefore, resumption of warfarin should not be based on the type of AF, but on the thromboembolic risk in patients with AF recurrence. In addition to the reinstating of warfarin in patients with AF recurrence, maintenance of the therapeutic range of warfarin is critical. In the present study, the INR were below the therapeutic range in the 2 patients with thromboembolic events who had continued on warfarin, which suggests the importance of both close monitoring of INR and determining the appropriate warfarin dose.

Undetected AF Recurrence

Although warfarin was discontinued in most of the patients free from AF without causing any thromboembolic events in this study, the possibility of undetected AF recurrence was a major motivation to continue warfarin in a minority of patients. There is a report that asymptomatic episodes significantly increase after catheter ablation in patients presenting with highly symptomatic AF before catheter ablation.¹⁵ According

to 2 reports in which AF recurrence was assessed by permanent pacemaker (PPM), continuous monitoring provided by the PPM was able to detect significantly more AF episodes than routine follow-up methods. One report determined that PPM detected atrial tachyarrhythmia recurrences in 30% of patients without symptoms of AF, and revealed that most of these episodes were <60 s in duration and subsided within 3 months.¹⁶ The second report compared freedom from AF as assessed by patient symptoms (71% of patients after catheter ablation), 24- to 48-h Holter monitor recording every 6 months (64%), 1-week Holter monitor recording every 6 months (58%), and continuous monitoring by the PPM (43%). The authors concluded that the more rigorous the monitoring, the more AF was uncovered. However, the duration of atrial tachyarrhythmia was significantly reduced from a median of 3.6 to 0.3 h/day after catheter ablation.¹⁷ Data about the association between the duration of AF episodes and the occurrence of thromboembolic events are scarce Capucci et al that found that thromboembolic events were frequently observed only in patients in whom the duration of device-detected AF was longer than 24 h.¹⁸ Nademanee et al found that the incidence of thromboembolic events associated with undetected AF was low and concluded that undetected AF might be of short duration and inconsequential.⁹ In summary, the literature suggests that although the number of undetected AF episode may increase after catheter ablation, the duration of individual episodes decreases, usually to less than 24 h, a duration not associated with thromboembolic events. In the present study, undetected AF recurrence must have been present, because it was not assessed by continuous cardiac rhythm monitoring devices. However, because no thromboembolic events were associated with undetected AF recurrence, the follow-up method of using patient symptoms, serial electrograms and 24-h Holter monitor recordings to catch only significant AF recurrences associated with thromboembolic events may be sufficient. Combined with the fact that the prolonged use of event monitoring and PPM in all patients after catheter ablation would not be feasible in clinical practice, the results of the present study demonstrate the applicability and frequency of our follow-up method after catheter ablation.

Late AF Recurrence

According to the literature, the incidence of late AF recurrence is 5.8–13.0% at 2 years, and 25.5–46.8% at 5 years^{19–22} or approximately 7% per year after the first year.²³ The incidence of late AF recurrence was lower in the present study than in those previous reports. In addition to institutional differences, this is likely because late AF recurrence was defined as AF recurrence after the initial procedure in the previous studies, whereas we defined it as recurrence of AF after the last of one or more ablations. In line with previous reports, which demonstrated that late AF recurrence is more likely to occur in patients with hypertension,²¹ persistent AF, and in older patients,²³ a late AF recurrence followed by a thromboembolic event occurred in an aged hypertensive patient in our study. In addition to the fact that persistent AF was the sole independent predictor for AF recurrence in the present study, clinicians should be aware of the importance of long-term vigilance for AF recurrence, especially in patients with thromboembolic risk and/or persistent AF.

Study Limitations

First, our study was small, retrospective and an observational cohort study. Second, most of the patients enrolled in our study were at low to moderate risk for thromboembolic events, which may have led to the low incidence of thromboembolic

events. To address these 2 issues, a larger and randomized trial including a greater proportion of patients with high thromboembolic risk would be required for a comparison of the continuation or discontinuation of warfarin. However, discontinuation of anticoagulation in patients with a high risk of thromboembolism after ablation may be ethically unfeasible. Thus, it is still safe and ethical to continue warfarin in patients with thromboembolic risk regardless of the cardiac rhythm after catheter ablation. Third, it is likely that some of the patients we regarded as being free from AF had undetected AF recurrences in the absence of continuous monitoring devices. These false negatives, if detected, should have been included in the patients with AF recurrence. Because no late thromboembolic events were observed in patients free of AF (true and false negatives), we believe our results and methods for AF recurrence detection are nevertheless relevant in clinical practice. Fourth, we partially attributed the lower incidence of late AF recurrence in our study to the difference in the definition of late AF recurrence, but the decreasing frequency with which we monitored patients after 12 months after the final procedure may have also been a factor. Therefore, in future studies close follow-up during a long-term period should be continued in order not to overlook significant AF episodes. Lastly, screening of stroke using magnetic resonance imaging was not performed, so minor stroke events may have been undetected.

Conclusion

Maintenance of sinus rhythm after catheter ablation of AF was associated with a lower incidence of thromboembolic events during a long-term follow-up. Stroke occurred in 1 patient who had AF recurrence late (≥ 1 year) after catheter ablation. AF may occur late after catheter ablation, which is not predictive by any cardiac rhythm monitoring. Thus, discontinuation of warfarin after successful ablation should be based on risk factors. However, anticoagulation therapy using warfarin includes some issues; such as bleeding, intolerability, or unstable INR control, and these may be attributable to thromboembolism in patients who are taking warfarin. The results of the present study suggest that catheter ablation reduces thromboembolic events if patients continue anticoagulation regardless of the ablation outcome.

Disclosure

There are no financial or other relations that lead to a conflict of interest.

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