Feasibility and Safety of Uninterrupted Dabigatran Therapy in Patients Undergoing Ablation for Atrial Fibrillation

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Abstract

Objective Uninterrupted oral warfarin strategy has become the standard protocol to prevent complications during catheter ablation (CA) for the treatment of atrial fibrillation (AF). However, little is known about the safety and efficacy of uninterrupted dabigatran therapy in patients undergoing CA for AF. Therefore, this study investigated the safety and efficacy of uninterrupted dabigatran therapy and compared the findings with those for uninterrupted warfarin therapy.

Methods Bleeding and thromboembolic events during the periprocedural period were evaluated in 363 consecutive patients who underwent CA for AF at Nagoya University Hospital, and received uninterrupted dabigatran (n=173) or uninterrupted warfarin (n=190) for periprocedural anticoagulation.

Results A total of 27 (7%) patients experienced either bleeding or thromboembolic complications. Major bleeding complications occurred in 2 (1%) patients in the dabigatran group (DG) and 2 (1%) patients in the warfarin group (WG). Eight (5%) patients in the DG and 9 (5%) patients in the WG experienced groin hematoma, a type of minor bleeding complication. Meanwhile, no patient in the DG and 1 (1%) in the WG developed cerebral ischemic stroke. Overall, there was no significant difference between the groups for any category. The activated partial thromboplastin time (APTT) independently predicted periprocedural complications in the DG.

Conclusion Uninterrupted dabigatran therapy in CA for AF thus may be a safe and effective anticoagulant therapy, and appears to be closely similar to continuous warfarin; however, it is essential to pay close attention to the APTT values when using dabigatran during CA.

Key words: dabigatran, atrial fibrillation, catheter ablation

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Introduction

Catheter ablation (CA) has generally been established as the standard therapy for atrial fibrillation (AF) (1, 2), and its popularity is gradually increasing (3). However, stroke and thromboembolism can be serious periprocedural complications following left atrial ablation (3). AF ablation utilizing uninterrupted dose-adjusted warfarin has been shown to be

safe and it is associated with fewer major bleeding complications (4, 5) than an approach using low molecular-weight heparin while bridging with discontinuous warfarin (6). Because in interrupted anticoagulation therapy for AF ablation, heparin is used as an anticoagulant during the periprocedural period, in particular, against an activated coagulation cascade (7), we have to simultaneously be on the lookout for both thromboembolic complications and bleeding complications.

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Dabigatran, an oral direct thrombin inhibitor, has been approved as a new oral anticoagulant for the prevention of stroke in patients with nonvalvular AF as an alternative to warfarin (8). However, whether dabigatran is as safe and efficacious as warfarin for periprocedural anticoagulation therapy in AF ablation remains controversial. Some studies have shown the safety and feasibility of periprocedural dabigatran use during ablation for AF (9, 10), while others found dabigatran to be associated with a higher frequency of periprocedural embolic events than warfarin (11), which is consistent with the published findings of meta-analyses (12, 13). In addition, this controversy might result from the various time points at which dabigatran was withheld or restarted (9-11) and while also possibly depending on the interrupted dabigatran strategy for left atrial ablation compared with uninterrupted warfarin therapy (9-11). Three meta-analyses showed that dabigatran use to be equally safe and effective in comparison to warfarin use (14-16). However, the effectiveness of dabigatran use still remains unclear because the protocols for dabigatran use differ from trial to trial (14-16).

We therefore propose a new strategy of uninterrupted dabigatran administration throughout the AF ablation procedure since this strategy has not yet been fully investigated. The aim of this study is to evaluate the safety and efficacy of uninterrupted periprocedural dabigatran compared with uninterrupted warfarin therapy and to identify any possible risk stratification factors for periprocedural dabigatran use.

Materials and Methods

Study subjects

We conducted a retrospective chart review of 400 consecutive patients who underwent radiofrequency CA for AF at the Nagoya University Hospital between April 2012 and November 2013. All patients provided their written informed consent. At least 4 weeks prior to CA, 190 patients received dabigatran at a dose of 110 or 150 mg twice daily, and 210 patients received dose-adjusted warfarin. The exclusion criteria were as follows: age >75 years; creatinine clearance <30 mL/min (17). The dose of dabigatran was determined according to the renal function or age. A low dose of dabigatran (110 mg twice daily) was administered to patients who had the following conditions: mild renal dysfunction [creatinine clearance (Ccr), 30-50 mL/min], advanced age (70-75 years), a past history of upper gastrointestinal ulcer, or the coadministration of glycoprotein inhibitors (amiodarone or verapamil). On the other hand, the warfarin dose was adjusted to maintain a target international normalized ratio (INR) of 1.6-2.6 for older patients (70-75 years) and 2.0-3.0 for younger recipients (younger than 70 years). Dabigatran was administered twice a day at 7 AM and 7 PM. Warfarin and dabigatran were continued throughout the periprocedural period, respectively. Furthermore, the patients in the dabigatran group (DG) received morning and evening

dose on the day of the procedure as usual. Heparin was used only during the CA procedure. All patients continued taking each agent for at least 3 months after the CA procedure.

Ablation procedure

All patients were admitted to our hospital on the day before undergoing the CA procedure. In both groups, blood samples were obtained from every patient approximately 2 hours after they took the anticoagulant because of the peak plasma concentration of dabigatran (18). In tests of blood coagulation, prothrombin time (PT) and activated partial thromboplastin time (APTT) values were obtained using the STA Neoplastin Plus[®] (Diagnostica Stago, Asnières, France) and the STA APTT[®] (Diagnostica Stago) reagent, respectively. Transthoracic and transesophageal echocardiography were performed to confirm the cardiac function and exclude the presence of atrial thrombus just before the CA procedure. The morning and afternoon session was started at 9 AM, 1 PM, respectively. Two 8 Fr. sheaths, one 8.5 Fr. steerable sheath, and one 6 Fr. sheath were inserted in the right femoral vein, with one 8 Fr. sheath in the left subclavian vein and one 4 Fr. sheath in the right femoral artery. Intravenous heparin was administered with an initial dose of 5,000 units immediately after inserting the sheaths, the activated clotting time (ACT) was monitored every 30 minutes after the heparin boluses, and additional heparin was administered as necessary with the goal to achieve an ACT of 300 to 350 seconds. After transseptal puncture was performed under intracardiac echocardiography, three sheaths were placed in the left atrium (LA). A circular ring catheter (Lasso[™], Biosense Webster, Diamond Bar, USA) was placed in the ostium of each pulmonary vein (PV) and pulmonary venography was performed for each PV. Encircling PV isolation was performed with a 3.5 mm tip open-irrigated ablation catheter (Biosense Webster) and the CARTO3[™] mapping system (Biosense Webster) by the double-Lasso technique (19). The radiofrequency energy output was titrated to 25-35 W at a flow rate of 17-30 mL/min, with a maximum temperature of 42°C. After the successful isolation of all PVs, isoproterenol (5-20 µg/min) was administered, and burst atrial pacing was performed until the shortest cycle length that allowed 1:1 atrial capture from proximal coronary sinus (CS), distal CS, and high right atrium to induce AF. If AF was induced and sustained, then additional substrate modification, including ablation targeting the complex fractionated atrial electrograms, linear ablation of the LA, and isolation of the superior vena cava were performed (20-22). If AF did not subside after these procedures, then the sinus rhythm was restored by internal cardioversion. Cavotricuspid isthmus ablation was performed in all patients (23). Immediately after completion of the CA procedure, protamine (30-40 mg) was administered to reverse the effect of heparin and then all the sheaths were removed from the patient.

Table 1. Patient Characteristics.

	Dabigatran n=173	Warfarin n=190	p value
Age (years)	59±13	59±9	0.76
Sex (female)	39 (23)	44 (23)	0.76
BW (kg)	67 ± 13	66 ± 13	0.54
BMI (kg/m ²)	24±4	24±3	0.67
Non Paroxysmal AF	49 (28)	68 (36)	0.08
Coronary artery disease (%)	10 (6)	7(4)	0.39
Hypertension	68 (39)	63 (33)	0.32
Diabetes mellitus	12 (7)	22 (12)	0.11
History of heart failure	12 (7)	19 (10)	0.25
Prior stroke/TIA	7 (4)	10 (5)	0.54
CHADS2 score	0.6 ± 0.9	0.7 ± 0.9	0.55
0	95 (55)	97 (51)	0.44
1	52 (30)	60 (31)	0.81
≥2	26 (15)	33 (17)	0.52
CHA2DS2-VASc score	1.2±1.2	1.3±1.4	0.25
HAS-BLED score	0.8 ± 0.9	0.9 ± 0.9	0.61
LA size (mm)	38 ± 6	39 ± 7	0.15
LVEF (%)	62 ± 7	61 ± 7	0.15
LAA velocity (cm/s)	65 ± 24	62 ± 25	0.50
BNP (pg/mL)	32 (16, 73)	41 (20, 83)	0.11
Ccr (mL/min)	96 ± 35	90 ± 34	0.11
PT (sec)	16 ± 4	23±5	< 0.001
INR	1.3 ± 0.4	2.2 ± 0.5	< 0.001
APTT (sec)	53 ± 16	44 ± 8	< 0.001
Fibrinogen (mg/dL)	308 ± 57	316 ± 71	0.13
D-dimer (µg/mL)	0.6 ± 0.2	0.6 ± 0.4	0.12
Medication			
Aspirin	14 (8)	17 (9)	0.69
Clopidogrel	2 (1)	0 (0)	0.15
PPI/H ₂ RA	46 (27)	41 (22)	0.36
NSAID	3 (2)	2 (1)	0.61
AAD	31 (18)	43 (23)	0.20

Values are the mean ± standard deviations (SD) or n (%). Abbreviations: BW: body weight, BMI: body mass index, AF: atrial fibrillation, TIA: transient ischemic attack, LA: left atrium, LVEF: left ventricular ejection fraction, LAA: left atrial appendage, BNP: brain natriuretic peptide, Ccr: creatinine clearance, PT: prothrombin time, INR: international normalized ratio, APTT: activated partial thromboplastin time, PPI: proton pump inhibitor, H₂RA: histamine H₂-receptor antagonist, NSAID: non-steroidal anti-inflammatory drugs, AAD: antiarrhythmic drug

Postprocedural management and follow-up

Hematomas and pericardial effusion with or without tamponade were considered to be bleeding complications. Bleeding requiring blood transfusion and pericardial effusion with drainage were classified as major bleeding complications. Small groin hematomas and pericardial effusion that did not require drainage, which were confirmed after the procedure, were classified as minor bleeding episodes. Cerebrovascular accidents, transient ischemic attacks, and systemic emboli were classified as thromboembolic complications after intracranial hemorrhage was ruled out based on the findings of computed tomography. Patients who developed complications received appropriate intervention promptly. Periprocedural complications are defined as adverse events which occur within 30 days before or after the ablation procedure.

Statistical analysis

All continuous variables are expressed as the mean ± SD. All categorical variables are reported as the number (per-

Table 2. Procedural Values.

	Dabigatran n=173	Warfarin n=190	p value
ACT after heparin bolus (sec)	278 ± 68	315 ± 61	< 0.001
Maximum ACT (sec)	344 ± 54	358 ± 47	< 0.05
Minimum ACT (sec)	243 ± 43	270 ± 37	< 0.001
Mean ACT (sec)	284 ± 48	312 ± 35	< 0.001
procedure time (min)	153 ± 46	168 ± 40	0.79
UFH (U/kg/h)	62 ± 29	58 ± 27	< 0.001

Values are the mean ± SD, Abbreviations: ACT: activated clotting time, UFH: unfractionated heparin, U: unit

centage) of patients. The unpaired Student's *t*-test was used to analyze variables that exhibit normal distribution to compare continuous variables while Mann-Whitney *U* test was used for the variables that didn't exhibit it, and categorical variables were compared using either the chi-square test or Fisher exact test. Thereafter, univariate and multivariate logistical regression analyses were performed to evaluate the predictors of complications. Subsequently, the receiver-operating characteristic (ROC) curve was analyzed to determine the optimal cutoff value of APTT. For this cutoff point, the sensitivity and specificity were calculated using standard formulas. A p value <0.05 was considered to be statistically significant. All results were analyzed using the SPSS software program version 18.0 (SPSS, Chicago, USA).

Results

Baseline characteristics

A total of 400 patients underwent left atrial CA. Thirty-seven patients (9%) were excluded based on the exclusion criteria. There were 173 patients in the DG and 190 patients in the warfarin group (WG). The baseline characteristics of each group are summarized in Table 1. Briefly described, there was no differences were observed with the exception of some factors identified by the anticoagulation test between both groups.

Procedural values

The procedural values are summarized in Table 2. The ACT after heparin bolus, maximum ACT, minimum ACT, and mean ACT were significantly lower in the DG than in the WG. The procedure time did not differ between the groups. The mean total unfractionated heparin requirement per weight and time was significantly higher in the DG than in the WG.

Complications

The details of complications during the periprocedural period are shown in Table 3. A total of 27 (7%) patients had either bleeding complications or thromboembolic complications, with bleeding complications accounting for 26 (7%) of these. Major bleeding complications occurred in 2 (1%) of 173 patients in the DG and 2 (1%) of 190 patients in the

Table 3. Complications.

	Dabigatran n=173	Warfarin n=190	p value
Total bleeding complications	12 (7)	14 (7)	0.89
Major bleeding complications			
Cardiac tamponade	2 (1)	2 (1)	0.93
Vascular complication	0 (0)	0 (0)	N/A
Minor bleeding complications			
Groin hematoma	8 (5)	9 (5)	0.96
Pericardial effusion without tamponade	1 (1)	3 (2)	0.36
Thromboembolic complications			
Stroke or TIA	0 (0)	1 (1)	0.34
Total complications	12 (7)	15 (8)	0.75

Values are n (%), Abbreviations: TIA: transient ischemic attack,
N/A: not available

WG. Pericardial effusion with tamponade occurred in 2 (1%) patients in the DG and 2 (1%) patients in the WG. All patients with pericardial tamponade required pericardiocentesis. Pericardiocentesis was successfully performed, and the hemodynamic function was restored in all patients. Minor bleeding complications occurred in 9 (6%) patients in both groups. In the DG, the administration of dabigatran was discontinued for two days in the patients that demonstrated major bleeding complications while it was continued in the patients that showed minor bleeding complications. Thromboembolic complications occurred in 1 (1%) patient in the WG, whereas no thromboembolic complications were observed in the DG. Taken together, there were no significant differences were found between both groups in any of these categories.

Predictor of complications

We subsequently performed a univariate logistic regression analysis to examine any correlations between the conventional risk factors and complications. The HAS-BLED score was the only predictor of complications in the WG, while APTT and mean ACT were associated with complications in the DG (Table 4). Meanwhile, the start time of session was not predictive of bleeding and/or thromboembolic complications in the DG (Table 4). According to a multivariate logistic regression analysis after controlling for predictive values in univariate analysis, APTT independently predicted the occurrence of periprocedural complications in the DG (Table 5). The distribution of the APTT value was shown in the patients with or without complications (Fig. 1). APTT value was higher than in the patients with complications than in those without complications. The ROC curve was used to estimate the APTT values which predict complications as shown in Fig. 2. The area under the curve (AUC) was 0.86 (95%CI 0.78-0.94, $p<0.001$). In addition, Fig. 2 showed that a cutoff value of 65 seconds was able to predict the occurrence of complications with a sensitivity and specificity of 66.7% and 87.1%, respectively. Meanwhile, the ROC curve analysis of the mean ACT values demonstrated that a cutoff value of 298 seconds (AUC=0.74; 95%CI 0.59-0.90) was able to predict complications with a 75.7% of sensitivity and a 71.7% of specificity.

Discussion

Main findings

The present study demonstrated no differences in the periprocedural complications between uninterrupted dabigatran use and uninterrupted warfarin use, which thus shows the safety and efficacy of uninterrupted dabigatran in patients undergoing ablation for AF. In addition, APTT independently predicts the occurrence of periprocedural complications in dabigatran therapy.

Periprocedural complications in uninterrupted dabigatran strategy

The uninterrupted warfarin strategy is currently recommended (4-6) because the CA procedure stimulates thrombogenicity and increases the risk of thromboembolic complications (7). Therefore, adequate anticoagulation therapy is required continuously, not only during the CA procedure but also before and immediately after the procedure. Given the aforementioned increase in thrombogenicity, discontinuing dabigatran during the periprocedural period may expose CA recipients to temporary suboptimal anticoagulation, especially in cases without heparin-bridging, owing to the short half-life of dabigatran activity (18). This has been reported to result in a higher occurrence of thromboembolic complications than with uninterrupted warfarin treatment (11), and this phenomenon is considered to depend on discontinuing dabigatran during the procedural period. In a meta-analysis comparing most of the patients receiving interrupted dabigatran use with the patients receiving warfarin use, dabigatran use was significantly associated with higher frequency of thromboembolic events (12). In this study, we maintained persistent anticoagulation condition using uninterrupted dabigatran for periprocedural anticoagulation therapy, even if protamine was administered to reverse the effect of heparin immediately after the procedure, with the goal of preventing thromboembolic complications without increasing bleeding complications during the periprocedural period. Recently, Maddox et al. reported a series involving the use of uninterrupted dabigatran throughout the AF ablation procedure as an alternate approach to the use of uninterrupted warfarin (24). Further evaluations are required to determine which method is better: interrupted or uninterrupted dabigatran therapy.

Coping with bleeding during anticoagulant use

When anticoagulants such as warfarin and dabigatran are used uninterruptedly during the periprocedural period, we have to pay careful attention to bleeding complications. Warfarin has vitamin K as an antidote, but it takes several hours for its action to take effect. Especially in the case of severe and life-threatening bleeding, fresh frozen plasma, prothrombin complex concentrates and activated recombinant factor VII (rVIIa) are required to cancel the anticoagu-

Table 4. Univariate Predictors of Complications.

	Dabigatran n=173			Warfarin n=190		
	Complications			Complications		
	Yes	No	p	Yes	No	p
No. of patient	12	161		15	175	
Age (years)	63 ± 12	59 ± 13	0.27	62 ± 6	59 ± 9	0.07
Sex: female	4 (33)	35 (22)	0.44	3 (20)	43 (25)	0.69
BW (kg)	62 ± 16	67 ± 13	0.13	68 ± 14	66 ± 14	0.52
BMI(kg/m ²)	22 ± 3	24 ± 4	0.25	25 ± 5	23 ± 4	0.20
Non Paroxysmal AF	2 (17)	25 (16)	0.60	6 (40)	65 (37)	0.63
Coronary artery disease	0 (0)	10 (6)	1.0	0 (0)	6 (3)	1.0
Hypertension	3 (25)	65 (40)	0.29	3 (20)	65 (37)	0.27
Diabetes mellitus	0 (0)	12 (7)	1.0	2 (13)	20 (11)	0.51
History of heart failure	0 (0)	12 (7)	1.0	0 (0)	20 (11)	1.0
Prior stroke/TIA	1 (0)	6 (4)	0.44	1 (7)	8 (5)	0.44
CHADS2 score	0.4 ± 0.7	0.7 ± 0.9	0.24	0.8 ± 0.9	0.6 ± 0.8	0.37
0	8 (67)	87 (54)	0.72	7 (47)	90 (51)	0.44
1	3 (25)	49 (30)	0.40	5 (33)	55 (31)	0.77
≥2	1 (8)	25 (16)	0.54	3 (20)	30 (17)	0.69
CHA2DS2-VASc score	1.5 ± 1.4	1.2 ± 1.2	0.35	1.4 ± 1.4	1.3 ± 1.3	0.77
HAS-BLED score	0.8 ± 0.8	0.8 ± 0.9	0.96	1.3 ± 0.8	0.7 ± 0.9	<0.05
LA (mm)	37 ± 8	39 ± 7	0.48	39 ± 6	40 ± 7	0.85
LVEF (%)	59 ± 7	63 ± 7	0.11	61 ± 6	61 ± 7	0.96
Ccr (mL/min)	90 ± 32	97 ± 35	0.51	81 ± 26	92 ± 37	0.77
D-dimer (μg/mL)	0.6 ± 0.1	0.6 ± 0.2	0.53	0.6 ± 0.1	0.7 ± 0.5	0.34
INR	1.3 ± 0.2	1.3 ± 0.4	0.61	2.2 ± 0.5	2.2 ± 0.7	0.99
APTT(sec)	71 ± 18	51 ± 13	<0.001	47 ± 9	44 ± 9	0.23
ACT after heparin bolus (sec)	315 ± 80	277 ± 67	0.50	338 ± 53	313 ± 60	0.14
Maximum ACT (sec)	360 ± 47	345 ± 45	0.21	356 ± 45	357 ± 46	0.92
Minimum ACT (sec)	263 ± 52	242 ± 42	0.12	286 ± 46	269 ± 36	0.08
Mean ACT (sec)	313 ± 80	286 ± 43	<0.05	313 ± 44	312 ± 34	0.87
Procedure time (min)	172 ± 50	152 ± 44	0.63	138 ± 40	170 ± 44	0.47
Morning session	6 (50)	75 (47)	0.82			
Afternoon session	6 (50)	86 (53)	0.82			
UFH (U/kg/h)	50 ± 33	62 ± 21	0.12	41 ± 27	48 ± 22	0.28
Medication						
Aspirin	0 (0)	14 (9)	1.0	3 (20)	13 (7)	0.10
Clopidogrel	0 (0)	2 (1)	1.0	0	0	1.0
Dabigatran 300 mg	2 (17)	37 (23)	0.61			

Values are the mean ± SD or n (%). Abbreviations are summarized in Table 1 and Table 2.

Table 5. Univariate and Multivariate Predictors of Complications in Patients with Dabigatran Use.

	Univariate Analysis			Multivariate Analysis		
	OR	95% CI	p value	OR	95% CI	p value
APTT (sec)	1.08	1.04-1.13	< 0.001	1.09	1.04-1.14	< 0.001
Mean ACT (sec)	1.02	1.00-1.04	< 0.05			

Values are mean ± SD or n (%) and 95% confidence interval (CI). OR: odds ratio
Abbreviations are summarized in Table 1 and Table 2.

lant effect. On the other hand, dabigatran does not have any effective antidotes. rVIIa and prothrombin complex concentrates (PCC) might be active for the rapid reversal of dabigatran's effect (25). In addition, a monoclonal antibody has been developed for clinical application (26), although its efficacy remains unclear. Furthermore, we should carefully monitor for the presence of systemic thrombotic emboli because rVIIa and PCC may cause an increased risk of thrombotic complications when the coagulation factors are rapidly replaced during anticoagulation (27, 28). There were no pa-

tients who required the administration of antidotes, such as coagulation factor complexes, to cancel both drugs during the periprocedural period in this study. Therefore further evaluations are required for the use of rVIIa and PCC.

ACT level during AF ablation

The concomitant effect of dabigatran and heparin remains unclear. Dabigatran has been shown to prevent ACT from prolongation and it requires a greater amount of heparin administration compared with warfarin in a standard-procedure

Figure 1. The APTT value and complications. The APTT value is higher in the patients with complications than in those without complications. The error bar indicates the mean $\pm$ SD.

Figure 2. The ROC curve showing the optimal cut off value for APTT to predict complications with a sensitivity of 66.7% and a specificity of 87.1%. The area under the curve is 0.86. AUC: area under the curve, CI: confidence interval

heparin protocol during AF ablation (29). A poor response to heparin with dabigatran is fairly consistent with our results. The ACT level, however, was associated with complications during dabigatran use. In addition, the ROC curve suggested that the mean ACT value of 297 seconds could predict complications with a 75% of sensitivity and a 71% of specificity. These results may suggest that we should reconsider heparin administration to maintain a lower target ACT level in an uninterrupted dabigatran strategy than warfarin therapy. We have already understood that open-irrigated tip catheters can also allow lower ACT levels (30). However, another report showed that ACT <300 seconds predicted the occurrence of silent stroke which was confirmed by performing magnetic resonance imaging after the procedure (31). Therefore, future detailed investigations are required to determine the optimal ACT levels in uninterrupted dabigatran use.

The significance of preoperative APTT values in the DG

It is crucial for the prevention of bleeding complications to recognize the degree of anticoagulant effect of dabigatran in the preoperative phase because an adequate dose of heparin is used to maintain the ACT levels during the periprocedural period of AF ablation, especially in the patients receiving uninterrupted dabigatran therapy. The ecarin clotting time and thrombin time assay are reported to be useful and highly sensitive as tools for determining dabigatran's anticoagulant effect (32). However, these tests are not generally available in hospital laboratories. Meanwhile, PT or APTT is routinely and easily available at any time. A previous report showed the APTT levels to be correlated with the plasma concentration, although its concentration-response curve was curvilinear (33). This fact suggests that the excessive prolongation of the values causes the occurrence of bleeding events. The present study demonstrated that preoperative high APTT levels (>65 seconds), which correspond to about

double that of the standard value (33 seconds) in this institution, predicted the occurrence of bleeding complications with a high specificity and a relatively low sensitivity. However, further investigation is required with regard to the blood sampling time because dabigatran has an intra-individual variability due to its low bioavailability (34).

Limitations

There are some limitations associated with this study. First, the present study was a single-center retrospective observational study. Second, older patients with a severe renal function, who had either a high CHADS₂ score or HAS-BLED score, were not sufficiently investigated due to the exclusion criteria (17). In addition, there might have been some selection bias in the two groups due to the research method used in this study. Finally, a larger number of patients would be needed to confirm the efficacy of preventing thromboembolic or bleeding events because the low event rates of complications observed in both groups might have been related to the small sample size.

Conclusion

The findings of this study suggested that uninterrupted dabigatran use during AF ablation for anticoagulant strategy could maintain the same level of the safety and efficacy as that associated with uninterrupted warfarin use. If we can pay close attention to APTT values, then uninterrupted dabigatran use may become an alternative anticoagulation method with warfarin for AF ablation.

The authors state that they have no Conflict of Interest (COI).

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