Atrial lead threshold testing failure: are we seeing double?

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An atrial pacing threshold is shown (Figure 1A). Modality of pacing is AAI at 90 bpm. The first paced beat is followed by two consecutive ventricular depolarizations. The second atrial paced beat is not followed by any ventricular-related sensed beat. The third is normally conducted to the ventricles.

The electrocardiographic behaviour observed concomitantly to the first two atrial paced beats is explained with a double response (Figure 1B) (antegrade conduction over both the fast and the slow AV-nodal pathway) followed by a pseudo-atrioventricular block due to collision of the following antegrade impulse generated by atrial paced beat and the putative retrograde conduction over the fast pathway. Furthermore, the normal conduction to the ventricle of the third atrial paced beat can be explained with the assumption that this third atrial paced beat has a shorter AV interval than the second paced beat. Therefore, retrograde conduction of the slow pathway can cause subsequently a block in the slow pathway due to collision of the antegrade conduction over the slow pathway. The AV interval during the second paced beat is longer (decremental characteristic of the fast pathway) thereby antegrade conduction through the slow pathway is possible before retrograde conduction occurs: dual response.

An alternative explanation of alternating conduction via a slow and a fast AV-nodal pathway was not completely excluded by pacing the atrium at 80 bpm. As shown in Figure 2, at that heart rate every atrial paced beat moved together with a ventricular depolarization. This could be interpreted as conduction exclusively via the fast pathway or as an aborted dual response due to a collision of the antegrade impulse over the slow pathway with the retrograde developed after conduction over the fast pathway (Figure 2B). The difference in P-wave morphology is given to the fact that different leads are showed in the figures.

Dual response is a well-known electrophysiological phenomenon, described for the first time in 1975 by Wu et al.\(^1\) and associated with a non-reentrant AV-nodal tachycardia for the first time by Csapo in 1979.\(^2\) The most accepted explanation for the simultaneous conduction of the impulses over the slow and the fast pathways is the different conduction properties of these two pathways.\(^3,4\) In the majority of individuals with dual AV-nodal physiology, the impulses originating in the atrium are conducted to the ventricles through both pathways but the fast pathway impulse arrives to the distal common pathway before that of the slow pathway, contributing to the consequent ventricular depolarization and to a partial retrograde activation of the slow pathway itself. In some subjects, the conduction of the slow pathway can be sufficiently slow to allow recovery of the conduction over the distal common pathway and the distal portion of the slow pathway, consequently permitting ventricular capture by the impulse conducted through the slow pathway, as explained in our case.
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References