Inappropriate pacing due to T-wave oversensing

Rafle Fernandez, Christos G. Mihos, Jose L. Torres, Alfonso O. Tolentino

Oversensing of T waves is not an uncommon phenomenon, which can result in inhibition of the next pacing stimulus and lengthening of the effective pacing interval in pacemakers (1) (Figure 1). Double counting is more likely to occur when the QRS-T complex falls outside of an algorithm-specific timing window of the devise (2). TWOS is a common cause of inappropriate ICD shock therapy, and loss of biventricular pacing, with possible CRT nonresponse (3). It is also crucial because it remains one of the Achilles heels of subcutaneous and intravenous implantable cardioverter defibrillators, leading to inappropriate shock therapy (2,4,5). In pacemakers, the resulting lengthening of the effective pacing can lead to bradycardia, which occasionally becomes clinically symptomatic (1), like in this case (Figure 1).

TWOS can lead to pacemaker tachycardia in biventricular pacemaker by T wave oversensing outside the post-ventricular atrial refractory period in the atrial channel (6). Based on the premise that TWOS arises from double counting of the QRS-T complex, efforts have been made when implanting subcutaneous ICDs to try to prevent it based on pre-implantation ECGs, but until the present, an explicit clinical parameter is lacking strong evidence support (2). TWOS can also arise from myocardial ischemic induced hyperacute T waves (5), T wave changes induced by hyperkalemia (7), Brugada syndrome’s intrinsic arrhythmogenic changes (8), diaphragmatic myopotential oversensing (9), any changes in intraventricular conduction delay leading to changes in QRS and T-wave morphology as in the case post alcohol septal ablation in hypertrophic obstructive cardiomyopathy (10). Lowering atrial or ventricular sensitivity (Figure 2), altering ventricular pacing, adjusting post-ventricular atrial refractory period, changing AV delay, and sensitivity vector from dedicated to the integrated bipolar system and other interventions can eliminate or reduce the incidence of TWOS. However, attention needs to be placed to prevent under detection of critical electrical events (1,3,6,8).

Clinically symptomatic TWOS is a relatively rare event, but when present can cause significant morbidity. This makes its detection and awareness critical to the general clinician, cardiologist, and electrophysiologists. In order to overcome TWOS, different parameters can be changed in the device detection system. These changes should be done whenever possible under the guidance of electrophysiologists for a prompt and safe clinical outcome.
Figure 1 Example of T-wave oversensing post permanent pacemaker implantation. Pacemaker programed DDD-R 60/120 bpm with sensitivity of 0.9 mV. ECG tracing shows sinus rhythm with atrial sensed and ventricular pacing every other P wave (2:1 AV block) (upper panel of image). Devise interrogation strip showed oversensing in the RV channel, consistent with T-wave oversensing (lower panel of image).

Figure 2 Example of subsequent reprogramed devise to a lower sensitivity of 4 mV. ECG tracing showing sinus rhythm with normal atrial sensed and ventricular pacing (upper panel of image). Devise interrogation strip showed normal sensing and pacing (lower panel of image).

Acknowledgments

Funding: None.

Footnote

Provenance and Peer Review: This article was commissioned by the Guest Editors (Christos G. Mihos) for the series “Novel Concepts in Cardiopulmonary and Structural Heart Disease” published in Journal of Thoracic Disease. The article did not undergo external peer review.

Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at http://dx.doi.org).
The series “Novel Concepts in Cardiopulmonary and Structural Heart Disease” was commissioned by the editorial office without any funding or sponsorship. CGM served as the unpaid Guest Editor of the series and serves as an unpaid editorial member of Journal of Thoracic Disease from Jan 2019 to Dec 2020. The other authors have no other conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Open Access Statement: This is an Open Access article distributed in accordance with the Creative Commons Attribution-NonCommercial-NoDerivs 4.0 International License (CC BY-NC-ND 4.0), which permits the non-commercial replication and distribution of the article with the strict proviso that no changes or edits are made and the original work is properly cited (including links to both the formal publication through the relevant DOI and the license). See: https://creativecommons.org/licenses/by-nc-nd/4.0/.

References
