Response of narrow QRS tachycardia to premature atrial extra. What is the mechanism?

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A R T I C L E   I N F O

Article info
Received 13 October 2016
Accepted 23 November 2016
Available online 23 November 2016

Keywords:
Long RP tachycardia
Slowly conducting accessory pathway
Premature atrial extra

A B S T R A C T

A 60-year-old woman was referred for radiofrequency catheter ablation of narrow QRS tachycardia that was terminated with intravenous adenosine. Twelve-lead ECG showed no baseline preexcitation. Echocardiogram was essentially normal. The electrophysiological study showed a normal AH interval of 114 ms and HV interval of 48 ms during sinus rhythm. Anterograde study demonstrated no dual AV nodal physiology. Atrial pacing protocols easily and reproducibly induced narrow QRS tachycardia (Fig. 1A & 1B). Premature atrial extra (PAE) stimuli were delivered during the tachycardia (Fig. 2). What is the mechanism of the tachycardia?

1. Commentary

The tachycardia represents a regular narrow QRS tachycardia with long RP interval (Fig. 1A). The likely differentials for the long RP tachycardia are atypical AV nodal re-entrant tachycardia (AVNRT), orthodromic AV re-entrant tachycardia (AVRT) with slowly conducting accessory pathway and atrial tachycardia (AT). The intracardiac recordings (Fig. 1B) showed 1:1 A-V relation, stable tachycardia cycle lengths and ventriculo-atrial (VA) intervals. The VA interval recorded at the site of earliest atrial activation recorded at coronary sinus distal (CS D) dipoles placed in the CS distal region was 260 ms. The possibilities for this tachycardia with long VA interval are atrial tachycardia from the left atrium (LA), orthodromic AVRT involving slowly conducting left lateral accessory pathway and AVNRT with LA inputs to the AV node.

During the long RP tachycardia PAE stimuli were delivered from the right atrial (RA) appendage (Fig. 2). It was delivered at a prematurity of 300 ms. In response to it, the tachycardia continued with advancement of the local ventricular (V) electrogram (EGM) and the next atrial (A) EGM, with same retrograde activation sequence. As suggested by the similar VA intervals prior to the atrial extra stimulus and VA interval of the pulled ventricular electrogram suggesting VA linking. The delta AH interval (AH during atrial extra − AH during tachycardia) was less than 10 ms suggesting same anterograde nodal pathway involved during tachycardia and during PAE stimulus. This doesn’t exclude an atypical AVNRT. Presence of VA linking makes atrial tachycardia less likely.

A His refractory premature ventricular extra (PVE) (Fig. 3) was delivered from the right ventricular apex during tachycardia at a coupling interval of 422 ms. The ectopic has advanced the following atrial electrogram (A) and reset the tachycardia. This observation proves that the mechanism of the long RP tachycardia is AV re-entry. The tachycardia was mapped at the 3 O clock position of the mitral annulus and successfully ablated. Retrogradely and slowly conducting accessory pathways are usually located in the septal location. Free wall locations are uncommon.

2. Discussion

The differentials entertained for narrow QRS tachycardia with long VA interval and eccentric retrograde activation are AT, orthodromic AVRT involving left sided bypass tract and left sided AVNRT. Ventricular pacing maneuvers are helpful in understanding the mechanism in these situations. Even though PAE is classically helpful in distinguishing between junctional tachycardia and AVNRT, demonstration of absence of VA linking in response to PAE...
can be helpful in diagnosing AT.

The mechanisms by which eccentric retrograde atrial activation occurs during AVNRT are unclear. The most likely cause is that the perinodal transitional cells [1–3] documented in the histologic studies are not electrically silent and serve as an atrial input to the compact node. Anatomic and histologic studies [1–3] have demonstrated that the perinodal region is heavily populated by the transitional cells. These cells are also present in the deeper layer of the atrial septum and may serve as the electric connection between the left atrium and the compact AV node. An alternative explanation for eccentric retrograde atrial activation during AVNRT is the presence of a bystander left-sided AP. But this has not been convincingly demonstrated. In this index case AVNRT was convincingly excluded by the response to His refractory PVE.

The index case stresses the importance of PAE stimuli during narrow QRS tachycardia in understanding the tachycardia mechanism especially in ruling out atrial tachycardia. This also gives an example of a slowly conducting accessory pathway around mitral
Fig. 2. Represents surface electrocardiogram (LaVF,V1,V6) and intracardiac electrograms right atrial appendage (HRAD), His bundle region (HBED), coronary sinus proximal (CS P) dipole placed at CS proximal region, CS 7,8, CS 5,6, CS 3,4, CS distal (D) and right ventricle apex (RVA), showing response to atrial extra stimulus delivered at a prematurity of 300 ms during the tachycardia.

Fig. 3. Represents surface electrocardiogram (LaVF,V1,V6) and intracardiac electrograms right atrial appendage (HRAD), His bundle region (HBED), coronary sinus proximal (CS P) dipole placed at CS proximal region, CS 7,8, CS 5,6, CS 3,4, CS distal (D) and right ventricle apex (RVA), showing response to ventricular extra stimulus delivered at a prematurity of 422 ms during the tachycardia.
annulus, which are often ablated through coronary sinus approach, that could be ablated with an endocardial approach.

**Conflict of interest**

The authors declare that they have no conflict of interest.

**Funding**

None.

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