Detection of a Riata™ insulation failure by the Medtronic Lead Integrity Alert™

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We describe a case of insulation failure in a Riata implantable cardioverter defibrillator lead [St Jude Medical (SJM), St Paul, MN, USA] detected by the Lead Integrity Alert (LIA)™, without impedance changes. The Medtronic LIA may permit early detection of Riata lead failure.

Case summary

We present a 57-year-old man with ischaemic cardiomyopathy, left ventricular ejection fraction of 35%, who suffered a cardiac arrest in July 2004 and received a St Jude Medical (SJM) implantable cardioverter defibrillator (ICD) with Riata lead model 1580. He underwent generator replacement in December 2010 with a Medtronic VR-D274VRC ICD. Eleven months later, the alert tone was heard, due to Lead Integrity Alert (LIA) activation following 390 short V–V intervals sensed since 21 October 2011 (see Supplementary material online, Figure S1A). A representative ventricular electrogram displaying the sensed short V–V intervals is shown in Supplementary material online, Figure S1B. The right ventricular (RV) pacing impedance was unchanged at 418 Ω, the RV and superior vena cava (SVC) coil impedances were stable at 50 and 51 Ω, respectively. Fluoroscopy of the lead showed two areas with possible disruption; at the subclavian junction and lead separation with extrusion of the metallic conductors near the tricuspid valve. The defect was visible on chest X-ray, just below the proximal coil (see Supplementary material online, Figure S2). The lead was successfully extracted.

Two defects on the ICD lead were evident ex vivo. The first occurred 14.4 cm proximal to the SVC coil, and represented an outside–in abrasion 5 mm long (Figure 1A), not seen on chest X-ray because this portion of the lead was beneath the ICD. The second defect occurred 2.6 cm below the SVC coil, as seen on chest X-ray and represented an inside–out abrasion 3 cm long, with exposure of the ICD conductors (Figure 1B). It was not clear as to which defect was responsible for the short V–V intervals and activation of the LIA.

Discussion

The LIA was developed to prevent inappropriate shocks due to oversensing with ICD lead failures.1 Lead Integrity Alert criteria resulting in an audible alert are met by detecting ≥30 non-physiologically short R–R intervals ≤130 ms within 3 days, or by detecting two episodes of non-sustained ventricular tachycardia (cycle lengths ≤220 ms for ≥5 consecutive sensed events) in 60 days.1 The algorithm has been studied extensively with Medtronic leads only.

In December 2010, SJM issued an advisory regarding lead abrasion failures in the Riata leads, with plans to discontinue the Riata family. Erkapic et al.2 recently reported on 357 patients receiving Riata leads during 42 ± 24 months follow-up, in which 8% required surgical intervention due to lead failure, with insulation defects at the tricuspid valve accounting for 20% of failures. Impedances were normal in all patients, and a specific insulation defect could only be established fluoroscopically. The Medtronic LIA algorithm may be useful for early detection of Riata lead failure, preventing inappropriate ICD shocks. Remote monitoring may be used in place of an audible alert for patients with compromised hearing.
Supplementary material
Supplementary material is available at Europace online.

Conflict of interest: M.A.W. has received honoraria from Medtronic and Boston Scientific. K.A.E. has received honoraria from Medtronic, Boston Scientific, and St. Jude Medical, and has been a consultant for Medtronic and Boston Scientific.

References

CASE REPORT

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Unusual adverse consequence of reverse ventricular remodelling following cardiac resynchronization therapy

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Cardiac resynchronization therapy has been shown to produce reverse ventricular remodelling in patients with severe heart failure. We report an unusual case of T-wave oversensing, most likely as a consequence of reverse ventricular remodelling resulting in change of the implantable cardioverter-defibrillator lead redundancy.

Case presentation
A 28-year-old male underwent implantation of a biventricular implantable cardioverter-defibrillator (ICD) (Medtronic Concerto II CRT-D, Medtronic Inc., Minneapolis, MN) for non-ischaemic dilated cardiomyopathy with a left ventricular ejection fraction (LVEF) of 20%. An active fixation ICD lead (Medtronic Sprint Quattro Secure 6944) was positioned at the right ventricular (RV) apex, the atrial lead (Medtronic 5076) at the antero-superior right atrium, and the left ventricular (LV) lead (Medtronic 4194) in the lateral marginal branch of the coronary sinus. Pacing thresholds and impedances were normal in all leads. P-wave amplitude was 1.1 mV, and R-wave amplitude was 17 mV in the RV and 20 mV in the LV. Device programming parameters were as follows: DDDDR mode, 50–150 b.p.m.; paced atrioventricular (AV) delay 130 ms, sensed AV delay 100 ms; LV offset 10 ms; ventricular and atrial sensitivity at 0.3 mV. At implant, defibrillation threshold was 25 J and sensing was 100% with RV sensitivity at 1.2 mV.

Follow-up device interrogations revealed stable lead parameters. The patient’s functional capacity improved to New York Heart Association Class I and LVEF increased to 40%. At 12 months of follow-up, intermittent T-wave oversensing was noted only after paced QRS complexes with resultant double-counting detection (VS–VS) following a biventricular paced event (see Figure 1). Right ventricular R-wave amplitude was 20 mV. The rate threshold criteria for ventricular tachycardia or fibrillation were not met and there was no inappropriate device therapy.

Serum electrolyte levels were normal. A chest X-ray revealed significant reduction in cardiac size compared to Day 1 post-implant (see Figure 1). Reverse ventricular remodelling was accompanied by an increase in ICD lead redundancy, which may have changed the orientation of the lead to the endocardium resulting in T-wave oversensing.

The device was reprogrammed to LV pacing only with upper tracking rate and upper sensor rate of 125 b.p.m. Ventricular sensitivity was altered from 0.30 to 0.45 mV, ventricular blank post-ventricular pacing increased from 200 to 240 ms, and ventricular sense response maximum rate decreased from 130 to 125 b.p.m. Following these changes, T-wave oversensing was no longer observed even at faster rates and continuous ventricular pacing was restored.

Discussion
Causes of T-wave oversensing include reduction of R-wave amplitude and relative or dynamic increase in the T-wave amplitude,1 progressive cardiomyopathy,1 electrolyte abnormalities,1 and myocardial ischaemia.2 In our patient, reverse ventricular remodelling with cardiac resynchronization therapy (CRT) resulted in reduced cardiac size and greater ICD lead redundancy. The change in ICD lead orientation likely led to T-wave oversensing and subsequent loss of biventricular pacing. Cardiac resynchronization therapy has also been shown to partially restore abnormal Ca2+ homeostasis induced by dysynchronous cardiac contraction in heart failure patients.3 Through such ion channel remodelling, CRT may alter cardiac repolarization with consequent T-wave oversensing.

Conflict of interest: none declared.

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