Inappropriate mode switch consecutive to P-wave double counting

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We report a case of multiple inappropriate mode switches in a patient with a dual-chamber pacemaker, resulting from P-wave double counting due to a double potential on the atrial electrogram. The differential diagnosis of this rarely reported phenomenon is discussed.

Case report

A 76-year-old woman was implanted with a dual-chamber pacemaker because of symptomatic brady-tachy syndrome. A 52 cm CapSureFix Novus lead (Medtronic Inc., Minneapolis, MN, USA) was placed on the anterolateral wall of the right atrium (Figure 1) and a 58 cm CapSureFix Novus lead (Medtronic Inc.) was positioned at the right ventricular apex. A Sorin Reply (Sorin Group, Milan, Italy) dual-chamber pacemaker was implanted and programmed to SafeR Mode (ADI-DDD) with bipolar sensing set to 0.1 mV.

At six weeks’ routine follow-up, the patient was asymptomatic and a 12-lead electrocardiogram (ECG) showed normal sinus activity with intrinsic narrow QRS complexes. Device statistics was relevant for 37 episodes of mode switching, most of which were consecutive to double counting of P-waves with a PP interval of about 80 ms (Figure 2). This cause of mode switch is rarely reported in the literature.1 Differential diagnosis includes:

1. Farfield R-wave (FFRW) oversensing: sensing of the R-wave on the atrial channel may occur before the ventricular channel in up to 28% of patients,2 especially in the case of right bundle branch block (which was absent in our patient). The timing of the FFRW on the atrial channel has however been reported to anticipate sensing on the ventricular channel by 40 ms2 and was about 100 ms in our case, making this very unlikely. Finally, during appropriate mode switch for atrial tachycardia, the double potential was no longer visible (Figure 3) but would have been in case of FFRW oversensing.

2. Double counting of the P-wave due to interatrial conduction block with oversensing of the left atrium may theoretically occur. However, P-wave morphology and duration were normal on the ECG.

3. A double potential due to conduction delay may be observed near the crista terminalis, or elsewhere in the right atrium in elderly patients.3 This was perceived to be the most likely explanation in our patient. This is compatible with the fact that the double potential was not visible during atrial tachycardia (Figure 3), probably due to the different electrical activation wavefront.

In Sorin Reply pacemakers, after an atrial sensed event, an absolute non-programmable blanking period of 30 ms is started and is followed by a 50 ms relative refractory period (that may be repeated three times) which should avoid double counting of P-waves. Sensing during this refractory period starts a new refractory period and is used to trigger mode switch. In this family of pacemakers, the mode switch criterion is not related to a frequency limit but to a probabilistic counter of premature atrial sensed events:4 any atrial sensed event starts a window of atrial rate acceleration detection (WARAD) corresponding to 62.5% of the previous PP interval (75% if the sinus rhythm is faster than 85 bpm); mode switching occurs if 28 of 32 P-waves are detected during the WARAD.

In our case, the P-wave was systematically double-counted after 85–93 ms. Two distinct peaks of P-wave amplitude are observed on autosensing histograms, corresponding to the ‘real’ P-wave and the oversensed double potential (Figure 2). In this particular case, the patient remained asymptomatic because of preserved normal intrinsic rhythm.

Figure 1 (A) Postero-anterior chest X-ray. (B) Left anterior chest X-ray.

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In this device, neither the post-atrial sensed blanking period, nor the mode switch criterions are programmable. In case of symptoms relating to episodes of mode switching, sensitivity may be lowered (with a risk of atrial undersending), unipolar sensing could be tested, or the lower rate might be set to override sinus rhythm in order to promote atrial pacing (with verification of absence of atrial double counting during atrial pacing). Finally, the atrial lead may be re-positioned to another site with better sensing.

This case illustrates the importance of carefully analysing atrial electrograms at implantation, not only in terms of electrograms amplitudes, but also in terms of morphology, to avoid sensing issues such as farfield R-wave oversensing and P-wave double counting.

**References**