Spontaneous regression of submural pseudoaneurysm after radiofrequency catheter ablation in a patient with Wolff-Parkinson-White syndrome

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Introduction
Cardiac rupture is a rare complication of radiofrequency catheter ablation (RFCA) of supraventricular tachycardia (SVT).1,2 It results in life-threatening cardiogenic shock or cardiac tamponade, which requires urgent pericardiocentesis. In most cases, bleeding is stopped spontaneously, and surgical repair is rarely needed. Left ventricular (LV) pseudoaneurysm is a form of cardiac rupture contained by pericardium or fibrous tissue. The diagnosis of LV pseudoaneurysm is often difficult, and it has a risk of rupture and leads to death. However, the natural course of LV pseudoaneurysm after RFCA is not well known because of scarce reports in the literature. In the present case, submural LV pseudoaneurysm was discovered in a patient who developed cardiogenic shock a few days after successful ablation of an accessory pathway. After acute management, the lesion regressed spontaneously, and the patient remained asymptomatic until one year after the procedure.

Case report
A 39-year-old male patient had a history of palpitations for the past 2 months. He had a diagnosis of paroxysmal SVT at another hospital. The patient did not have any other medical history. Physical examination was unremarkable. A resting electrocardiogram showed subtle preexcitation that indicated a left-sided accessory pathway. Preprocedural transthoracic echocardiography was normal.

RFCA was performed using a 4-mm-tip, nonirrigated conventional ablation catheter (Therapy; Irvine Biomedical, Irvine, CA) under temperature mode. The maximum temperature was set to 60°C, and the power was limited to 40 W. Radiofrequency energy was delivered along with the mitral annulus from the septal to lateral area via retrograde aortic approach following unsuccessful transseptal puncture. The procedure was prolonged, and a considerable degree of manipulation was required to access the septal mitral annulus. A relatively large amount of energy was delivered, as the total number of ablations was 21 times, and the total duration of ablation was 555 seconds (longest duration was 61 seconds). There were no sudden impedance rises or popping sounds during RFCA. The procedure was finished successfully at the septal mitral annulus without evidence of antegrade or retrograde accessory pathway conduction (Figure 1). Immediate postprocedural echocardiography (which was routine practice of our institution) showed no pericardial effusion or valvular dysfunction. The patient was discharged 3 days after the procedure.

Twelve days postprocedure, the patient presented with sudden-onset syncope and chest discomfort at an emergency department of another institution. Chest computed tomography showed large pericardial effusion (Figure 2A). Urgent pericardiocentesis was performed. Drained fluid was bloody and consistent with hemorrhagic pericardial effusion. Follow-up computed tomography revealed a 2.7 × 1.7-cm pseudoaneurysm without thrombus just beneath the posterior mitral annulus (Figure 2B). Two-dimensional echocardiography showed the pseudoaneurysm with a small neck in the submural area, which most likely was created by the ablation catheter. Color flow and Doppler studies revealed systolic filling and diastolic emptying of the sac (Figure 3). Mild mitral regurgitation was observed.

The pericardial drain was removed after 8 days. Follow-up echocardiography showed no pericardial effusion, but the pseudoaneurysm was still observed. Given the risk of cardiac surgery, the patient was managed medically and discharged home. Serial computed tomographic (Figure 2C) and echocardiographic (Figure 3) follow-up showed regression of the pseudoaneurysm. The patient remained asymptomatic until a year after the RFCA.

Discussion
RFCA is a well-established treatment of cardiac arrhythmia, with proven effectiveness and safety. LV pseudoaneurysm, a form of cardiac rupture with concealment by adherent
pericardium or scar tissue, is an extremely rare complication of RFCA with a wide range of clinical effects. It can occur early after the index procedure or very late, even decades later, after the procedure. Various degrees of clinical manifestation have been reported, from asymptomatic to recurrent cardiogenic shock.

Cardiac rupture may be associated with catheter manipulation, delivery of more lesions, or anticoagulation. Steam pop refers to the audible sound produced by myocardial explosion when tissue temperature is sufficient to vaporize. It is one possible explanation of LV rupture during RFCA. Pseudoaneurysm may also occur in similar situations.

In left-sided accessory pathway ablation, the success rates and complication rates of ablation by the transaortic and transseptal approaches seem to be similar. Instead, the techniques are complementary; crossover can facilitate successful ablation, if one approach fails. However, if a transaortic approach is used, complications of the left ventricle should be considered, as the ventricular insertion sites are targeted. Furthermore, as more aggressive ablation strategies in the left ventricle are increasingly used, concerns regarding such mechanical complications may rise. More importantly, LV pseudoaneurysm can be overlooked and delayed diagnosis might be possible.

Patients with LV pseudoaneurysms are prone to a risk of cardiac rupture and sudden death. Surgery is considered the treatment of choice for appropriate candidates. Most of the evidence has been derived from patients with myocardial infarction or cardiac surgery who already have a diseased heart.

Figure 1 A: Surface electrocardiography and intracardiac electrograms from the ablation catheter positioned in the inferior septal mitral annulus show the changing atrial activation sequence (arrow) of the coronary sinus after initiation of radiofrequency energy (arrowhead) during pacing at the right ventricle. Corresponding catheter position (ablation catheter [Abl]) in the left anterior oblique (B) and right anterior oblique (C) projections. dCS = distal coronary sinus; pCS = proximal coronary sinus.
However, the natural history of LV pseudoaneurysms after RFCA is not well known. Patients who have undergone SVT ablation usually have a healthy heart. Moreover, cardiac rupture or cardiac tamponade after RFCA is usually healed after acute management, and surgical treatment is not usually required. Gill and colleagues\textsuperscript{11} reported spontaneous regression of submitral pseudoaneurysm after mapping during an electrophysiology study. Therefore, careful follow-up may

![Figure 2](image1.png)

**Figure 2** Serial follow-up of contrast-enhanced computed tomography of the left ventricular pseudoaneurysm. 

**A:** At presentation, a round enhancing mass (arrows) was shown at the base of the left ventricle proximal to the coronary sinus. A large amount of pericardial effusion (PE) was observed. 

**B:** Immediate postpericardial drainage (yellow arrow); the image shows a 2.7 × 1.7 cm outpouching (arrow) arising from the basal inferior left ventricular wall connected to the narrow track (arrowhead) just beneath the mitral annulus. 

**C:** At 3 months after the event, the pseudoaneurysm (arrows) regressed to a size of 1.2 × 0.8 cm.

![Figure 3](image2.png)

**Figure 3** Transsthoracic echocardiographic parasternal long-axis view of the left ventricular pseudoaneurysm. 

**A:** A left ventricular pseudoaneurysm (2.5 × 1.6 cm) is indicated by the white arrows. A large amount of pericardial effusion (PE) was noted. 

**B:** Color Doppler imaging displays the neck of the pseudoaneurysm at the interior margin of the mitral annulus (arrowhead). Flow into the pseudoaneurysm during systole is illustrated. 

**C, D:** At 6 months after the event, the pseudoaneurysm was not evident, and color flow mapping shows no abnormal flow except for mild mitral regurgitation.
be other option for managing patients with LV pseudoaneurysms with a small risk of rupture after RFCA. In high-risk patients for surgery and rupture, transcatheter closure of LV pseudoaneurysms may also be considered, although the long-term results are not well known, and experiences are rare in this submitial position with native valve.

Because of the low detection rate of clinically relevant complications, performing routine echocardiography after RFCA is not recommend. However, a recent ablation strategy, such as substrate modulation or homogenization, is prone to more mechanical complications associated with catheter ablation. When ablation procedures require creation of extensive lesions, a prolonged time of catheter manipulation in the left ventricle, or highly pressurized chambers, serial echocardiographic examination can facilitate the detection of unusual mechanical complications of RFCA.

**Conclusion**

This case demonstrates the importance of considering potentially life-threatening rare complications after catheter ablation, such as LV pseudoaneurysm. Management of LV pseudoaneurysm might vary between patients.

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