

EP CASE REPORT

The double adenosine test: a simple and non-invasive tip to unmask unapparent pre-excitations: an example of Mahaim fibres

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Case description

A 16-year-old man presented at the cardiac emergency department for palpitations. At admission, the heart rate was 210 bpm and the blood pressure was 110/50 mmHg. The 12-lead electrocardiogram at admission recorded a wide-QRS tachycardia with left bundle branch block (BBB) morphology and superior axis (see Supplementary material online, Figure S1). At presentation, differential diagnoses included (i) ventricular tachycardia (VT), (ii) supraventricular tachycardia (SVT) with BBB/aberrant conduction, and (iii) antidromic atrioventricular re-entrant tachycardia (AVRT). A first adenosine injection (10 mg IV bolus) resulted in the abrupt termination of the tachycardia (Figure 1, upper panel), and the 12-lead ECG recorded during sinus rhythm demonstrated a normal PR interval (170 ms) followed by narrow QRS complexes (see Supplementary material online, Figure S2). At that stage, the remaining possible diagnoses included (i) atrioventricular nodal reciprocating tachycardia (AVNRT) with functional left BBB, (ii) orthodromic AVRT with functional left BBB, (iii) adenosine-sensitive atrial tachycardia with functional left BBB/aberrant conduction, and (iv)



Figure 1 Upper panel. First adenosine test, during ongoing tachycardia. The administration of a bolus of adenosine (10 mg IV) resulted in abrupt termination of the wide QRS tachycardia. This response suggests three possible diagnoses: AVNRT, AVRT, or triggered atrial tachycardia. Close analysis of the electrocardiogram following tachycardia termination suggests the presence of an accessory pathway. Indeed, varying degrees of pre-excitation with QRS patterns similar to that during tachycardia can be suspected, especially on the last two QRS complexes of the ECG. Lower panel. Second adenosine test, during sinus rhythm. During sinus rhythm, the PR interval is normal (170 ms) and the QRS complexes are narrow, without visible pre-excitation. Adenosine administration (10 mg IV) triggered a progressive widening of the QRS complexes, until they became fully pre-excited. As the anterograde conduction over the atrioventricular node was totally blocked by adenosine, this response provides definite evidence for anterograde conduction over an accessory pathway. Pre-excited complexes are preceded by a long PR interval (190 ms), which is inconsistent with a typical (rapidly conducting) accessory pathway. A premature atrial beat is followed by a further increase in the PR interval, which proves the decremental properties of the accessory pathway. Altogether, these findings prove that the anterograde conduction occurs over an accessory pathway with slow and decremental conduction properties. Note that the morphology of the pre-excited QRS complexes is strictly the same as that during wide complexes tachycardia, demonstrating that the bypass tract is involved in the tachycardia mechanism. Finally, the fact that the QRS is relatively narrow (135 ms) and that its morphology is very close to that of a typical left bundle branch block favours the diagnosis of a right atriofascicular bypass tract (rather than an atrioventricular one), which turned out to be the case during the electrophysiological study.

antidromic AVRT. A second bolus of adenosine (10 mg IV) was then administered *during sinus rhythm*. The adenosine-induced block of the atrioventricular node resulted in a progressive widening of the QRS complexes, followed by fully pre-excited QRS complexes (Figure 1, lower panel). This finding provided evidence for an antegradely conducting accessory pathway, which was not visible during sinus rhythm before adenosine infusion. The morphology of these QRS complexes being strictly the same as that during wide-QRS tachycardia, functional BBB was definitely excluded and a diagnosis of antidromic AVRT was made. At that stage, differential diagnoses included (i) antidromic AVRT due to a typical rapidly conducting accessory pathway and (ii) antidromic AVRT due to a long decrementally conducting accessory pathway. The long PR interval (190 ms) despite 1:1 atrioventricular conduction over the bypass tract after adenosine administration as well as its prolongation following premature atrial beats provided the definitive evidence for an atypical accessory pathway with slow and decremental conduction properties (the so-called 'Mahaim fibres'). Subsequent electrophysiological study confirmed the diagnosis, and the bypass tract was successfully ablated at the lateral tricuspid annulus.

Discussion

In patients presenting with wide QRS tachycardia, a prompt and accurate diagnosis is mandatory. In non-haemodynamically compromised patients, adenosine administration during ongoing tachycardia is helpful if a supraventricular tachycardia with aberrant conduction is considered¹. When adenosine abruptly terminates the tachycardia, close inspection of the electrocardiogram during sinus rhythm should look for a pre-excitation. Unfortunately, a pre-excitation can be completely unapparent during sinus rhythm despite the presence of an antegradely conducting accessory pathway. This is typically the case in the so-called Mahaim fibres.^{2,3} These atrioventricular or atriofascicular bypass tracts give rise to antidromic tachycardias, in which the bypass tract serves as the anterograde limb of the circuit and the atrioventricular node as the retrograde limb of the re-entrant circuit. The key point is that these bypass tracts demonstrate slow and decremental properties ('atrioventricular node-like structure'), so that the baseline electrocardiogram during sinus rhythm shows normal QRS complexes or only minimal pre-excitation. In this situation, a second adenosine administration, *during sinus rhythm*, is a simple tip to unmask the pre-excitation on the surface ECG. By blocking the anterograde conduction over the atrioventricular node, adenosine infusion will indeed result in ventricular activation occurring exclusively over the accessory pathway. The use of this simple method is not limited to the diagnosis of Mahaim fibres, but is very helpful to unmask an inapparent pre-excitation whenever there is a doubt on the baseline ECG. Without this test, a misdiagnosis of SVT with functional bundle branch block can easily be made.

Supplementary material is available at *Europace* online.

Acknowledgements

We are grateful to Brigitta Schwarze for her valuable help in language editing.

Conflict of interest: none declared.

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