Response to atrial overdrive pacing during narrow QRS tachycardia. What is the mechanism?

Suchit Majumdar b,a, Krishna Kumar Mohanan Nair b,*, Narayanan Namboodiri b, Ajitkumar Valaparambil b

a Dept of Cardiology, Apollo Gleneagles Hospital, Calcutta, West Bengal, India
b Department of Cardiology, Sree Chitra Tirunal Institute for Medical Sciences and Technology, Thiruvananthapuram, Kerala, 695011, India

ABSTRACT

A 35-year old lady with no pre-excitation on surface electrocardiogram underwent EP study for recurrent palpitation and documented adenosine responsive narrow QRS tachycardia. Regular narrow QRS tachycardia was induced with critical AH delay on programmed atrial stimulation. An atrial overdrive pacing (AOD) was performed during the tachycardia (Fig: 1 & 2). What is the response to AOD and what is the mechanism of tachycardia?

Commentary

The tachycardia was a regular narrow QRS tachycardia with tachycardia cycle length (TCL) of 375 ms and HA interval to earliest CS A was 46 ms. The differential diagnosis for a regular narrow QRS, tachycardia with 1:1 V - A relation are junctional tachycardia [JT], slow fast AV nodal reentrant tachycardia [AVNRT] and atrial tachycardia [AT] with prolonged anterograde conduction time. AOD was performed at a pacing cycle length (PCL) 25 ms shorter than the TCL from proximal CS and the response during pacing and on cessation was noted. Following observations were made. (see Figs. 1 and 2)

1. There was atrial capture at the PCL of 350 ms.
2. There was 1:1 AV conduction at the PCL of 350 ms.
3. There was no change in the QRS morphology during atrial pacing.
4. The AH interval during atrial pacing [AH (P) = 450 ms] was more than PCL (350 ms) and the AH interval [AH (T) = 325 ms] during tachycardia.
5. The first His bundle electrogram immediately after cessation of pacing was related to the penultimate atrial paced beat and not to the last atrial paced beat giving the pseudo A-H-H-A response.
6. Tachycardia continued after cessation of pacing and the first return electrogram of the tachycardia occurred in the atrium making the real response as A-H-A.
7. The V-A interval of the first tachycardia beat or return cycle interval after termination of AOD and that of other tachycardia beats were identical.

The V-A relationship after AOD could help distinguish AVNRT from AT. Fixed V-A intervals on return cycle length and tachycardia are suggestive of V-A linking and the response is consistent with AVNRT and not with AT [1].

During AVNRT AOD would be expected to transiently entrain the tachycardia, with continuation of the tachycardia after cessation of pacing. The first return electrogram would be atrial, resulting in an A-H-A response. AOD during JT will transiently suppress the arrhythmia focus, with immediate resumption of the tachycardia after cessation of pacing. The first return electrogram would be a junctional beat led by a His signal, resulting in an A-H-H-A response [2]. Identification of the correct return beat, by measuring the last H–H interval which is equal to the paced cycle length, is pertinent to arrive at correct conclusions. There are exceptions to this rule in

* Corresponding author.
E-mail address: kakkam@sctimst.ac.in (K.K. Mohanan Nair).
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Fig. 1. Surface electrocardiogram (I,II,V2) and intracardiac electrograms – right atrium (at right atrial appendage) [RAP], His bundle electrogram distal (HBED), His bundle electrogram proximal (HBEP) coronary sinus (CS) 9,10 at CS ostium, CS 7,8 & CS 1,2 dipoles at distal CS, right ventricle (RV) at RV apex showing response to atrial overdrive pacing (AOD) during the narrow QRS tachycardia.

Fig. 2. Surface electrocardiogram (I,II,V2) and intracardiac electrograms – right atrium (at right atrial appendage) [RAP], His bundle electrogram distal (HBED), His bundle electrogram proximal (HBEP) coronary sinus (CS) 9,10 at CS ostium, CS 7,8 & CS 1,2 dipoles at distal CS, right ventricle (RV) at RV apex showing response to atrial overdrive pacing (AOD) during the narrow QRS tachycardia (with annotations).
the background of dual AV nodal physiology. While a short AH interval in the last paced beat terminates AVNRT by capturing the fast AV nodal pathway, however it can lead to a 1:2 response with a shorter AH through fast AV nodal pathway terminating tachycardia and then conducting through the slow AV nodal pathway and a longer AH interval, thereby reinitiating the AVNRT. This can also create a true A-H-H-A response for AVNRT. Usually in that case, 1:2 response can be seen in sinus rhythm or at tachycardia initiation. Also, in JT, if the fast AV nodal pathway is poorly conducting, the paced atrial beat can conduct down through slow AV nodal pathway and echo resulting in A-H-A. This is seen more often with injured fast pathway during ablation or poorly conducting fast AV nodal pathway at baseline [2].

In the index case the first His bundle electrogram immediately after cessation of atrial pacing is related to the penultimate atrial paced beat and not to the last atrial paced beat which in turns reflects anterograde decremental conduction (AH interval during pacing more than the PCL) property of the slow AV nodal pathway and resulting in pseudo A-H-H-A response upon cessation of AOD. Hence, it is recommended to find the last entrained H, by measuring AH or the H—H intervals in order to avoid the confusion. As here the response was actually A-H-A, AVNRT was diagnosed in conjunction with other evidences.

Slow AV nodal pathway ablation was done in our case which rendered the tachycardia noninducible.

Declaration of competing interestCOI

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