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Case Report

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Two Arrhythmias, One Diagnosis, All from Surface ECGs

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ABSTRACT

A 48-year-old male with known supraventricular tachycardia presented with wide complex tachycardia and he was cardioverted. The patient was initially diagnosed with both ventricular tachycardia and supraventricular tachycardia. After reviewing electrocardiograms, a correct diagnosis of orthodromic atrioventricular reciprocating tachycardia with left-sided accessory pathway was made which was confirmed and successfully ablated in subsequent electrophysiological study. Not all wide complex tachycardias are ventricular tachycardia. If the rate of narrow complex supraventricular tachycardia becomes slower with the development of a bundle branch block, it is diagnostic for the presence and participation of the ipsilateral accessory pathway, which is called Coumel's law.

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Introduction

This case demonstrates the diagnostic challenge and importance of accurate electrocardiogram (ECG) interpretation of tachyarrhythmias. A 48-year-old male presented with wide-complex tachycardia (WCT) that was initially treated as a ventricular arrhythmia, and subsequently developed a narrow complex tachycardia. This case discusses the key findings on ECGs that confirmed a diagnosis of orthodromic atrioventricular reciprocating tachycardia (ORT) with a left-sided accessory pathway, leading to successful resolution of his tachyarrhythmia after radiofrequency ablation.

Case Description

A 48-year-old male with a history of alcoholism, polysubstance abuse, supraventricular tachycardia (SVT), and coronary artery disease status post recent drug-eluting stent placement to the left anterior descending artery, presented with palpitations to the emergency department. The patient was found to be in a WCT [Figure 1] with oxygen desaturation. In the emergency department, he was cardioverted with synchronized 200 J to sinus tachycardia at a rate of 102/min. The patient was diagnosed with ventricular tachycardia (VT) and amiodarone infusion was started. Overnight, the patient went into a narrow complex tachycardia (NCT) with a heart rate of 200/min [Figure. 2] which was not sustained. The Electrophysiology service was consulted for further management of both VT and SVT. After careful examination of the two ECGs, we noted that the WCT on initial presentation [Figure 1] was slightly slower than the NCT [Figure. 2]. There was no ventricular pre-excitation noted on the post-cardioversion ECG [Figure 3]. Based on these findings, a diagnosis of ORT with a left lateral accessory pathway was made. VT was ruled out and the amiodarone drip was discontinued. The subsequent electrophysiology study confirmed the left-sided accessory pathway which was ablated successfully. Both narrow and wide complex tachycardia rhythms were no longer inducible after radiofrequency ablation.

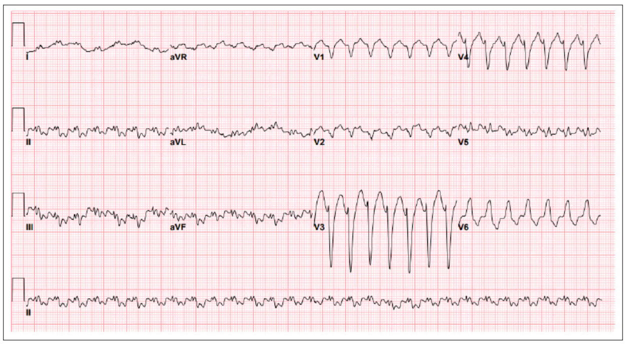

Figure 1: 12 Lead Electrocardiogram Showing Regular Wide Complex Tachycardia at a Rate of 177 Beats Per Minute in Left Bundle Branch Block Morphology and in RSR' Pattern in the Inferior Leads

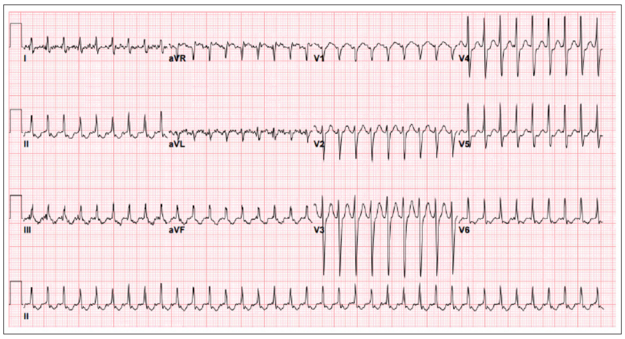

Figure 2: 12 Lead Electrocardiogram Showing Regular Narrow Complex Tachycardia with Retrograde P Waves with R Wave

Progression in V3-4

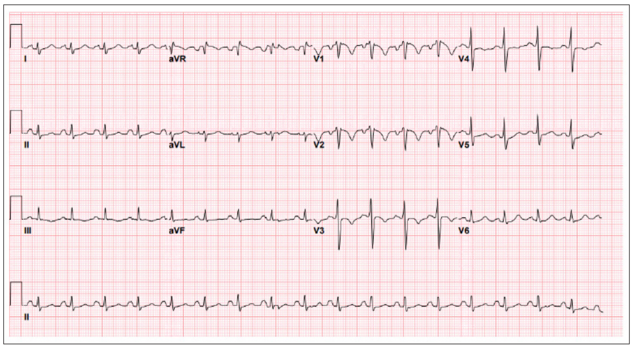

Figure 3: 12 Lead Electrocardiogram Showing Sinus Tachycardia at a Rate of about 102 Beats Per Minute, Right Axis Deviation, Biatrial Enlargement

Discussion

Our patient was diagnostically challenging because he had both narrow and wide complex tachyarrhythmias. The WCT in this patient was initially thought to be ischemic in etiology, as he had an ischemic event just 5 weeks ago just 5 weeks ago with stent placement. In addition, the patient was a known user of alcohol, and his left ventricular ejection fraction was 45% from recent echocardiography. This history of structural heart disease put him at a higher risk of ventricular tachycardia, and his WCT was treated as VT until proven otherwise, and cardioversion was performed.

Even though the majority of WCT in patients with structural heart disease is VT, ECGs should be approached systematically before making the diagnosis. The WCT ECG [Figure. 1] showed typical left bundle branch block (LBBB) morphology and the QRS axis in aVR was negative. There was no AV dissociation, and the patient did not lose consciousness during the event. In summary, there was no conclusive evidence of VT on that ECG. The ECG in normal sinus rhythm [Figure. 3] did not show ventricular pre-excitation and the PR interval was 150 msec. However, the left lateral accessory pathway most often does not present with pre-excitation, especially in younger patients with robust AV node conduction. Therefore, ORT with an accessory pathway could not be excluded.

The rate of the NCT was approximately 200/min, slightly faster than the WCT, but morphologically similar to his baseline ECG. The wide complex rhythm showed QRS complexes of around 120 msec with LBBB morphology and RSR` pattern in the limb leads. VT is less likely with these features even in the setting of known ischemic cardiomyopathy. VT would generally result in a right superior axis with a positive R wave in aVR, and the precordial leads usually show an atypical right bundle pattern with large R or M wave in V1 [1].

However, the rates of these two tachyarrhythmias were very close. The most likely explanation was that the patient had one arrhythmia mechanism - the narrow complex SVT - which developed aberrant conduction with LBBB and slightly slowed down, resulting in the WCT.

SVT encompasses atrioventricular nodal reentry tachycardia (AVNRT), atrioventricular reentrant tachycardia (AVRT), and atrial tachycardia (AT). AVNRT is the most common SVT, but it was ruled out since AVNRT relies on the small circuit in the triangle of Koch, and AVNRT does not slow down with the development of either of the bundle branch blocks. There is also a retrograde P wave at the end of the QRS complex resulting from the sudden reversal of atrial activation. AT originates from the atrium, and it also does not slow down due to aberrant conduction from the bundle branch block. Focal AT could have a different P wave morphology or heart rate variability. After excluding AVNRT and AT, the only rational diagnosis left is AVRT.

AVRT may demonstrate orthodromic or antidromic conduction. ORT is a macro-reentrant arrhythmia using the AV node for antegrade conduction from the atrium to the ventricle, and the accessory pathway for retrograde conduction from the ventricle to the atrium. ORT is known to be affected by the bundle branch block ipsilateral to the accessory pathway since the bundle branch is involved in the pathway to complete the circuit. The fact that the WCT has a slightly longer tachycardia cycle length (slower rate) than the narrow complex SVT indicates that ORT with an accessory pathway ipsilateral to the bundle branch block is involved. This phenomenon is often referred to in cardiac electrophysiology as Coumel's law [2]. In this patient, the LBBB caused the WCT to slow down, and hence, the left-sided accessory pathway is the culprit of the SVT. The development of a right bundle branch block would not slow down his SVT rate due to his macroreentry circuit being on the left side of the heart [3,4].

Just from the surface ECGs, the diagnosis was ORT with a left lateral accessory pathway and the ablation procedure was planned including intracardiac echocardiography and transseptal puncture. The intracardiac electrogram (EGM) showed eccentric ventriculoarterial (VA) conduction with the earliest signal in the distal coronary sinus catheter electrodes as shown in Figure 4. ORT was readily induced with atrial extra stimuli or rapid atrial pacing. Ventricular extra-stimuli readily entrained the SVT. The left lateral accessory pathway was confirmed, and transseptal puncture was performed followed by cardiac mapping. The earliest atrial signal was targeted during the SVT and ventricular pacing. The ablation site was at the lateral mitral annulus near the distal CS electrodes. Focused ablation was performed which successfully terminated the SVT [Figure 5]. The follow-up electrophysiological (EP) study in Figure 6 showed the concentric VA conduction during right ventricular pacing. Accessory pathway conduction was absent, and the same pacing rate created a retrograde Wenckebach VA block. Repeat EP study 30 minutes later confirmed the absence of accessory pathway conduction. The patient was followed up over several months. The tachycardia never recurred.

Figure 4: Before Ablation, Pacing the Ventricle and Conducting to Atrium via Left Lateral Pathway

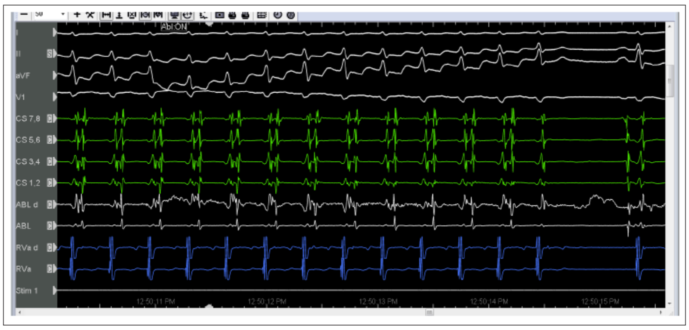

Figure 5: Ablation and Termination of SVT

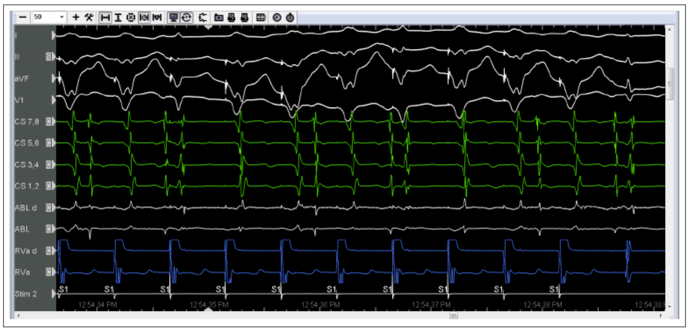

Figure 6: After Ablation, Ventricular Pacing without Conduction to the Atrium

Conclusions

- Correct interpretation of the ECG can prevent the potential complications of incorrect treatment, perhaps long-term amiodarone use in this case. It also helps to plan for the ablation procedure such as preparing for left heart access if necessary.
- When a patient presents with two different arrhythmias, one should consider whether one etiology could be causing both.
- Development of a bundle branch block during SVT resulting in slowing of the tachycardia cycle length was diagnostically important in identification of ORT with an ipsilateral accessory pathway.
- Absence of ventricular pre-excitation on the ECG does not exclude the presence of an accessory pathway, especially a left-sided accessory pathway.

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