CASE REPORT

U Wave during Supraventricular Tachycardia: Simulation of a Long RP Tachycardia and Hiding the Common Type AVNRT

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The main tool for the differentiation of supraventricular tachycardia is the 12-lead electrocardiogram (ECG). Especially differentiating the atrioventricular nodal reentrant tachycardia (AVNRT) from the atrioventricular reentrant tachycardia (AVRT) due to concealed accessory pathway or from an atrial tachycardia (AT) is very important for catheter setting and ablation approach in an electrophysiological study. In our case we saw the occurrence of a U wave during tachycardia—simulating a pseudo P wave. This mimicked a long RP-tachycardia, although it was a common type AVNRT.

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The value of the 12-lead electrocardiogram (ECG) for analysis of narrow QRS complex tachycardia is well established.¹ Especially differentiating the atrioventricular nodal reentrant tachycardia (AVNRT) from the atrioventricular reentrant tachycardia (AVRT) due to concealed accessory pathway or from an atrial tachycardia (AT) is very important for catheter setting and ablation approach in a following electrophysiological study. Changes in repolarization due to tachycardia were usually reflected in ST segment depression.² In our case we saw the occurrence of a U wave during tachycardia—simulating a pseudo P wave.

CASE REPORT

A 51-year-old woman presented in our department with typical symptoms of an AVNRT with

sudden on- and off-set of a regular tachycardia. In the 24-hour holder ECG we saw a narrow QRS Tachycardia (~140 bpm) which started after a premature beat (Fig. 1). Caused by a positive deflection after the T wave in one lead the tachycardia appeared like a long-RP tachycardia. Due to the highly symptomatic patient and the existing tachycardia documentation we decided to perform an electrophysiological study.

EP STUDY

Quadripolar diagnostic catheters were positioned in the high right atrium (HRA), the right ventricular apex (RV) and the His position while an octapolar diagnostic catheter was placed in the coronary sinus (CS).

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Figure 1. Holder-ECG with beginning of the SVT after an atrial extra beat. The arrows show the additional wave after the T wave, which simulates a long RP tachycardia.

The decremental VA-conduction during ventricular pacing revealed the absence of a concealed accessory pathway. The programmed atrial pacing demonstrated the existence of an AV slow pathway (with an AH-Jump-phenomenon >60 ms; S1 440 ms, and S2 360 ms). Subsequently the tachycardia occurred with heart rate 130 bpm and short VA-Interval (<40 ms) (Figs. 2B and C). The triggered ventricular pacing showed no preceding of the atrial potentials. The analysis of the 12 lead ECG during tachycardia in the EP-lab showed the same positive wave after the T wave in the precordial leads V_2 – V_4 simulating a P wave like in a long-RP tachycardia. Simultaneous analysis of the surface ECG and the intracardial signals revealed that the additional wave did not accord to any of the atrial signals (HRA or CS). This excluded presence of a retrograde P wave (Fig. 2C). Determining the QT-interval between sinus rhythm and SVT reveals only slight differences (306 ms vs. 298 ms), whereas the corrected QT-intervals already differ considerably (349 ms vs. 435 ms). With this increased QTc during SVT the differential diagnosis of a biphasic or humped T wave is even more unlikely. Next to an artifact the sole remaining reason for the appearing wave is the presence of a U wave. Notably is in this case the absence of an U wave in all leads during sinus rhythm (Fig. 2A). Perez Riera et al. analyzed polarity, location and different types of U wave³. In the consecutive examined ECG recordings the observed U waves were usually found in the

precordial leads and especial V_2 – V_4 like in our case.

These observations led to the diagnosis of a common type AVNRT. So the HRA catheter was removed and an ablation catheter was inserted. In the typical location of the triangle of Koch we ablated the slow pathway successfully. Neither the tachycardia nor the AH jump phenomenon were detectable after the ablation.

DISCUSSION

The analysis of the P wave during supraventricular tachycardia can lead to the right diagnosis. Especially when suspecting that a long RP tachycardia is target of the ablation the presence of a pseudo P wave must be excluded and a common type AVNRT must be examined. Etiological the pseudo P wave (and the resulting pseudo RP Tachycardia) can be caused—as in our case—due to a U wave. The U wave was first described by Einthoven 1912. Since then different theories have been described to explain the origin of the U wave. Some authors saw structural changes as cause of the sixth wave (e.g., ventricular septum or papillary muscles).⁴ Others characterized an electric origin of the U wave like negative afterpotentials, early or delayed afterdepolarization and Purkinje system.⁵ Special consideration deserves the fact that under certain conditions the U wave is only present during tachycardia but not during sinus rhythm.

Figure 2. (A) 12-lead ECG of the Sinus rhythm in the EP Lab. In none of the leads an U wave can be detected. (B) Surface ECG in the EP Lab during consecutive tachycardia. The arrows now show the additional wave after the T wave, visible in the precordial leads V₂–V₄ simulates a long RP tachycardia. (C) Surface and intracardiac ECG in the EP Lab during Tachycardia. The arrows show the additional wave after the T wave, visible in the precordial leads V₂–V₄ which simulates a long RP tachycardia. The black cycles show the intracardiac potentials (atrial and ventricular). The black line shows the position of the “pseudo P wave” without intracardiac potentials at same time. So the additional wave must be interpreted as U wave.

Lab et al. and Choo et al. described mechano-electrical feedback as a possible origin of the U wave.^{6,7} This altered mode of action where an increase in heart rate causes an increase in contractility which changes mechano-electrical

feedback may the ECG U wave pattern exclusively seen during tachycardia.

This seems to be also reasonable in our case. We suspect changes of the repolarization during tachycardia due to mechano-electrical feedback as

cause of the U wave with simulation of a long RP tachycardia.

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