

Renal Infarction Associated with Atrial Fibrillation Following ICD Implantation: A Case Report and Literature Review

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Case Report

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Abstract

Background: Atrial fibrillation increases the risk of thromboembolism in the kidney. Renal infarction in atrial fibrillation receiving implantable cardioverter defibrillator (ICD) treatment is rarely seen.

Case Presentation: We reported a case of a 76-year-old woman who presented with palpitations and short of breath with ECG showing paroxysmal atrial fibrillation (AF) and long RR interval. The patient was diagnosed congestive heart failure with NYHA class III-IV and received an ICD implantation as the onset of ventricular tachycardia. The seventh after ICD implantation operation, she complained of right lower abdominal pain with fever and blood WBC increased. Right renal infarction was confirmed after abdominal enhancement computed tomography scan. Anticoagulation therapy was given immediately, the patient had an stable international normalized ratio (INR) and mild elevated serum creatinine levels during follow-up.

Conclusion: This case enlightened us some comprehension about the strategy for periprocedural anticoagulation and prevention of thromboembolism in the elderly with paroxysmal atrial fibrillation. Renal infarction and anticoagulation strategies for atrial fibrillation during perioperation were reviewed in this paper.

Background

Acute renal infarction is a relatively rare cause of acute abdominal pain, and its diagnosis is often overlooked or delayed. A national prospective observational cohort study reported a frequency of 0.007% of acute renal infarction in approximately 250,000 patients who complained of abdominal pain in the emergency department(ED)^[1]. Atrial fibrillation (AF) and renal artery injury are the major causes of renal infarction ^[2-4], perioperative anticoagulation strategies remain important for the prevention of thromboembolic events, particularly inpatients with AF and a high risk of thromboembolism., There was some evidence-based series and guidelines for the indications and strategies of anticoagulation already, while the truly frequency of anticoagulation in AF population is less than expectation in real world

Case Report

A 76-year-old woman complained of dyspnea for one month with exacerbation for three days attended the clinic. Her history included paroxysmal AF, hypertension, and coronary atherosclerotic heart disease. Seven years ago, she received a DDD pacemaker due to syncope, which was induced by the frequent onset of a long RR intervals (the maximum was 4510ms) by Holter examination. She maintained sinus rhythm before a sudden ventricular tachycardia (VT) attack and had no oral or injected anticoagulants in the past two years. She was a complaint of syncope at the emergency department, and ECG revealed paroxysmal ventricular tachycardia. After an electrical conversion in the emergency department, the ventricular tachycardia terminated and an atrial fibrillation initiated. She was then admitted to the cardiac care unit (CCU), Department of Cardiology, Beijing Friendship Hospital. Physical examination revealed

that blood pressure was 106/59mmHg with a heart rate of 102 beats per minute and a pulse rate of 90 beats per minute. The temperature was 36.5°C. There was slight rale in both basal lungs, and the heart rhythm was irregular with no cardiac murmur. There was mild edema in both lower extremities. Laboratory analysis showed complete blood count (CBC), urinalysis, coagulation function, myocardial enzymes, and kidney function were normal. ECG showed AF rhythm with no evidence of abnormal ST-T change like acute myocardial infarction. Renal ultrasound showed that kidney size and renal blood flow signals were normal. The patient received implantable cardioverter defibrillator (ICD) implantation within 48 hours after VT attack. She received no anticoagulation therapy during the periprocedure given the age, bleeding risk of pocket hematoma, and duration of AF less than 48 hours. Seven days after the implantation, the patient presented abdominal pain with diarrhea, vomit, and fever (T = 38.7°C), blood tests revealed white blood cell (WBC) count was $18.1 \times 10^9/L$ and neutrophilic granulocyte percentage was 89.9%, urine tests showed red and white cells under microscope. Lactate dehydrogenase was 830U/L. After antiinflammation therapy with Cefoperazone sodium and Sulbactam sodium, the patient remained paroxysmal abdominal pain. Nine days after ICD implantation, the enhanced abdominal computed tomography (CT) scan showed a filling defect of the contrast agent in mid-distal of the right renal artery and a cuniform low-density region in the right renal (Fig. 1). Doppler ultrasound showed decreased blood flow in the right renal artery compared with the left side. Hereto, a diagnosis of unilateral acute renal infarction was made. As the patient had no other identified cause for thromboembolism except AF, her renal infarction and thromboembolism of the right renal artery were most likely associated with AF. The patient received anticoagulation immediately, which was enoxaparin 40mg subcutaneous injection twice a day and warfarin for 2.5mg Qd after 3 days of enoxaparin, enoxaparin was ceased when the international normalized ratio(INR) reached 2.0 and warfarin was continued. On the 14th after implantation, the abdominal pain was not complained and temperature was normal, blood routine revealed white blood cell count was $8.7 \times 10^9/L$, and neutrophilic granulocyte percentage was 67.4%. After 3-year follow-up, the right renal size reduced from 9.6×4.5cm to 4.8×2.2cm and serum creatinine increased from 1.13mg/dl to 2.38mg/dl with a stable INR between 2.0 to 2.5.

Discussion

The two leading causes of renal infarction are thromboembolism and *in situ* thrombosis. The former is an obstruction of a blood vessel by a blood clot from the heart, among which atrial fibrillation is the most common cause^[5,6]. It is reported that the incidence rate of renal arterial thromboembolism is about 2% in a series of almost 29862 patients(14 917 men and 14 945 women, 50 to 89 years old) with AF following for up to 13 years^[7], and other series reported of the prevalence of acute renal infarction(ARI) in patients from emergency department was 0.013 % and 70% of the patients had atrial fibrillation in a single center in Japan^[8]. While a multicentric survey in Turkey reported in 121 renal infarction patients, only 36(about 30%) patients had thromboemboli due to atrial fibrillation^[9]. It seems the incident of ARI varies depending on the characteristics of the cohort (age, gender, comorbidities etc) and the length of follow-up.

Patients with acute renal infarction usually complain of an acute attack of osphalgia or diffuse abdominal pain, often accompanied by nausea, vomit, and occasionally fever. The majority of patients may have hematuria and slightly elevated WBC and C-reactive protein, as well as elevated lactate dehydrogenase levels^[4]. Because the symptoms of renal infarction are not specific, it is often not diagnosed immediately after the onset, usually more than two days^[3, 10].

For a patient with osphalgia, a general CT scan is a preferred initial test, and inflammation, urolithiasis, and other common acute abdominal diseases should be ruled out prior to the diagnosis of renal infarction, because renal infarction is a relatively rare disease in a patient with osphalgia or celiacgia. On this occasion, if physical examination, CBC, laboratory biochemical analysis, urinalysis, and abdominal B-ultrasound could not confirm the cause of abdominal pain, contrast-enhanced CT examination is essential for the diagnosis^[4].

In a Turkey survey, the patients enrolled was mainly of middle age, and the final mean creatinine was found to be 1.69 ± 0.16 mg/dl^[9]. As for this elderly patient, her creatinine increased significantly up to 2.38mg/dl during 3 years' follow-up. This difference of final serum creatinine may be related to the severity of infarction and the different compensatory ability of the unilateral normal kidney between elderly and middle-aged people. It was reported that acute renal infarction causes irreversible loss of renal mass, but it rarely leads to end-stage renal disease or long-term mortality^[11].

In most series studies of thromboembolic renal infarction, the majority of patients received anticoagulation therapy, in which many patients had other anticoagulation indications like AF^[3, 12, 13]. Intravenous heparin or subcutaneous injection of low-molecular-weight heparin(LMWH) followed by oral warfarin is a common approach. This patient received LMWH followed by oral warfarin and maintained INR between 2.0 to 2.5, which is a standard therapy for renal infarction.

Beyond the diagnosis of renal infarction, the most important problem is what can we learn from this case? If the renal infarction can be avoided or prevented? Is there a better choice of treatment for this patient before thromboembolism happened?

According to ACCP guidelines, the recommendation^[14] of antithrombotic therapy for atrial fibrillation for patients with AF, including those with paroxysmal AF, who are at high risk of stroke (eg, CHADS2 score = 2), oral anticoagulation rather than no therapy was recommended in Grade 1A class. This patient had a score of 3(age ≥ 75 , history of hypertension, and congestive heart failure). The CHA₂DS₂-VASc score also estimates the risk of thromboembolism in patients with atrial fibrillation^[15]. Patients with a CHA₂DS₂-VASc score of 4 to 5 are considered moderate risk[5–10% annual risk of venous thrombus embolism(VTE)]. And for this patient, congestive heart failure(+ 1), hypertension(+ 1), and age ≥ 75 years(+ 2), female(+ 1), made a score of 5 in total. CHADS2 and CHA₂DS₂-VASc scores both suggested that this patient had a moderate to high risk of thromboembolism, which means anticoagulation therapy should be given when AF first onset, even considering perioperation of ICD. At the mean time, bleeding risk should also be estimated when antithrombotic therapy should be given. The HAS-BLED score is used

to predict the risk of bleeding for anticoagulation therapy in patients with non-valvular atrial fibrillation^[16, 17]. This patient had a score of 2, meaning she was not of high bleeding risk.

As for anticoagulation strategies during cardiac rhythm device periprocedure, it is recommended for unfractionated heparin(UFH) or LMWH as a bridging therapy by American College of Chest Physicians(ACCP) 9th Edition guidelines^[14] and American College of Surgeons' Guidelines^[18]. However, there are some different results published these years. BRUISE CONTROL study is the largest randomized controlled trial to evaluate antithrombotic strategies in patients with Cardiac implantable electronic device(CIED) implantation^[16], it showed in 681 patients with an annual risk of thromboembolic events of 5% or more, compared with the heparin bridging strategy(HBS), continued warfarin treatment during CIED surgery markedly reduced the incidence of clinically significant device-pocket hematoma.

There are several meta-analysis published focusing on the evaluation of bleeding and thromboembolic rate of vitamin K antagonist and heparin bridging therapy in patients receiving cardiac rhythm devices. In a meta-analysis involving thirteen articles and 5978 patients, the results demonstrated that compared with holding or continuing anticoagulant (AC), HBS significantly increased bleeding events^[19]. In another review which included 34 studies with 1 randomized trial, the meta-analysis showed there was no difference in the risk of thromboembolic events compared with the bridged and nonbridged groups, and patients receiving perioperational HBS appeared to have an increased risk of overall and major bleeding, and a similar risk of thromboembolic events compared with non-HBS patients^[20]. Ghanbari et al. identified 8 studies enrolling 2,321 patients in a meta-analysis^[21], compared with heparin-bridging therapy, a strategy of continuous warfarin therapy throughout CIEDs implantation is associated with a decreased risk of bleeding without increased risk of thromboembolic events. In another meta-analysis evaluating patients on chronic oral anticoagulant (OAC) therapy undergoing CIEDs implantation, it is indicated that implantation of CIEDs with uninterrupted OAC therapy seemed better than both of HBS and OAC interruption therapy for lowering the bleeding risk^[22]. In a comparison of continuous oral anticoagulant versus HBS in patients undergoing CIED surgery, seven studies with totaling 2,191 patients were included in a meta-analysis, continuous OAC was associated with a significantly lower risk of postprocedure bleeding risk compared with HBS, and there was no difference in the thromboembolic events between two strategies^[23].

Network meta-analysis (NMA) has some advantages over traditional meta-analysis. A network meta-analysis of observational studies tested the antithrombotic therapy during the CIED implantation, in which thirty-one observational studies, 41,174 patients were included. Continued warfarin, interrupted warfarin, and interrupted NOACs all reduced the risk of bleeding compared with HBS, and interrupted NOACs therapy might be the optimal anticoagulation strategy for the perioperative period of CIED implantation^[24].

As can be seen from the above random controlled study and meta-analysis, continuous oral anticoagulation does not increase the bleeding risk and may reduce thromboembolic events, it may be

the best option for perioperative CIED implantation. Some authors suggested HBS was given only in patients at high risk of stroke when anticoagulation was interrupted.

Conclusion

For this elderly female patient with moderate to high risk of thromboembolism and low bleeding risk, appropriate anticoagulation like OAC can prevent thromboembolic events due to paroxysmal atrial fibrillation. If anticoagulation was given before ICD implantation, renal infarction might be avoided, and according to evidence-based medical study results, there was no need to interrupt OAC during ICD implantation if she had received anticoagulant before.

In medical practice, anticoagulations should be given to patients with atrial fibrillation according to guideline's recommendation to avoid thromboembolism events if there is no contraindication or any other unapplicable conditions.

Declarations

- **1.Ethical Approval and Consent to participate:** This case report has been approved by the Biomedical Ethics Committee, Beijing Friendship Hospital, Capital Medical University, the consent to participate is not applicable.
- **2. Consent for publication:** All the authors agreed with publication.
- **3.Availability of data and materials:** The data and materials is available.
- **4.Competing interests:** There is no conflict of interest.
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Figures

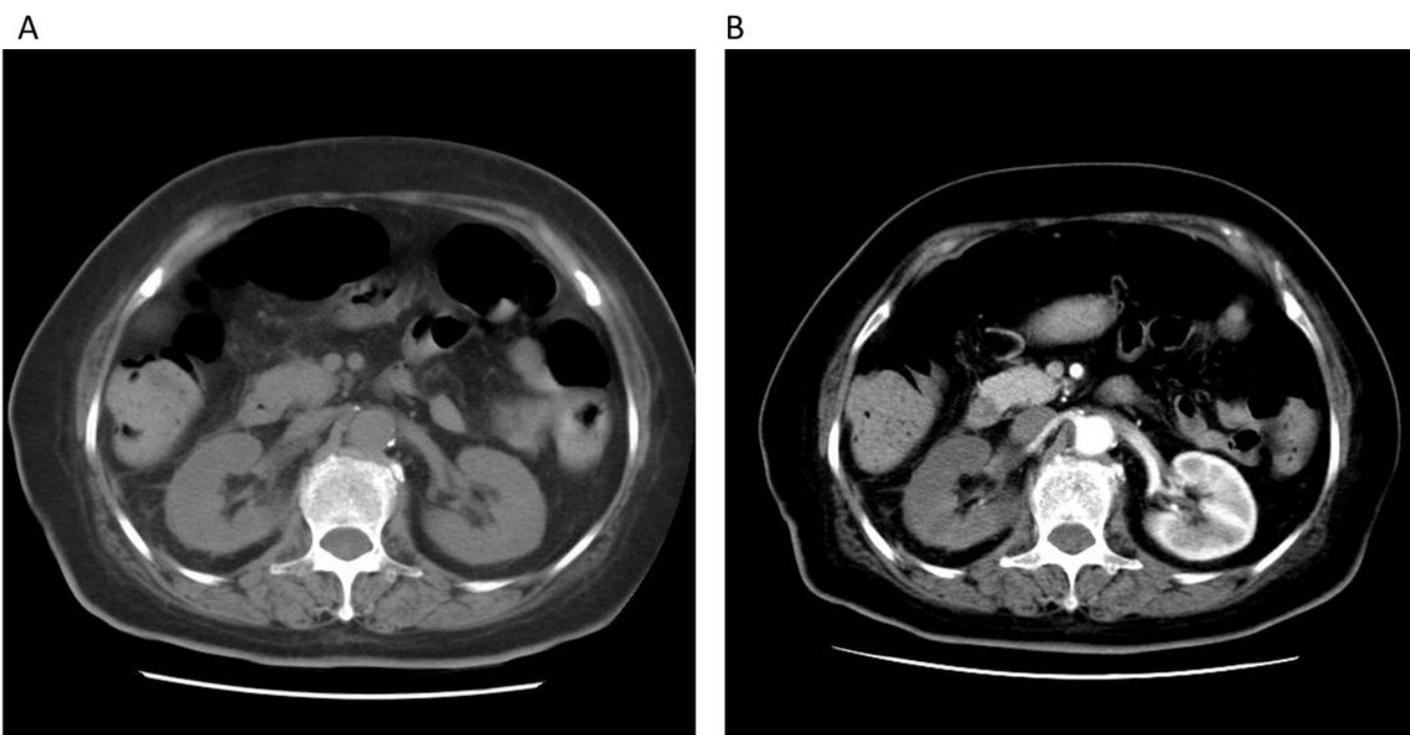


Figure 1

General and contrast-enhanced abdominal CT scan A. Abdominal general CT scan, both kidney can be seen with similar density; B. Abdominal contrast-enhanced CT scan, the right kidney artery and right