Catheter Ablation of Atypical Atrial Flutter after Cardiac Surgery Using a 3-D Mapping System

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ABSTRACT
Three-dimensional (3D) mapping systems are useful tools for the diagnosis and treatment of atypical arrhythmias following open heart surgery. In this case, a patient experienced incessant tachycardia after aortic valve surgery. Two-dimensional fluoroscopy-guided catheter ablation and intensive antiarrhythmic pharmacological treatment, in addition to a permanent pacemaker, failed to control the tachycardia. A 3D mapping system revealed that the mechanism of the tachycardia involved macroreentry around the right atriotomy scar, and the tachycardia circuit was blocked by 3D-guided catheter ablation.

Key words: atrial flutter, catheter ablation, 3D mapping systems

Introduction
Electrophysiological study and fluoroscopy-guided radiofrequency (RF) catheter ablation (RFCA) have become standard modalities for treatment of paroxysmal supraventricular tachycardia. However, there are serious limitations in fluoroscopy-guided ablation procedures, including poor resolution of soft tissue, poor visualization of the site of origin, difficulty in mapping complex arrhythmias, and exposure of

patients and physicians to relatively high levels of radiation. During the last decade, clinical applications of the 3-dimensional (3D) mapping system have enabled real-time display of the ablation catheter in cardiac anatomy and led to an increased rate of procedure success in difficult cases.

In this report, we present the successful catheter ablation of atypical atrial flutter after open heart surgery, using a 3D mapping system.

Case & Discussion
In February of 2013, a 65-year-old man was admitted to the Arrhythmia Center of Seoul National University Hospital for the management
of incessant atrial flutter. His current medical problems included hypertension and dyslipidemia. His medical history was significant for aortic valve-replacement surgery using a mechanical valve in 2006. He was regularly followed at the Cardiac Surgery Center and was taking warfarin, hydrochlorothiazide, and a statin. He had started to feel intermittent palpitations with chest pain after surgery, and was diagnosed with atrial flutter at a regional hospital. RFCA was performed at that hospital in 2011, but the patient’s symptoms were not improved because of failed ablation. His palpitations were sustained despite the use of antiarrhythmic agents such as beta-blockers or amiodarone. In addition, he experienced sudden syncope and was diagnosed with tachycardia–bradycardia syndrome by Holter monitoring in June 2012. Although his syncope resolved after implantation of a permanent pacemaker, he continued experiencing intermittent palpitations despite an intensive regimen of antiarrhythmic medications. Consequently, he visited our Arrhythmia Clinic in January 2013.

At his visit, 12-lead ECG showed a regular narrow–QRS tachycardia with 2:1 AV conduction (Figure 1). The heart rate was 139 bpm; blood pressure, 109/78 mmHg. Echocardiography confirmed a well-functioning mechanical aortic valve with a normal transaortic pressure gradient and normal cavity size. However, it also showed global hypokinetiﬁcs of the left ventricle, with decreased systolic function and an ejection fraction (EF) of 43%. Coronary CT angiography showed no signiﬁcant stenosis in the coronary arteries.

After the patient provided written informed consent, he was transferred to the electro-physiology laboratory while he was experiencing tachycardia. Tachycardia cycle length was 226 ms. Entrainment mapping showed that the difference between the post-pacing interval (PPI) and tachycardia cycle length was <50 ms at the lateral wall of the tricuspid annulus and >80 ms at the septal wall (Figure 2). Therefore, we concluded that the origin of the circuit was the right atrial free
Figure 2. Entrainment mapping. Stimulation was delivered at the septal side using an ablation catheter (ABLd, white arrow in the fluoroscopy image). Postpacing interval is 310 ms, which indicates that the septal wall is a remote site from the reentry circuit.

Figure 3. Electroanatomical mapping. Activation map shows macroreentry at the right atrial free wall. Red dots indicate ablation sites on gaps in the scar area and the isthmus between the scar and the tricuspid annulus. Tachycardia was terminated during RF energy delivery at the area marked by the yellow dot.

Conclusion

Intra-atrial reentrant tachycardia related to
postoperative scar tissue often develops after open heart surgery; this tachycardia is difficult to manage and may result in significant postoperative morbidity. In this case, the patient had right atriotomy scar–related atrial flutter, which was easy to be misdiagnosed as typical atrial flutter. The structural changes that occur after open heart surgery can serve as substrates for arrhythmias. Treatment of these types of arrhythmias sometimes requires an unconventional approach. Studies have reported that in patients with a history of open heart surgery, atypical arrhythmia can be successfully cured by catheter ablation. Catheter ablation procedures guided by 3D–mapping systems may increase the ablation success rate and improve patient outcomes.

Reference


자율 학습 문제

부정맥연구회지에서는 매호 자율 학습 문제를 수록합니다. 해당 호에 실린 원고를 바탕으로 출제된 문제로
선생님들의 자기 계발에 도움이 되시길 바랍니다. 많은 참여 부탁드립니다. 모범 답안은 다음 호에 게재합니다.

1. **Remote-controlled 시스템 중 magnetic navigation 시스템에 대한 설명이 아닌 것은?**
   ① 자기장의 힘으로 자석이 붙어있는 catheter를 움직인다
   ② 기존의 모든 catheter를 사용할 수 있다.
   ③ 큰 금속 이식물을 가지고 있는 환자에게는 금기이다.
   ④ 전공 위험이 거의 없다.

2. **Magnetic navigation 시스템은 어느 정도의 자기장에서 구현되는가?**
   ① 0.08 Tesla
   ② 0.8 Tesla
   ③ 1.5 Tesla
   ④ 3.0 Tesla

3. **CARTO® 시스템에 대한 설명으로 적당하지 않은 것은?**
   ① Catheter 위치 인식을 위해 자장과 전류를 이용한 음하 방식을 이용한다.
   ② AccuResp라는 프로그램을 통해 혈류에 의한 음직임을 동기화한다.
   ③ Circular mapping catheter를 통해 fast anatomical mapping을 시행할 수 있다.
   ④ 모든 catheter를 사용할 수 있다.

4. **NavX™ system에 대한 설명으로 적당하지 않은 것은?**
   ① 초기에는 non-contact mapping인 Esite Array™가 사용되었다.
   ② Esite NavX™는 6개의 electrode에서 8 KHz의 전류 신호가 발출되면서 형성된 자기장을 이용하는 시스템이다.
   ③ 최근 OneModel 기법을 통해 false space를 없애고 editing time을 감소시켜 더 빠르고 정확한 mapping이 가능해졌다.
   ④ Magnet 기반 시스템을 이용하여 catheter 위치를 확인한다.