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Metabolic benefits of rivaroxaban in non-valvular atrial fibrillation patients after radiofrequency catheter ablation

Jun ZHU[1], Rong-jun GAO[1,2], Qiang LIU[1], Ru-hong JIANG[1], Lu YU[1], Ya-xun SUN[1], Pei ZHANG[1], Jian-wei LIN[1], Yang YE[1], Zu-wen ZHANG[1], Shi-quan CHEN[1], Hui CHENG[1], Xia SHENG[1], Chen-yang JIANG[†‡1]

([1]*Department of Cardiology, Sir Run Run Shaw Hospital, School of Medicine, Zhejiang University, Hangzhou 310016, China*)

([2]*Traditional Chinese Medicine Hospital of Wuhu, Anhui 241000, China*)

[†]E-mail: cyjiang@zju.edu.cn

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Abstract: Background and objective: Rivaroxaban is a new oral anticoagulant for stroke prevention in patients with non-valvular atrial fibrillation (NVAF), which has less drug–food interaction than warfarin. We conducted this prospective randomized study to evaluate the metabolic benefits as well as the safety and efficacy with rivaroxaban versus warfarin in patients with NVAF following radiofrequency catheter ablation (RFCA). Methods: From April to July 2014, 60 patients with NVAF undergoing RFCA were prospectively enrolled in our study. Following RFCA, all patients were randomly assigned to receive rivaroxaban (Group R, n=30) or warfarin (Group W, n=30). Metabolic indices including serum total protein, albumin, globulin, and high-density lipoprotein (HDL) as well as bleeding, stroke, and systemic thromboembolism events were evaluated and compared during follow-up after 15, 30, 60, and 90 d of RFCA procedure. Results: Serum total protein, albumin, globulin, and HDL levels were all significantly elevated at each follow-up stage in Group R when compared to the baseline (P<0.05 respectively). In Group W, the metabolic indices decreased at first and then had an increasing trend. There were no deaths or thromboembolic complications in each group. The prevalence of total bleeding complications was similar between Group R and Group W (11/30, 36.7% vs. 10/30, 33.3%, P=0.79). Conclusions: Patients with NVAF receiving rivaroxaban after RFCA procedures appear to benefit from a metabolic perspective compared with warfarin, providing practical clinical reference for the choice of the anticoagulant. Rivaroxaban seems to be as safe and effective in preventing thromboembolic events as warfarin for these patients.

Key words: Atrial fibrillation; Radiofrequency catheter ablation; Anticoagulation; Rivaroxaban
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1 Introduction

Atrial fibrillation (AF) is the most common clinical arrhythmia around the world and has the potential to increase the stroke rate by 4–5 times (January *et al.*, 2014). Anticoagulation therapy is the most effective method to prevent stroke and systematic thromboembolism events (Vazquez *et al.*, 2010). Up to now, the optimal anticoagulation protocols after radiofrequency catheter ablation (RFCA) for non-valvular atrial fibrillation (NVAF) patients are still being investigated (Santangeli *et al.*, 2012; Kim *et al.*, 2013). Warfarin has been shown to be safe and effective when maintaining a therapeutic international normalized ratio (INR) between 2 and 3 (Ansell *et al.*, 2008). However, warfarin has a number of limitations when it comes to clinical use, such as low patient compliance, narrow therapeutic window, and various interactions with food and medications. Patients taking warfarin are asked to avoid dietary changes,

‡ Corresponding author
ORCID: Chen-yang JIANG, http://orcid.org/0000-0002-1015-8691; Jun ZHU, http://orcid.org/0000-0003-1111-6159

especially with foods that are rich in vitamin K, in order to maintain a stable INR level. As an alternative to vitamin K antagonists (VKAs), new oral anticoagulants (NOACs) such as rivaroxaban have an advantage of less drug–food interactions (Heidbuchel *et al.*, 2013) and have been approved for the prevention of stroke and systemic embolism in patients with NVAF. There have been some investigations regarding the safety and feasibility of rivaroxaban administration in NVAF patients (Fox *et al.*, 2011; Dillier *et al.*, 2014; Lakkireddy *et al.*, 2014). However, there are little data exclusively on Chinese patients and almost none on the patients' metabolic changes. We conducted this prospective, randomized, warfarin-control study to evaluate the metabolic benefits with rivaroxaban and reassessed the safety and efficacy of rivaroxaban administration in NVAF patients, hoping to provide a practical clinical reference for the choice of an anticoagulant.

2 Materials and methods

2.1 Study population

The study continuously enrolled 60 paroxysmal or persistent NVAF patients who were scheduled to have RFCA procedures between April and July 2014 at the Sir Run Run Shaw Hospital (SRRSH), School of Medicine, Zhejiang University, Hangzhou, China. All patients provided a written informed consent and the study was approved by the Ethics Committee at SRRSH. Patients were screened by inclusion criteria and exclusion criteria before randomization. Inclusion criteria were assessed as follow: (1) man or women >18 years of age; (2) patient was not on anticoagulation therapy prior to enrollment; (3) patient understood the aim of the study and consented to following the study protocol. Patients were excluded from the study based on pre-set conditional parameters, including: (1) AF due to cardiac valvular disease or reversible causes (such as electrolyte imbalance or hyperthyroidism); (2) patient had contraindication to the use of anticoagulation therapy. All patients received low molecular weight heparin (LMWH) twice a day upon hospitalization until the day before ablation. Trans-esophageal echocardiography (TEE) was performed on the morning of the procedure to rule out left atrial (LA) thrombus. There was no LA appendage thrombus detected on TEE in any of the patients from either group. Paroxysmal and persistent AFs were defined according to the American Heart Association/American College of Cardiology/Heart Rhythm Society (AHA/ACC/HRS) guidelines (January *et al.*, 2014): paroxysmal AF as self-terminating AF episodes lasting <7 d and persistent AF as AF episodes lasting >7 d. Early AF recurrence was defined as atrial arrhythmia ≥30 s (including AF, atrial flutter, or atrial tachycardia) during the 90-d follow-up period.

2.2 Anticoagulation regimen

The catheter ablation procedure has been described in our previous publications (Cheng *et al.*, 2014; Jiang *et al.*, 2014). After the RFCA procedure, patients were randomly assigned to the following two groups.

Rivaroxaban group (Group R, n=30): rivaroxaban (Xarelto®, Bayer AG, 51368 Leverkusen, Germany) was administered at a dosage of 20 mg (as no patients had a creatinine clearance level <50 ml/min) orally once per day after randomization. LMWH was discontinued subsequently after rivaroxaban administration. Patients were instructed to take the pills during evening with a meal.

Warfarin group (Group W, n=30): warfarin (Orion Pharma, Orionintie 1, 02200, Espoo, Finland) was introduced at a dosage of 3 mg orally once per day after randomization and was adjusted individually in order to maintain an INR level within 2–3. LMWH was discontinued once the INR level reached 1.5. Patients were asked to check the INR level either at a local hospital or with our facility at their own discretion. The frequency for INR examination was every 3 d post discharge and then once a week when the INR had stabilized between 2 and 3.

Both medications were continued for at least 90 d after RFCA procedure.

2.3 Clinical follow-up

Standard clinical follow-up was performed at 15, 30, 60, and 90 d after the RFCA procedure and any time when the patient experienced symptoms. Twelve-lead electrocardiogram (ECG) and blood analysis were routinely conducted. Blood analysis included complete blood cell count (CBC), electrolytes, renal function, liver function, and coagulation function. Urine and stool were also tested for occult bleeding.

The safety and efficacy endpoints were defined as follows: the safety endpoint was the composite endpoint of major bleeding (required medical intervention such as fatal outcome, intracranial hemorrhage, blood transfusion, or surgical intervention), overt bleeding (required medical attention not meeting criteria for major bleeding), minor bleeding (occult bleeding), and drug adverse effects. The efficacy endpoint was the composite endpoint of stroke and non-central nervous systemic embolisms.

2.4 Statistical analysis

Continuous variables are presented as mean value±standard deviation (SD) and compared using independent Student's *t*-test or nonparametric Wilcoxon tests where appropriate. Categorical data are presented as exact numbers or percentages and compared using Chi-square test or Fisher's exact test. The statistical significance for all tests was accepted at a two-tailed *P*-value <0.05. All analyses were performed with IBM SPSS Version 20.0 software (SPSS, Inc., Chicago, Illinois, USA) for Windows.

3 Results

3.1 Baseline characteristics

Throughout the study, 60 subjects were enrolled (Table 1). Patients in Group R trended towards an older age than those in Group W, but the differences were not significant (*P*=0.07). With a mean body mass index of 22–25, the patients were overweight but not obese. AF disease comorbidities were limited with the exception of a high rate of hypertension. $CHADS_2$ (congestive heart failure, hypertension, age, diabetes mellitus, and prior stroke, transient ischemic attack, or thromboembolism), CHA_2DS_2-VASc (congestive heart failure, hypertension, age, diabetes mellitus, and prior stroke, transient ischemic attack, or thromboembolism, vascular disease, female sex), and HAS-BLED (hypertension, abnormal renal/liver function, stroke, bleeding history or predisposition, labile international normalized ratio, elderly, drugs/alcohol concomitantly) scores were similar between the two groups with a moderate to high risk of thromboembolism. Mean left ventricular ejection fractions were around 70%, which was suggestive of an otherwise good cardiac condition. The main concomitant medication was amiodarone for nearly half of the patients in each group.

As shown in Table 2, 10 patients in Group R were in sinus rhythm (SR) upon applying the RFCA procedure while 11 in Group W were in SR (*P*=0.79). There were no significant differences in ablation strategy, cardioversion rate, procedural time, or fluoroscopy time between the two groups. After follow-up of 90 d, early recurrence rates in the two groups were also similar (16.7% vs. 20.0%, *P*=0.74).

Table 1 Baseline characteristics of patients on rivaroxaban and warfarin

Baseline characteristics	Group R (*n*=30)	Group W (*n*=30)	*P* value
Age (year)	62.1±9.7	56.8±11.9	0.07
Female sex	10 (33.3%)	15 (50.0%)	0.19
BMI (kg/m^2)	22.9±3.5	25.5±2.8	0.26
Paroxysmal AF	13 (43.3%)	14 (46.7%)	0.80
AF duration (month)	41.2±61.1	35.9±54.6	0.72
Medical history			
Hypertension	15 (50.0%)	16 (53.3%)	0.80
CAD	1 (3.3%)	1 (3.3%)	1.00
Diabetes mellitus	3 (10.0%)	4 (13.3%)	0.69
Prior TIA or stroke	6 (20.0%)	3 (10.0%)	0.28
Chronic renal insufficiency	0 (0.0%)	0 (0.0%)	1.00
$CHADS_2$ score	1.2±1.1	1.1±0.9	0.63
CHA_2DS_2-VASc score	2.0±1.5	1.8±1.4	0.46
HAS-BLED score	1.2±1.0	1.0±0.7	0.56
LAD (mm)	38.4±8.2	37.3±6.6	0.59
LVEF (%)	68.5±9.9	67.8±7.8	0.77
Concomitant medication			
Aspirin	0 (0.0%)	1 (3.3%)	0.31
Clopidogrel	0 (0.0%)	0 (0.0%)	1.00
β-Blocker	1 (3.3%)	5 (16.7%)	0.09
Amiodarone	14 (46.7%)	15 (50.0%)	0.80
ACEI or ARB	7 (23.3%)	6 (20.0%)	0.75
CCB	5 (16.7%)	7 (23.3%)	0.52
Statins	7 (23.3%)	7 (23.3%)	1.00

Data are expressed as mean±SD or exact number (percentage). BMI: body mass index; AF: atrial fibrillation; CAD: coronary artery disease; TIA: transit ischemic attack; LAD: left atrial diameter; LVEF: left ventricular eject fraction; ACEI: angiotensin converting enzyme inhibitor; ARB: angiotensin receptor blocker; CCB: calcium channel blocker

3.2 Metabolic effect

With patients receiving rivaroxaban, serum total protein, albumin, and globulin levels were all significantly elevated at 15, 30, 60, and 90 d follow-up, respectively, when compared with the baseline (Table 3). The elevation was considerably stable throughout the study as the quotients of actual number of each follow-up and baseline number consistently above 1.0 with a slightly decreasing trend (Fig. 1a). In Group W, the metabolic levels first decreased and then had an increasing trend (Table 3 and Fig. 1b). High-density lipoprotein (HDL) levels in both groups were increased significantly during follow-up when compared with the baseline.

3.3 Safety and efficacy endpoints

There were no deaths or thromboembolic events observed in either group. Altogether, 22/60 (36.7%) patients experienced bleeding or other complications (Table 4). The prevalence of total bleeding events (safety endpoint) was similar between Group W and Group R (33.3% vs. 36.7%, P=0.79). There was no major bleeding event in either group. Overt bleeding

Table 2 Comparison of procedural data between patients on rivaroxaban and warfarin

Group	Sinus rhythm upon RFCA	Additional linear ablation	Cardioversion during RFCA	Procedural time (min)	Fluoroscopy time (min)	Early AF recurrence 90 d post-RFCA
Group R (n=30)	10 (33.3%)	20 (66.7%)	15 (50.0%)	156.0±52.3	26.0±11.1	5 (16.7%)
Group W (n=30)	11 (36.7%)	18 (60.0%)	14 (46.7%)	134.3±40.4	21.0±9.3	6 (20.0%)
P value	0.79	0.59	0.80	0.11	0.08	0.74

Data are expressed as mean±SD or number (percentage). RFCA: radiofrequency catheter ablation; AF: atrial fibrillation

Table 3 Comparison of metabolic levels between patients on rivaroxaban and warfarin

Time	Serum total protein (g/L)		Albumin (g/L)		Globulin (g/L)		HDL (mmol/L)	
	Group R	Group W	Group R	Group W	Group R	Group W	Group R	Group W
Baseline	68.1±5.4	69.3±5.9	41.1±3.3	42.5±3.9	27.0±3.8	26.8±4.6	1.2±0.3	1.2±0.3
15 d	75.8±4.9*	66.8±5.0	45.4±1.9*	40.5±4.1	30.4±3.8*	26.3±3.8	1.4±0.4*	1.1±0.3
30 d	74.8±4.3*	68.6±4.2	45.1±2.7*	41.2±3.1	29.7±2.9*	27.4±3.4	1.4±0.5*	1.3±0.4*
60 d	73.5±4.2*	70.4±2.8	44.7±2.5*	42.8±3.4	28.8±3.4*	27.6±3.6	1.3±0.3*	1.5±0.3*
90 d	73.7±4.2*	74.3±3.2*	44.9±2.7*	43.5±4.2*	28.8±2.8*	30.8±4.2*	1.4±0.4*	1.5±0.4*

Data are expressed as mean±SD (n=30 in each group). * P<0.05 when compared with baseline in each group and metabolic index

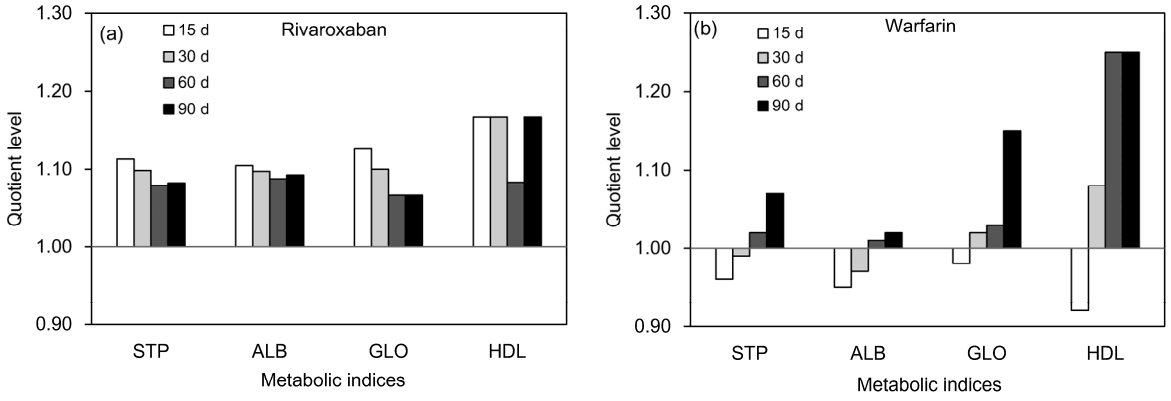

Fig. 1 Metabolic effect of rivaroxaban and warfarin on protein and lipids

Values are presented as quotient of actual number of each follow-up and baseline number. (a) Metabolic indices of patients in Group R at 15, 30, 60, and 90 d after RFCA, which showed elevated metabolic levels at each follow-up when compared with the baseline and a slightly decreasing trend. (b) Metabolic indices of patients in Group W at each follow-up, suggesting a drop at 15 d and an increasing trend. STP: serum total protein; ALB: albumin; GLO: globulin; HDL: high-density lipoprotein

Table 4 Comparison of complications between patients on rivaroxaban and warfarin

Endpoint	Group R (*n*=30)	Group W (*n*=30)	Total (*n*=60)	*P* value
Safety endpoint	12 (40.0%)	10 (33.3%)	22 (36.7%)	0.59
Major bleeding event	0 (0.0%)	0 (0.0%)	0 (0.0%)	1.00
Overt bleeding event	0 (0.0%)	2 (6.7%)	2 (3.3%)	0.15
Groin hematoma	0 (0.0%)	1 (3.3%)	1 (1.7%)	0.31
Increased menstruation	0 (0.0%)	1 (3.3%)	1 (1.7%)	0.31
Minor bleeding event	11 (36.7%)	8 (26.7%)	19 (31.7%)	0.41
Dental bleeding	4 (13.3%)	4 (13.3%)	8 (13.3%)	1.00
Hematuria	6 (20.0%)	3 (10.0%)	9 (15.0%)	0.28
Hematochezia	1 (3.3%)	1 (3.3%)	2 (3.3%)	1.00
Drug adverse effect	1 (3.3%)*	0 (0.0%)	1 (1.7%)	0.31
Efficacy endpoint	0 (0.0%)	0 (0.0%)	0 (0.0%)	1.00

Data are expressed as number (percentage). * One patient receiving rivaroxaban had a drug side effect of rash and itching, and therefore rivaroxaban was stopped and the patient was switched to warfarin

occurred in 2 (6.7%) patients in Group W (1 groin hematoma and 1 increased menstruation), while no event occurred in Group R (*P*=0.15). Minor bleeding occurred in 8 (26.7%) patients in Group W (4 dental bleeding, 3 hematuria, and 1 hematochezia) and 11 (36.7%) in Group R (4 dental bleeding, 6 hematuria, and 1 hematochezia) (*P*=0.41). One patient in Group R had a drug adverse effect of rash and itching; therefore rivaroxaban was stopped and the patient was switched to warfarin. All bleeding patients had uneventful recoveries after symptomatic treatments and they all resumed anticoagulation therapy.

4 Discussion

4.1 Main findings

Our study primarily focuses on the metabolic benefits as well as safety and efficacy with rivaroxaban administration in NVAF patients after undergoing RFCA. The main findings are:

1. Patients receiving rivaroxaban after RFCA procedures seem to benefit on a metabolic level with elevated serum total protein, albumin, globulin, and HDL compared with the warfarin patients. Less dietary restriction might be the underlying reason for this advantage.

2. Rivaroxaban appears to be a safe and effective alternative anticoagulant to warfarin in preventing thromboembolic events for these patients.

4.2 Metabolic benefit with rivaroxaban

To our best knowledge, there are little data reported regarding the metabolic effects with rivaroxaban and warfarin in NVAF patients after undergoing RFCA procedures. The two medications have no direct influence on patients' metabolic levels or nutritional conditions (Francart *et al*., 2014). However, due to the different drug–food interactions and doctors' orders, we found an interesting change in patients' metabolic indices. In our study, the results show that patients receiving rivaroxaban have elevated levels of serum total protein, albumin, and globulin at follow-up with a slightly decreasing trend as anticoagulation continues, while patients receiving warfarin have a drop in those levels at 15 d after medication and then have an increasing trend up to 90 d. At the end of follow-up, patients in both groups had similar levels for the metabolic indices.

Albumin is an essential plasma protein synthesized by the liver, which has various functions including transporting and binding of physiologically important compounds (e.g. fatty acids, bilirubin, tryptophan, electrolytes, and steroid hormones) and maintenance of osmotic pressure (Doweiko and Nompleggi, 1991). Healthy individuals maintain a plasma albumin concentration between 35 and 50 g/L through the rate of albumin synthesis, degradation, release from liver cells, distribution in the body, and exogenous loss (Doweiko and Nompleggi, 1991). The half-life of albumin is approximately 19 d (Duly *et al.*,

2003) and studies (Jackson *et al.*, 2001; Caso *et al.*, 2007; Thalacker-Mercer *et al.*, 2007) have shown that dietary protein intake can affect serum albumin levels due to its influence on the albumin fractional synthesis rate (FSR). Thalacker-Mercer *et al.* (2007) showed that an 18-d controlled feeding period with protein intake of 63%, 94%, and 125% of the recommended dietary allowance (RDA) resulted in significantly different levels of serum albumin. In clinical practice, patients are asked to have different dietary adjustments based on different anticoagulants after RFCA procedures. Patients receiving warfarin are advised to be much stricter with diet as doctors repeatedly tell them that various kinds of food can interact with warfarin, especially those that are rich in vitamin K. In our routine post-procedural medical order, patients are asked to stick to semi-fluid diets such as porridge, noodle, or dumplings as their staple food during the first 6 weeks after the RFCA procedure. Doctors would also suggest that patients should stay on similar diet when they are on warfarin as it is easier to maintain INR levels within 2–3 with less fluctuation. Dietary counseling might contribute to the drop of protein and HDL levels during the early period of follow-up. As patients continue with a similar diet, they expressed more complaints and began to diversify their choice of food (such as pork and others), thus potentially accounting for the elevation of proteins and lipids. For patients receiving rivaroxaban, they are told at the beginning of the treatment that this medication has little interaction with food so that they have fewer restrictions of diets. After receiving operations such as RFCA procedures, patients tend to have nutritious meals hoping to return sooner to good health. This may explain the continuous elevation of protein and lipids in the rivaroxaban group. Our study suggests that when choosing rivaroxaban as the anticoagulant after RFCA procedures, patients might have better nutritional states due to less concern over dietary restrictions, which could be helpful for recovery. As an alternative anticoagulant to warfarin, rivaroxaban has some clinical advantages in short-term administration from a nutritional perspective. This may help provide practical clinical reference regarding the choice of anticoagulant. Larger prospective randomized trials are needed to further verify the conclusion and investigate the benefits of long-term use of rivaroxaban.

4.3 Anticoagulation therapy and complication

Bleeding and thromboembolic events are the most common complications for AF patients receiving anticoagulation therapy (Vazquez *et al.*, 2010), which still remain a significant concern to clinical physicians. The incidence of periprocedural thromboembolic events in patients after AF ablation is reported to be 0.1%–1.1% (Takahashi *et al.*, 2009; Cappato *et al.*, 2010; Gaita *et al.*, 2010), while the incidence of bleeding complications in patients receiving anticoagulation therapy post procedure ranges from 12.2% to 20.0% (Hussein *et al.*, 2009; Kwak *et al.*, 2010). Up till now, a few randomized trials in the general AF population have demonstrated the non-inferior efficacy and safety of rivaroxaban over warfarin. Research from Eitel *et al.* (2013) showed that anticoagulation therapy with NOACs after AF ablation is safe and effective. Piccini *et al.* (2013) suggested that rivaroxaban could be used periprocedurally with no differences in long-term stroke or survival rates compared to warfarin. Similar as previous reports, our study shows that rivaroxaban administration after RFCA procedure is safe and effective. There were no deaths or thromboembolic events in either group. The overall bleeding rate was 35%, which seemed a little higher than that in previously published studies (Hussein *et al.*, 2009; Kwak *et al.*, 2010) mainly due to different definitions of bleeding complications. In the ROCKET-AF (rivaroxaban once-daily, oral, direct factor Xa inhibition compared with vitamin K antagonism for prevention of stroke and embolism trial in atrial fibrillation) study (Patel *et al.*, 2011), bleeding complications were classified as major bleeding (required medical intervention such as fatal outcome, surgical intervention, or blood transfusion), clinically relevant non-major bleeding (required medical attention not meeting criteria for major bleeding), and minor bleeding (other clinically overt bleeding episodes). The overall bleeding rate was around 15%. In the periprocedural rivaroxaban study conducted by Dillier *et al.* (2014), they categorized bleeding events as major bleeding (required medical intervention) and minor bleeding (hematomas and pericardial effusions). The overall bleeding rate was 8%–13%. In our study, besides major bleeding and overt bleeding (required medical attention not meeting criteria for major bleeding, such as hematoma and increased menstruation), we defined

minor bleeding as occult bleeding such as hematuria and hematochezia. The detection of bleeding complication was stricter than that of previous studies, which might result in higher bleeding rate. As a matter of fact, major bleeding and overt bleeding in our study were only 6.7%. Occult and dental bleedings were the most common complains in patients receiving both medications (Camm *et al.*, 2016), which should be handled seriously and taken into consideration when choosing anticoagulation therapy. Consistent with the findings by Dillier *et al.* (2014) and Lakkireddy *et al.* (2014), we found evidence neither of an increased risk of stroke or systemic embolism nor of an increased bleeding risk in patients treated with rivaroxaban compared with warfarin. Our data, along with the results from previous studies, suggest that rivaroxaban might represent an optimal anticoagulant agent for patients with NVAF following RFCA procedures.

4.4 Limitations

The present study is a single center, randomized, open-label study with a limited number of patients. Given the size of the study and the low event rate for thromboembolic events and bleeding complications, we are limited in drawing any final conclusions about the efficacy and safety of rivaroxaban in the prevention of thromboembolic events. However, the findings of the present study are consistent with previous reported studies, which provide more information and evidence for the clinical administration of rivaroxaban. Additionally, this study suggests that dietary counseling might be the underlying contributor for metabolic benefits with rivaroxaban administration. A detailed account of dietary intake during the 90-d follow-up period should be helpful to identify and confirm the mechanisms of the metabolic changes observed with the two medications, which could be perfected in the follow-up studies. Also, the time interval from warfarin administration to the target INR level for patients in Group W might be important to distinguish the influence of metabolic effects during the early period of follow-up.

5 Conclusions

Patients with NVAF receiving rivaroxaban after RFCA procedures appear to benefit with regard to the metabolic levels with elevated serum total protein, albumin, globulin, and HDL compared with warfarin. Less dietary restriction might be the underlying reason for this advantage, which may provide a practical clinical reference regarding the choice of anticoagulant in such patients. The use of rivaroxaban seems to be as safe and effective as warfarin in anticoagulation therapy after RFCA procedures.

Compliance with ethics guidelines

Jun ZHU, Rong-jun GAO, Qiang LIU, Ru-hong JIANG, Lu YU, Ya-xun SUN, Pei ZHANG, Jian-wei LIN, Yang YE, Zu-wen ZHANG, Shi-quan CHEN, Hui CHENG, Xia SHENG, and Chen-yang JIANG declare that they have no conflict of interest.

All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2008 (5). Informed consent was obtained from all subjects for being included in the study. Additional informed consent was obtained from all patients for whom identifying information is included in this article.

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中文概要

题　目：利伐沙班在非瓣膜病性房颤患者经导管射频消融术后抗凝中的代谢获益

目　的：评估非瓣膜病性房颤患者应用利伐沙班抗凝治疗相较华法林的代谢获益，及利伐沙班应用的安全性和有效性。

创新点：首次研究利伐沙班对房颤射频消融术后患者代谢水平影响，评估利伐沙班相较华法林抗凝治疗的代谢获益。

方　法：前瞻性入选 2014 年 4 月至 7 月共 60 例行经皮房颤导管射频消融术患者，随机分为利伐沙班治疗组和华法林治疗组。在术后 15、30、60 和 90 天检测代谢指标（包括血清总蛋白、白蛋白、球蛋白和高密度脂蛋白（HDL）等）变化，并随访出血、卒中和系统性栓塞事件等发生情况。

结　论：服用利伐沙班抗凝治疗患者在随访期间血清总蛋白、白蛋白、球蛋白和 HDL 水平较术前均显著升高，而华法林治疗组患者各项代谢指标呈先下降、后上升趋势。两组均没有发生死亡和栓塞事件，出血并发症发生率亦无明显差异。研究结果表明，非瓣膜病性房颤患者经导管射频消融术后接受利伐沙班抗凝具有代谢方面获益，与华法林相比两者在安全性和有效性方面无明显差异，研究结果可为临床选择合适抗凝方案提供参考。

关键词：心房颤动；导管射频消融；抗凝；利伐沙班