Searching for the R-wave in DDD Mode May Cause T-wave Pacing

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The original ascnchronous (V00) pacemakers without a circuit resulted in pacing on the T-wave in the presence of intrinsic ventricular activity. Demand (VVI) pacemakers appeared several years later, to suppress this potentially arrhythmogenic behavior of fixed rate pacing. Forty years after the introduction of cardiac pacing, this phenomenon has reappeared, which is a consequence of algorithms designed to respect the intrinsic AV conduction in DDD pacing.

In the case of sinoatrial dysfunction, the purpose of pacing is to assist the sinus node. Exclusive atrial pacing (AAI) has the disadvantage of not including a ventricular backup. Standard DDD pacing, however, includes other drawbacks. It evokes unnecessary ventricular pacing, which increases current drain, and induces either ventricular fusions or ineffective pseudofusions.

Most pacemaker companies offer algorithms which periodically prolong the AV delay to search for intrinsic R-waves. AV delays up to 350 ms are commonly reached to suppress ventricular pacing. Under these conditions an atrial escape interval may fall in a premature ventricular contractions (PVC) and into the ventricular blanking period and will be followed by a ventricular impulse on the T-wave. We observed this phenomenon in a patient during routine follow-up who was complaining of palpitations. The ECG showed two right ventricular stimuli during the repolarization phase of a PVC. The first stimulus was ineffective, while the second was effective, as it was due to a capture control algorithm and was delivered at maximum output. It induced a reentry tachycardia, which was fortunately terminated by a third algorithm.

Last but not least, these extremely long AV delays may cause "functional" loss of atrial capture, with atrial pulses falling in the refractory period of the atrium, thus causing various types of pacemaker induced tachycardia not always correctly managed by mode switch algorithms. Should AAI pacing be reconsidered on the basis of the effects of DDD pacing associated with R-wave detection algorithms, when the criteria for reliable AV conduction are fulfilled (1/1 conduction at atrial pacing, QRS < 120 ms).

We would like to answer in the affirmative, but with several qualifications. Although pure atrial pacing via a single lead connected to a single-chamber pacemaker appears to have been a reliable, long-term treatment in the past, this simple technique is hardly acceptable in 2003. Ventricular pacing may become necessary several years after implantation due to a progressive deterioration of the AV node. AV conduction may be altered by antiarrhythmic drugs or AV node ablation. Therefore, atrial dysfunctions should benefit from a dual-chamber pacemaker, regardless of the AV conduction.

With a downgrade to the AAI mode, a modern DDD pacemaker will suppress most diagnostic functions, making it impossible to follow the stability of the atrium. To benefit from the diagnostic advantages of smart DDD pacing and eliminate the disadvantages of long AV delays, one can program a DDD mode with a standard AV delay and subthreshold ventricular output. This "ADD" mode, however, is not indicated when there is any doubt concerning AV conduction or when antiarrhythmic treatment may evoke bradycardia during atrial fibrillation with mode switching. A choice should be made among all the side effects of DDD pacing associated with algorithms detecting the R-wave. These choices include pacing the T-waves, inducing various types of PMTs, causing "functional" loss of atrial capture, and the absence of ventricular backup in ADD pacing. Regular patient follow-up is of course mandatory to verify the quality of AV conduction and possibly resume ventricular capture if an ADD mode has been selected.

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