Atrial Tachycardia Ablated Successfully from the Aorta

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Abstract

We present a case of recurrent highly symptomatic atrial tachycardia. During electrophysiology (EP) study, this was found to arise close to the AV node. To avoid conduction system damage by radiofrequency (RF) ablation, the aortic cusps were mapped. The tachycardia focus was close to the non-coronary cusp and ablated safely and successfully from this site.

Case History

A 2 year lady, presented with episodic recurrent, fast and regular palpitations which were associated with pre-syncope. She had two such episodes in one year. Her clinical examination, and echocardiography were normal. The event ECG (Figure 1) showed incomplete RBBB (also present in sinus rhythm) and narrow complex tachycardia 175/min without discernible P waves.

In view of her symptoms, an EP study and RF ablation was planned. The retrograde VA conduction was absent. On mapping, the earliest atrial activation in the right atrium was found near apex of triangle of Koch, preceding P wave onset by 25 ms; a large His potential was seen at this site. The aortic cusps were then mapped via the femoral artery. A remarkable fractionated atrial signal was found and the earliest activation preceded P wave onset by 31 ms. Pre-ablation aortic root angiography and continuous visualization of the ablation catheter during RF delivery was used to minimize the risk of injuring the coronary arteries and other important structures. RF application using a conventional 4-mm tip ablation catheter at this site terminated tachycardia within 4 seconds of starting RF energy (Figure 2). No tachycardia could be induced after RF ablation despite vigorous stimulation protocols. There was no procedure-related complications. She is asymptomatic at 6 months of follow-up, without any anti-arrhythmic drug.

Discussion

Focal AT originates typically from the crista terminalis, the tricuspid or mitral annulus, pulmonary veins or septal region.1 Most ATs are amenable to curative RF ablation. However, RF ablation of an AT originating from the apical region of the triangle of Koch carries a risk of inadvertent damage to the AV nodal conduction system. It has been shown that in the vicinity of the AV node a focal AT may originate from either side of the interatrial septum. Therefore, in many cases careful mapping of both the right and left side of the interatrial septum is crucial to decrease the risk of post-ablation AV block. Another structure and a potential source of arrhythmias, which is located close to the His bundle, is the aortic root. In a normal heart, the aortic root is adjacent to epicardial atrial myocardium and occupies a central location within the tricuspid and mitral annulus2 (Figure 3). When viewed from the right atrial side, the interatrial septum near the AV node includes a small region anterior to the limbus of the fossa ovalis, the roof of the coronary sinus, superior margin of the membranous interventricular septum, septal leaflet of the tricuspid valve, and prominence formed by the non-coronary cusp. The non-coronary cusp forms the superior margin of the interatrial septum as it joins to the fibrous skeleton of the heart at the central fibrous body (through which penetrates the His bundle). However,
the muscular network connecting the non-coronary cusp with the atria remains unknown. This heterogeneity in morphology may be related to several factors—the breakthrough site into the atria, the lie of the heart and the intra-atrial conduction pattern being important factors.

When the earliest atrial activation is recorded from the His bundle region during the AT, mapping of the non-coronary cusp should be performed in order to avoid aggressive RF deliveries near the His bundle region, resulting in the potential risk of inadvertent AV block. Ablation in the aortic cusps needs to be undertaken with care to prevent damage to the coronary ostia.

The differential diagnosis of a regular narrow QRS tachycardia and earliest activation in the His bundle region includes the following:

(i) Slow-fast AVNRT; (ii) orthodromic AVRT mediated by an anteroseptal accessory pathway; (iii) atrial tachycardia arising from the apex of the triangle of Koch; (iv) “non-coronary cusp” atrial tachycardia; (v) automatic junctional tachycardia and (vi) mitral annular tachycardia.

We have described successful catheter ablation of focal AT originating from an unusual site in the non-coronary aortic cusp. The tachycardia was characterized by easy induction and termination by programmed atrial stimulation. Ventricular pacing had no effect on atrial activation during the tachycardia. The P-waves were positive in lead I and aVL and negative or isoelectric in the inferior leads II, III, and aVF. In the precordial leads V1 and V2, P-waves were negative. In our patient, the absence of VA conduction ruled out an accessory pathway. The V-A-A-V sequence brought out by rapidly delivered ventricular stimuli during tachycardia, as mentioned earlier, clearly established the diagnosis of atrial tachycardia. The aortic cusps, especially the left cusp, have been well documented to be sites of origin for idiopathic ventricular tachycardia. It has been reported in recent years that the noncoronary cusp may be a target for some ATs that appear to arise in close proximity to the AV node.3 The anatomy of the interatrial septum is complex, leading to potential difficulties in identifying the site of the AT origins in this region.

The clinical and electrophysiological characteristics suggesting noncoronary aortic cusp origin of AT include: (i) abrupt onset and offset of the tachycardia, (ii) easy induction and termination by atrial stimulation, and (iii) earliest activation in the RA near the His bundle. Furthermore, the tachycardia can be terminated by adenosine. Surface ECG is only of limited help, as the P-wave morphology during the tachycardia is similar to that seen during focal AT originating from the interatrial septum or parahisian region. Before ablation in the aortic root, it is essential to demonstrate that the local activation in the non-coronary aortic cusp precedes that recorded at the His region. In addition, pre-ablation aortic root angiography and continuous visualization of the ablation catheter during RF delivery should be used to minimize the risk of injuring the coronary arteries and other important structures.

**Conclusion**

Although ATs originating from the NC aortic cusp are uncommon, their ablation is feasible and safe. NC aortic cusp ATs must be invoked and systematically disclosed when a peri-AV nodal AT origin is suspected, in order to avoid a potentially harmful energy application at the vicinity of the AV conductive tissue.

**References**