

CASE IMAGE

An inappropriately–appropriate ICD therapy: What is the mechanism and what interventions can be done?

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Key Clinical Message

R-wave double counting is a rare cause of ventricular oversensing that can lead to inappropriate shocks. Optimizing device programming is essential for the avoidance of subsequent inappropriate therapies.

Abstract

R-wave double counting is a rare cause of ventricular oversensing that can lead to inappropriate shocks. We present the case of a female patient, 52-years-old with a history of end-stage hypertrophic cardiomyopathy. The patient suffered an implantable cardioverter-defibrillator (ICD) shock. Cardiac device interrogation revealed ventricular tachycardia (VT) with a cycle length of 420 ms that was misclassified in the ventricular fibrillation (VF) zone owing to R-wave double counting. Optimizing device programming is essential for the avoidance of subsequent inappropriate therapies. Possible therapeutic options are briefly presented in the case.

KEYWORDS

ICD therapies, implantable cardioverter defibrillator, R-wave oversensing

1 | CLINICAL IMAGE

1.1 | Clinical question

A 52-year-old female with a history of end-stage hypertrophic cardiomyopathy with an Abbott Fortify ST 1235–40 single-chamber ICD was evaluated following a shock. Cardiac device interrogation is presented in [Figure 1A](#). What is your diagnosis?

1.2 | Answer

Cardiac device interrogation revealed ventricular tachycardia (VT) with a cycle length of 420 ms that was misclassified in the ventricular fibrillation (VF) zone owing to R-wave double counting, leading to shock and termination of the VT. The device baseline tachycardia configuration was as follows: A monitor-only zone commencing at 496 ms, a VT treatment zone at the cycle length of 351 ms,

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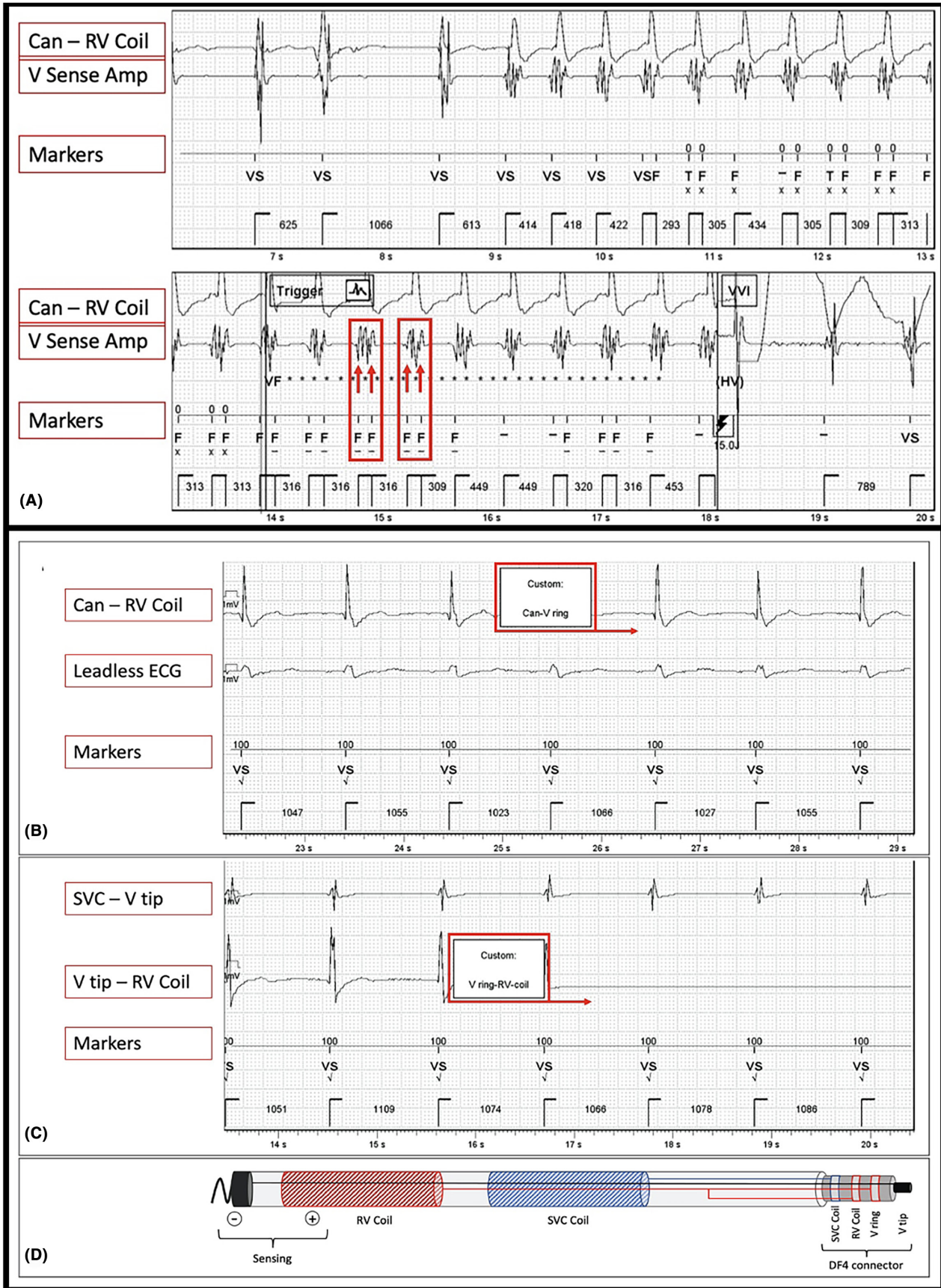


FIGURE 1 (A) A ventricular tachycardia event was misclassified in the ventricular fibrillation zone owing to R-wave double counting and finally leading to shock and termination of the ventricular tachycardia. (B) “Can to RV-coil” electrogram configuration results in a similar electrogram to the “Can to V-ring” configuration. (C) “V-ring to RV-coil” configuration results in flat-line electrogram, as RV-coil also has the role of sensing anode (ring). (D) Schematic representation of an integrated dual-coil bipolar lead.

and VF zone detection at 270 ms. The lead manufacturer and model were unknown due to prior device replacements. The lead integrity was evaluated, and no issues were found. As the lead type was unknown (true or integrated bipolar), different electrogram (EGM) configurations were used for differential diagnosis. The existence of an integrated bipolar lead was established since the EGM recording of “Can to RV-coil” was identical to the one demonstrated by changing to “Can to V-ring” and the configuration “V-ring to RV-coil” showed a flat-line EGM, as expected in an integrated bipolar lead where the RV-coil also has the role of sensing anode (ring). (Figure 1 B,C)

R-wave oversensing can be eliminated most of the time by extending the ventricular blanking duration from the nominal value. This modification will affect the fastest frequency at which the device can detect VF and should be applied with caution. This was the intervention of our choice, being aware that true VF under-sensing can occur when the blanking interval is overextended. Subsequently, additional testing regarding the ability of the device to detect appropriately VT/VF following the new device programming was conducted before patient discharge. In devices that permit manual changes in the sensing algorithm, as in Abbott/SJM-manufactured ICDs, additional interventions can be applied. We can delay the sensitivity decay and/or affect the maximum amplitude of the sensed signal before the decay initiation to the programming sensitivity begins. This modification is highly effective in solving the problem of R-wave double counting.¹ Altering the sensitivity value may be considered as another therapeutic option. However, in R-wave oversensing, it is rarely useful. R-wave double counting remains a rare cause of ventricular oversensing, occurring mainly due to a marked ventricular conduction delay between the sensing bipole of the lead.² It is reported to be up to five times more frequent in integrated bipolar ventricular leads than dedicated bipolar leads, an observation that may be justified by their design properties (Figure 1D).³

AUTHOR CONTRIBUTIONS

Athanasios Saplaouras: Writing – original draft. **Panagiotis Mililis:** Writing – review and editing. **Ourania Kariki:** Writing – review and editing. **George Bazoukis:** Writing – review and editing. **Athena Batsouli:** Writing – review and editing. **Vasileios Antonakos:** Writing – review and editing. **Stylianos Dragasis:** Writing – review and editing. **Ilias Patsiotis:** Writing – review and editing.

Konstantinos P Letsas: Conceptualization; supervision; writing – review and editing. **Michael Efremidis:** Conceptualization; supervision; writing – review and editing.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest.

DATA AVAILABILITY STATEMENT

The data supporting the findings of this study are available upon request from the corresponding author.

CONSENT

A written informed consent was obtained from the patient.

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