

Unexpected Ventricular Tachycardia Induced by the Auto Capture Management Function of an Implantable Cardiac Device

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Abstract

Auto Capture Management (ACM) is useful in preserving battery longevity and in ensuring pacing. However, ACM sometimes leads to ventricular pacing with unsafe timing. We experienced a case of 30-year-old male with an implantable cardioverter defibrillator in whom RV pacing was performed at unfavorable timing by ACM algorithm. We wish to emphasize the importance of looking at the electrocardiogram for the management of cardiac implantable electrical devices.

Keywords: Cardiac implantable device; Auto capture management; Under-sensing

Case Presentation

A 30-year-old male received an Implantable Cardioverter Defibrillator (ICD) after resuscitation from Ventricular Fibrillation (VF). The atrial lead (Tendril; Abbott, Chicago, IL, USA) was positioned in the right atrial appendage. The Right Ventricular (RV) lead (Duarte; Abbott) was positioned in the RV apex. Atrial sensing was 5.0mV, ventricular sensing was 12mV, atrial pacing threshold was 0.75V/0.4ms, and ventricular threshold was 0.5 V/0.4ms during implantation. The ICD was programmed in DDD mode with a lower rate of 60 Beats Per Minute (bpm) and an upper tracking rate of 130bpm. The paced Atrioventricular (AV) interval was 200ms and the sensed AV interval was 150ms. Regarding additional programming, Auto Capture Management (ACM) was turned on for future remote monitoring. After ICD implantation, the cardiac monitor detected Non-Sustained Ventricular Tachycardia (NSVT) (Figure 1).

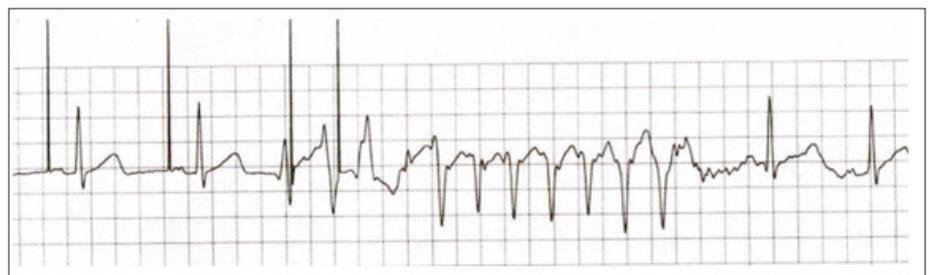


Figure 1: Cardiac monitor tracing during event detection.

What Happened in this Patient and How Can this Problem be Resolved?

Figure 1 is a post-ICD implantation cardiac monitor recording during the hospital stay. Detailed annotations were added to the cardiac monitor tracing (Figure 2). NSVT was induced following RV pacing at undesirable timing. In this case, the RV ACM function was on. The timing of this RV pacing was not delivered at paced nor sensed AV intervals; this pacing was a back-up pacing. ACM has a back-up pacing function where back-up ventricular pacing is performed with a 5-volt output if ventricular capture fails. If the timing of RV pacing results in fusion with an intrinsic R wave, the device cannot confirm capture or lack of capture, and back-up pacing

continues even when the patient has a conducted beat. The device was not able to sense the first Premature Ventricular Contraction (PVC) and atrial pacing continued with uncaptured pacing. This was followed by back-up ventricular pacing with the fusion avoidance

function, which occurred precisely on the T wave of the second PVC, resulting in NSVT. In this case, use of the ACM function led to an undesirable effect, with the potential for a life-threatening event. Thus, we disabled ACM in this patient.

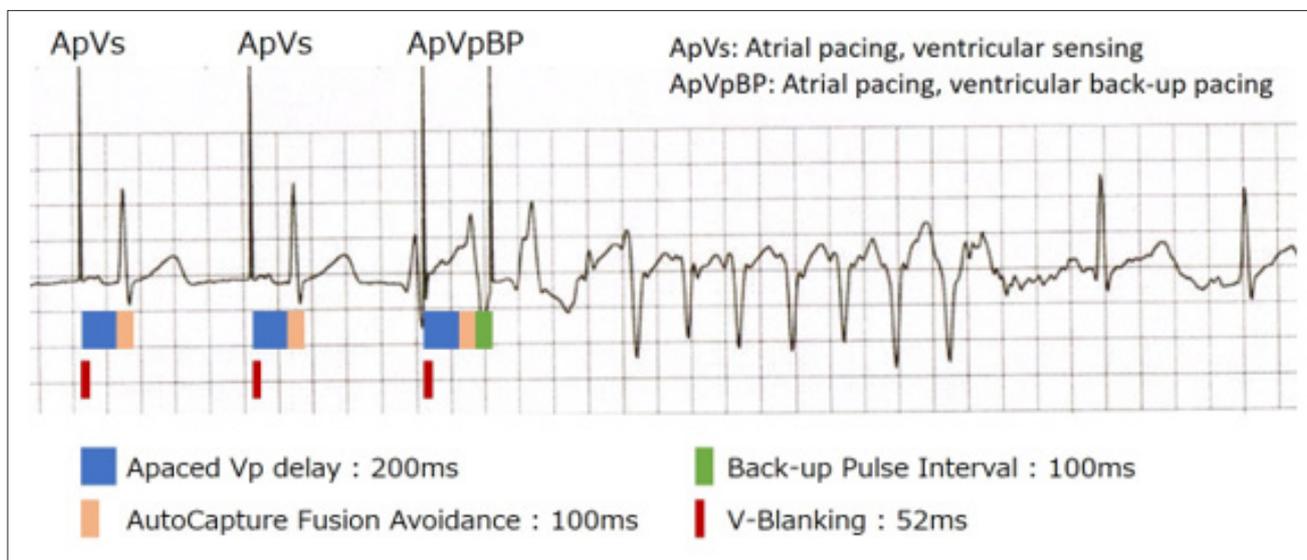


Figure 2: Cardiac tracing with detailed annotations. Back-up ventricular pacing resulted in the induction of non-sustained ventricular tachycardia.

Discussion

Remote Monitoring (RM) is recommended in the management of cardiac electrical devices (Cardiac Implantable Electronic Devices, CIEDs), according to the statements of the Heart Rhythm Society/American Heart Association/European Heart Rhythm Society and also the Japanese Heart Rhythm Society [1]. The benefits of remote monitoring have been shown in previous clinical studies [2-5]. When using RM, ACM is generally on (activated). ACM is useful in preserving battery longevity and in ensuring pacing. However, ACM sometimes leads to ventricular pacing with unsafe timing. There are also limitations to self-checks performed by CIEDs. Sensing failure cannot be detected by automatic device checks. The pacemaker cannot recognize whether sensing is detected correctly; for example, the detection may result from far-field sensing, or electromagnetic interference, or noise caused by lead fracture. Sometimes with DDD mode, under-sensing of atrial activity leads to mistimed ventricular pacing, and this can occasionally result in a spike on the T wave. All studies reported that remote monitoring significantly reduces the number of follow-up visits, time spent per visit by patients and physicians, increases patients' follow-up adherence, and improves outcomes. However, we must be careful to confirm that the device is working correctly and safely, and does not put the patient at risk. We here wish to raise an alert concerning the use of remote monitoring to manage CIEDs without looking at the electrocardiogram. There many potentially concerning issues related to device operation, which may be minor, but may also be severe, and in any case need to be corrected. Careful consideration

is needed with the use of remote monitoring and it is important not to place excessive trust in this modality.

Conclusion

ACM function is commonly used in RM management. However, we have to know a pit fall of this function like this case. Many minor issues may be encountered that, even if they are not immediately life-threatening, have the potential to lead to serious future problems in these patients. Recently, due to COVID-19, RM has been strongly recommended in clinical practice for follow-up of CIEDs, and we wish to raise the concern that there might be excessive trust in RM. We again emphasize that the aim of RM is not to save clinic time, but to provide better quality in the management of CIEDs as an additional option to the in-person visit. It is important to see the electrocardiogram for the management of CIEDs.

Conflict of interest

T. Nakai belongs to a department established by contributions from Abbott Medical, Biotronik Japan, Medtronic Japan, Japan Lifeline, and Boston Scientific. T. Nakai received lecture fees from Abbott Medical and Medtronic Japan. All of the other authors have no conflicts of interest to report.

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