IMAGES IN CARDIOLOGY

Electroanatomical Mapping to Curtail Heart Block Occurrence and Enhance Safety During Slow Pathway Ablation in Patients with Atrioventricular Nodal Reentrant Tachycardia

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Abstract

A case is presented of use of electro-anatomical mapping (EAM)-guided ablation of a slow pathway in a patient with symptomatic atrioventricular (AV) nodal reentrant tachycardia (AVNRT) as a safeguard against inadvertent AV block. ***Rhythmos*** 2022;17(4):79-80.

A 42-year-old gentleman sought medical attention and was seen in consultation in the cardiac arrhythmia clinic for symptomatic recurrent episodes of a narrow-QRS tachycardia since the age of 35 but of increasing frequency over the last 4 years. The episodes lasted for 1-2 h and some of them required visits to the emergency room. He had received treatment with a beta-blocker and was lately placed additionally on diltiazem, but he continued having recurrences. There was no manifest preexcitation on the 12-lead electrocardiogram (ECG). ECG recording during the tachycardia episodes showed a narrow-QRS tachycardia at 130-170 bpm with hardly discernible retrograde P waves at the end of the QRS complex. Past medical history includes history of diabetes mellitus and hypertriglyceridemia, both under medical therapy, and history of gall bladder disease. Echocardiography showed mild mitral regurgitation and a left ventricular ejection fraction of 60%. He consented to have an electrophysiological study (EPS) and undergo radiofrequency (RF) ablation.

During the EPS, a narrow-QRS tachycardia (cycle length 304 ms) with 1:1 atrioventricular (AV) ratio was easily induced during rapid atrial pacing while assessing AV conduction. Intracardiac recordings confirmed AV nodal reentrant tachycardia (AVNRT) as its mechanism (**Fig**. 1). A jump in the AH interval could not be determined due to readily inducible tachycardia with any atrial extrasystolic stimulation but was obvious during the initiation of the AVNRT.

Figure 1. ECG leads (I, II, III, aVF, V1 & V6) and intracardiac recordings (from the coronary sinus–CS, His bundle electrogram –HBE and right ventricular apex–RVA) display the simultaneous recordings of atrial and ventricular electrogram consistent with AVNRT.

Subsequent to the induction of the tachycardia and the determination of its mechanism, a set-up was planned and arranged to proceed with ablation of the slow pathway of the AV node. In addition to standard catheters employed for recordings from the right atrium, coronary sinus, the His bundle area and the right ventricle, a multipolar (64-pole) 8.5F catheter (IntellaMap Orion™, Rhythmia HDx™, Boston Scientific Inc, Marlborough, MA, USA) was used for electro-anatomical mapping (EAM) of the area and particularly the area of the AV node-His bundle to minimize the risk of AV block. A 7F quadripolar IntellaNav MiFi™ open-Irrigated catheter was used for further mapping and ablation.

The image in **Figure** 2 shows a 3D model in two projections (right anterior oblique – RAO on the left panel and left anterior oblique – LAO on the right panel) depicting the location of the AV node-His bundle (yellow dots) and the map/ablation catheter at the M1 position of the tricuspid annulus (red dots: site of slow pathway and successful ablation). The accelerated junctional rhythm was recorded during the 10th RF current application in the area of the slow pathway (M1 position at the RAO view, red dots). An additional RF application was delivered in the same position with similar response. Subsequent programmed cardiac stimulation failed to induce any tachycardia while there was no AH jump observed; this was repeated after a 20-minute waiting period with same result and the procedure was ended at that point, completing a 2-h duration (5-minute fluoroscopy time duration).

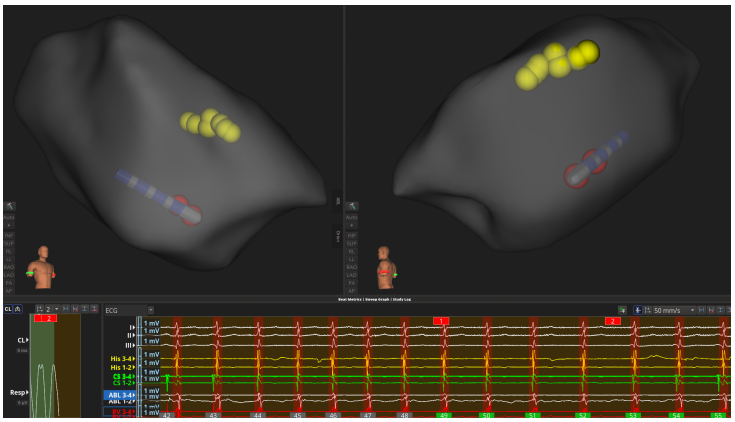

Figure 2. Electro-anatomical mapping: an RAO (left upper panel) and an LAO view (right upper panel) are displayed depicting the mapped location of the AV node-His bundle (yellow dots) and the position of the mapping catheter with its tip at the successful site of ablation (M1 position) (red dots). In the lower panel, an accelerated junctional rhythm is displayed during Rf application at the successful site of ablation of the slow pathway, located at a safe distance from the compact AV node and the His bundle (yellow dots).

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Radiofrequency ablation of the AVNRT is classically performed without the use of EAM, guided by standard fluoroscopy and intracardiac recordings with excellent results; [1-5] unfortunately, the procedure is plagued by a definite, albeit small (1-2%), percentage of heart block.[6] However, in prior multicenter experience, this percentage was found to be much higher, at 4.7%, commensurate with limited ablation experience of the reporting center(s) and the specific target of the ablation procedure (fast vs slow pathway).[7] This report also included procedures targeting the fast pathway of the AV node which inherently raises the percentage of AV block, which is the reason why this approach has been abandoned and since long, the slow pathway has been the target of ablation. Thus, the AV block complication was limited to 2% among the procedures involving slow pathway ablation.

Cryoablation is a safe and effective treatment for AVNRT; avoidance of AV block makes it an attractive option in patients, particularly in children and young adults; however, late recurrence is more common with cryoablation than with RF ablation.[8, 9]

A recent study comprising 1708 patients (56.4 ± 17.0 years, 61% females) undergoing ablation for AVNRT reported acute procedural success at 97%.[6] The overall incidence of heart block was 1.3%. Multivariate analysis showed that age >70 (odds ratio - OR 7.907, $P \leq 0.001$), baseline PR ≥ 190 ms (OR 2.867, $P = 0.026$) and no use of EAM (OR 0.306, $P = 0.037$) were independent predictors of heart block.

Finally, while both conventional EPS/fluoroscopic approach and non-fluoroscopic EAM provide excellent results in guiding ablation of typical AVNRT, EAM can offer shorter procedure and fluoroscopy times with reduced X-ray exposure, and may improve the efficiency of the procedure.[10] However, although EAM simplifies and improves AVNRT and other ablation procedures,[11] it is inherently associated with a higher cost which needs to be factored in and one has to be cognizant of. [12]

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