Avoiding ICD lead revision in a patient with chronically low R-wave amplitudes

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A patient with non-ischemic cardiomyopathy and a 10-year-old primary prophylactic implantable cardioverter-defibrillator system (ICD) was admitted after experiencing two ICD-shocks. The interrogation of the device revealed chronically low R-wave amplitudes leading to intermittent T-wave oversensing and inappropriate shock delivery. During box exchange, we could avoid lead revision by intraoperative testing and subsequent reprogramming of the sensing vector in certain ICD models.

Keywords: ICD, implantable cardioverter defibrillator, T-wave oversensing, sensing vector, true bipolar, integrated bipolar, extended bipolar

Introduction

Implantable cardioverter defibrillators (ICDs) require good quality intracardiac signals for appropriate arrhythmia detection. Low R-wave amplitudes during follow-up of patients with ICDs may lead to delayed detection of ventricular fibrillation (VF) (1), but also to T-wave oversensing with inappropriate ICD shocks (2). Troubleshooting of such cases can be challenging and often require surgical lead revision as the only solution (2, 3).

Case Report

A 48-year-old male patient with a history of non-ischemic cardiomyopathy received a primary prophylactic VVI-ICD in 2010 (Device: Medtronic Entrust Escudo D144VRC, Lead: Medtronic 6935 Sprint Quattro S, Medtronic Inc., Minneapolis, MN, USA) and a left ventricular assist device in 2011. He was admitted to the hospital in 2018 after experiencing two ICD shocks. Interrogation of the device revealed 405 non-sustained ventricular tachycardia (nsVT) and 5 sustained ventricular fibrillation (VF) episodes occurring in the last three months – two of those were shocked by the ICD. Further analysis of the shocked VF episodes revealed intermittent T-wave oversensing due to chronically low R-wave amplitude as the trigger of inappropriate shock delivery (Figure 2). R-wave sensing decreased gradually from 13.4 mV to an average of 3-4 mV in the last two years (last measurement: 3.4 mV) without any relevant change of other lead parameters.

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The patient was scheduled for box replacement (current battery voltage=2.64 V, ERI=2.61 V) and a potential lead revision. Intraoperatively we attempted to maximize the R-wave amplitude and prevent lead revision by testing both true bipolar (tip to ring) and integrated bipolar (tip to coil) sensing vectors. This assessment revealed that tip to coil sensing resulted R-wave amplitudes >5.0 mV compared to tip to ring sensing (2.1–4.8 mV). Since some of the newer generation ICDs have the option to change the sensing vector, we decided to implant such a device (Medtronic Evera S VR, DV-BC3D1), programming the sensing vector to integrated bipolar, without need of further lead revision. The patient was asymptomatic during the next 12 months. Consistent with clinical findings, interrogation of the device revealed excellent sensing values (last measured R-wave amplitude: 9.8 mV) at regular follow-ups.

FIGURE 1. Patient’s chest X-ray showing the position of the VVI-ICD system and left ventricular assist device in AP view

FIGURE 2. Misclassified VF episode due to intermittent T-wave oversensing leading to inappropriate shock delivery
In our patient we could avoid a surgical lead revision by implanting an ICD capable of switching sensing polarity. By reprogramming the sensing vector, a stable recovery of the R-wave amplitude (from 3.4 mV to 9.8 mV) was achieved. Although other programming options to handle T-wave oversensing (e.g., T-wave oversensing algorithms) are available not only in Medtronic devices, our findings endorse the development of ICDs with the programming capability to change the sensing vector configuration.

Conclusions

In patients with low R-wave amplitudes, surgical lead revision could be avoided in some cases by changing the sensing vector. Development of this function is endorsed in all commercially available ICDs.

Declaration of interest

The authors have reported that they have no relationships relevant to the contents of this paper to disclose. They attest that patient consent was appropriate.

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