Successful Catheter Ablation of Focal Atrial Tachycardia from the Aortic Root in a Patient with Prosthetic Aortic Valve

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Atrial tachyarrhythmia is a well-known post-surgical complication for congenital heart disease, but it can also occur in patients after virtually any other cardiac surgery. The mechanisms of post-operative atrial tachyarrhythmia include isthmus-dependent atrial flutter, intra-atrial scar-related reentrant tachycardia, focal atrial tachycardia (AT) and atrial fibrillation. Medical management of these patients can be quite challenging, as antiarrhythmic drugs have limited efficacy in these situations and catheter ablation may be technically difficult due to the presence of surgical sutures, scars, prosthetic valves or annuloplasty rings. We described a rare case of successful ablation of incessant atrial tachycardia in a 72-year-old male with a prosthetic aortic valve and prior mitral valve replacement. The successful ablation site was in the aortic root adjacent to the prosthetic valve.

Key Words: Atrial tachycardia • Catheter ablation • Prosthetic aortic valve

CASE REPORT

A 72-year-old male had a history of rheumatic heart disease and underwent prosthetic aortic and mitral valve replacement 12 years ago. Incessant atrial tachyarrhythmia with tachycardia-mediated cardiomyopathy had occurred in recent months and the tachycardia was refractory to amiodarone and beta-blocker therapy. Trans-thoracic echocardiography revealed a dilated left atrium of 50 mm in dimension, a left ventricle of 54 mm in dimension, and a decreased left ventricular ejection fraction of 45%. In the laboratory, sustained atrial tachyarrhythmia with a cycle length of 290 ms was induced with programmed stimulation. Intravenous bolus injection of adenosine induced transient atrioventricular block but could not terminate the tachycardia (Figure 1A).

The earliest activation site of the tachycardia was located at the right atrial (RA) mid-septum with a centrifugal activation pattern to the rest of both atria (Figure 1B). The voltage map demonstrated the low voltage zone locating along the interatrial septum (Figure 1C). The mapping catheter recorded the earliest atrial electrical potential at the RA mid septum adjacent to the low voltage area, which was 60 ms before the P wave. However, radiofrequency application at this site was ineffective in terminating the tachycardia. Further radiofrequency applications at the opposite site of the left atrium were also ineffective.

Given the patient’s prior history of aortic valve replacement, low voltage area along the interatrial septum and the failed initial endocardial ablation, scar-related atrial tachycardia (AT) within the aortic root was suspected. After detailed mapping within the aortic root via retrograde approach, an electrogram 66 ms earlier than...
the P wave was recorded near the prosthetic aortic valve. Biplane fluoroscopy was continuously visualized to avoid catheter encroachment into the prosthetic aortic valve and the coronary artery orifices were confirmed by injecting the contrast (Figure 1D). Radiofrequency application at this site successfully terminated the AT. Tachycardia did not recur after the administration of isoproterenol. There were no complications observed following the procedure. Echocardiography performed 6 months later showed a normalized left ventricular systolic function and a smaller left ventricle of 50 mm in dimension.

DISCUSSION

Atrial tachyarrhythmia is a well-known complication after surgery for congenital heart disease, but it can occur in patients after almost any other cardiac surgery. The mechanisms of post-operative atrial tachyarrhythmia include isthmus-dependent atrial flutter, intraatrial scar-related reentrant tachycardia, focal AT and atrial fibrillation.

Common focal AT origins were located at regions such as the crista terminalis, tricuspid annulus, coronary sinus ostium, pulmonary veins and mitral annulus. Because of the close anatomical relationship to the anterosuperior aspect of the paraseptal region, the non-coronary aortic valve cusp has been reported as a rare successful ablation site for focal AT. As the wall of non-coronary aortic valve cusp does not contain atrial myocardial tissue, the likely substrate for AT ablation in this region could be the adjacent atrial myocardium behind the aortic wall or an epicardial focus of AT that cannot be assessed directly from the endocardium due to thick atrial myocardium in the interatrial septum.

The diagnosis of focal AT originating from the non-coronary aortic valve cusp may be challenging because

![Figure 1](image-url)

**Figure 1.** (A) Twelve-lead electrocardiography of the atrial tachyarrhythmia. (B) The activation maps of the both atria during the atrial tachycardia. Red dots indicated the sites of unsuccessful ablation. (C) Voltage map showed the low voltage area (bipolar peak-to-peak voltage ≤ 0.5 mV, red color) located along the interatrial septum. (D) Right and left oblique fluoroscopic images showed the catheter position at the successful ablation site.
there are no specific electrophysiologic characteristics. Using an algorithm developing by Professor Kalman, a broad, notched upright P-wave in V1 and notched negative P-waves in the inferior leads in this case suggested a left inferior pulmonary vein focus. This discrepancy reflected that surgical atriotomy and the presence of structural heart disease can reduce the usefulness of the surface P wave morphology in localizing the origin of focal AT.

In a case series of 13 patients with AT arising adjacent to the noncoronary aortic sinus, Liu X et al. described that the atrial activation patterns during AT occurred simultaneously in both atrial septum, and the initial activation area was diffuse in the three-dimensional activation map. This was consistent with finding in our case.

Catheter ablation in the aortic sinus of Valsalva had been described as a safe and effective approach for AT, with a good long-term outcome. Ablation could be achieved through either a retrograde aortic or a transseptal approach. The utilization of a three-dimensional mapping system together with intracardiac echocardiography can be very useful in catheter navigation and anatomic recognition during the procedure. The electrograms at the successful ablation sites of the ATs usually presented with a small atrial activation and a large ventricular potential, though equal atrial and ventricular potentials or a larger atrial potential could be found in some patients. Due to good stability of the ablation catheter in the non-coronary aortic valve cusp, the focal AT was usually terminated within seconds after the radiofrequency application.

In patients with failed ablation of the focal AT, an unusual origin should be sought. Although the aortic cusps had been excised during the prosthetic aortic valve replacement in our patient, the earliest atrial signal was recorded at the posterior part of the aortic root, away from the ostia of the coronary arteries, which represented the relative position of the non-coronary aortic cusp. This report demonstrated that prior excision of aortic cusps during prosthetic valve replacement and presence of surgical sutures did not prevent successful catheter ablation in the aortic root.

REFERENCES