Unusual fracture in a Durata lead with shock coil fragmentation and cable externalization

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Introduction

Interaction between 2 leads in the right ventricle was reported to cause oversensing of electrical signals and inappropriate shocks in patients with an implantable cardioverter-defibrillator (ICD).[1,2] This case report describes unusual lead fractures after addition of a defibrillation lead. A characteristic intracardiac signal may have signaled the interaction between the ICD lead and a residual pacemaker lead.

Case report

A 50-year-old man with an ICD was admitted to our hospital. An unusual conductor fracture in the ICD lead (Durata 7120; St Jude Medical, Sylmar, CA) was found with shock coil fragmentation in the right ventricle (Figure 1, Supplementary Video, available online).

The patient had multiple medical problems, including lupus nephritis, chronic renal dysfunction on chronic hemodialysis, and secondary hyperparathyroidism. Prominent calcification of the myocardium and valves was diagnosed at the time of cardiac tumor excision in January 2006. The patient underwent pacemaker implantation for sick sinus syndrome in January 2008 and aortic and mitral valve replacement with tricuspid valve repair in July 2008. A pocket infection was treated without lead extraction in 2010.

In July 2011, he underwent a device upgrade to ICD (Paradym 8550; Sorin, Saluggia VC, Italy) after an episode of ventricular tachycardia. A Durata defibrillation lead was implanted without the extraction of pacemaker leads (CapSureFix Novus 5076; Medtronic, Minneapolis, MN). A residual pacemaker lead was used for right ventricular (RV) septal pacing and sensing.

In October 2011, an inappropriate shock occurred owing to oversensing of nonphysiological potentials (Figure 2A). These spike potentials with various amplitudes were recorded on the T wave by the pacemaker lead. Spike potentials were not reproducible either by body motion or by manual manipulation of the ICD pocket. In August 2012, nonphysiological noise was apparent just after the delivery of current. Therefore, the pacemaker lead was abandoned and an ICD generator was reconnected to the defibrillation lead for RV apical pacing and sensing. A chest radiograph did not demonstrate problems with the leads. Measurements of the Durata lead were 1.0 V at 0.35 ms for the RV pacing threshold and 4.6 mV for sensing. The impedance of RV pacing and RV shock coil were 512 Ω and 399 Ω, respectively. We confirmed that the spike potentials were not detected by the Durata lead during the procedure and before the discharge. However, 9 days after the procedure, spike potentials were recorded after RV sensing or RV pacing and on or just after the T wave by the defibrillation lead during an episode of nonsustained ventricular tachycardia (Figure 2B).

In June 2013, fragments of the distal coil were noted in the right ventricle on the fluoroscopic images (Figure 1). Residual shock coil protruded from the lead body. The measurements, including RV pacing threshold (0.75 V / 0.35 ms), sensing (9.2 mV), and impedance (RV and RV shock coil were 546 Ω and 430 Ω, respectively), were normal. In retrospect, splitting of the RV shock coil was appreciated on a radiogram 3 months prior to this event.

We decided on lead extraction and discussed the option of open heart surgery to remove the fragments. However, a third thoracotomy could be associated with a higher risk of bleeding and infection in this patient, who was currently receiving anticoagulants, hemodialysis, and prednisolone. Thus, percutaneous extraction was performed. The patient had a history of pacemaker pocket infection and underwent pocket revision without lead extraction in 2010. Therefore, all leads were extracted, although generator pocket reinfection was not apparent. The ICD lead was removed first. The protruded end of the RV shock coil was pulled back into the laser sheath (12F; Spectranetics, Colorado Springs, CO). The RV pacemaker lead was extracted, although it was strongly adherent to the tricuspid annulus, outside the annuloplasty ring. Finally, the atrial lead was successfully

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KEY TEACHING POINTS

- The present report describes an unusual fracture and shock coil fragmentation of a Durata defibrillation lead caused by the friction with the residual pacemaker lead.
- The resistance of the shock coil, right ventricular sensing, and pacing threshold remained within the normal range. However, spike potentials on the T wave were observed before the fracture of the implantable cardioverter-defibrillator lead.
- During the upgrade implantation, the operator has to confirm that the defibrillation lead is not in contact with the remaining lead in multiple views to avoid friction between leads.

removed. After the lead extraction, a new system was implanted in a submuscular pocket on the ipsilateral side because of a contralateral arteriovenous shunt.

The extracted ICD and RV pacemaker leads were sent to the respective manufacturers and detailed evaluation was conducted (Figure 3). External abrasion through the RV shock coil and breaching of the ring electrode lumen was noted at 4.5 cm from the distal tip of the Durata lead. One of the ring electrode cables was also abraded open in this region. The broken end of the RV shock coil was shifted distally. Part of a residual shock coil protruded from the lead body. External abrasion breaching the silicone-polyurethane copolymer (Optim) sheath was noted proximal to the RV shock coil at 8.2 cm from the distal tip. Flattened conductors were apparent in the ring electrode cables of the pacemaker lead (Figure 3E) as well as the residual RV shock coil (Figure 3B). We could not precisely differentiate lead

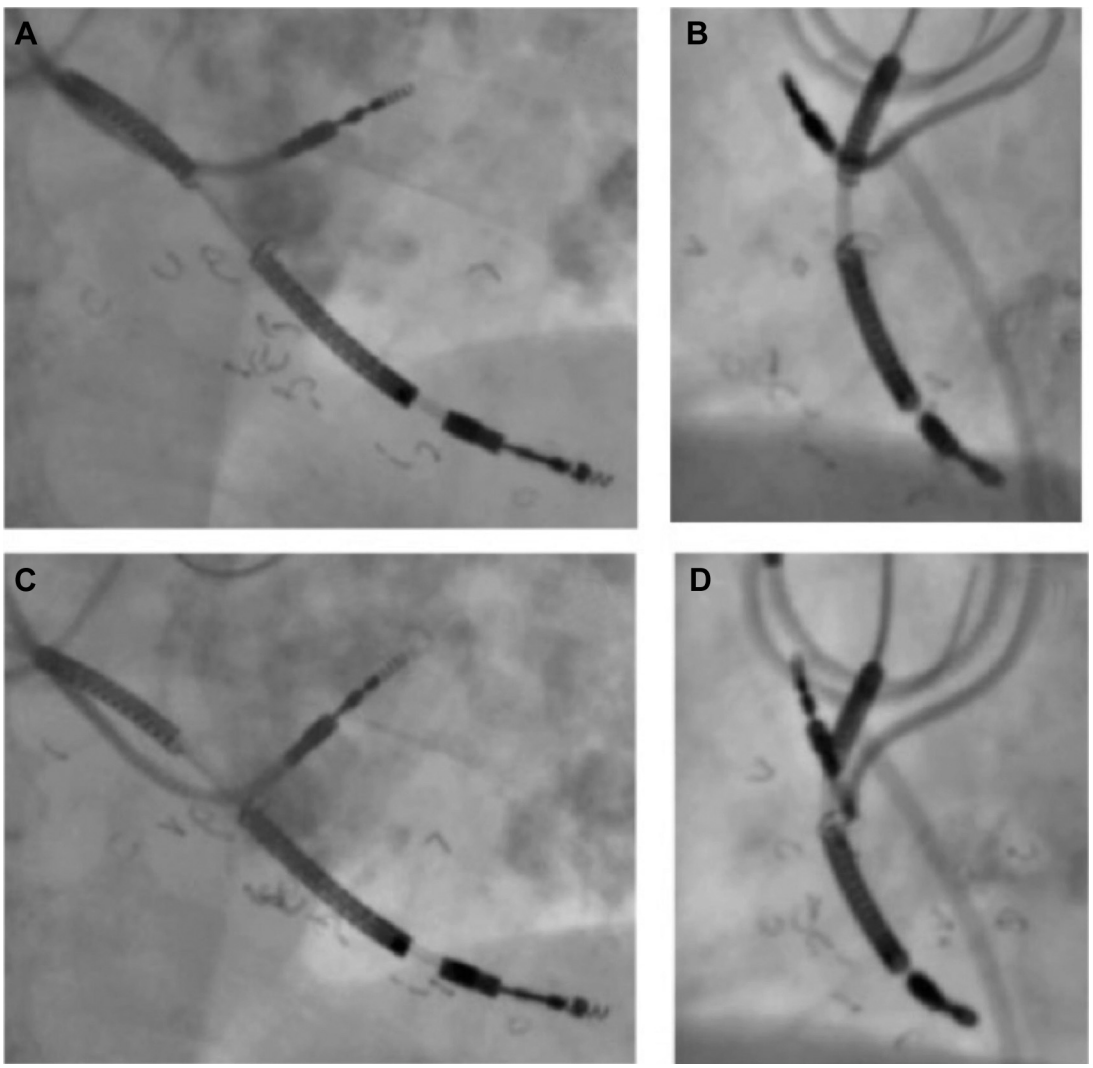

Figure 1 Fluoroscopic views of the leads. **A:** right anterior oblique view, diastolic phase; **B:** systolic phase; **C:** left anterior oblique view, diastolic phase; **D:** systolic phase. The right ventricular (RV) shock coil was torn off and coil fragments were embolized in the right ventricle. The piece of residual shock coil protruded from the lead body. The bottom edge of the pacemaker lead was scraping the defibrillation lead between split RV shock coils (Supplementary Video available online).

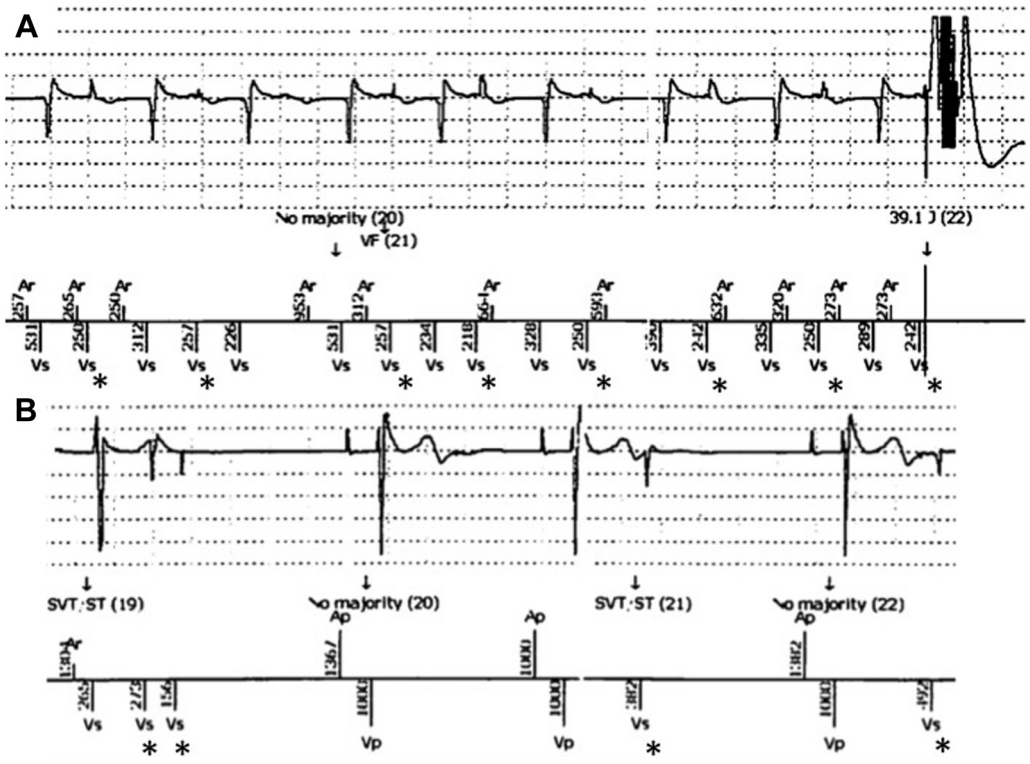

Figure 2 Spike potentials on T wave recorded by right ventricular (RV) pacemaker lead and then implantable cardioverter-defibrillator (ICD) lead. **A:** An ICD generator was connected to the residual pacemaker lead for RV septal pacing and sensing. T-wave synchronous spike potentials were oversensed prior to delivery of inappropriate shock. **B:** The defibrillation lead was then used for RV apical pacing and sensing. The nonphysiological potentials were apparent after RV sensing or RV pacing and on or just after T wave. A marker channel with atrial and ventricular intervals is also shown. Asterisks on the marker channel denote oversensed signals.

damage owing to lead friction vs extraction, although the metal compression suggested lead interaction.

Discussion

We present a case with an unusual disruption of shock coils from a Durata defibrillation lead caused by friction against the residual pacemaker lead. The electrical parameters, such as impedance, RV sensing, and pacing threshold, were stable, although only the spike potentials on the T wave were recorded by the RV pacemaker lead and then by the defibrillation lead before the conductor fracture.

The cable connected to the ring electrode was externalized from the extracted shock lead. The Durata lead is less susceptible to "inside-out" insulation failures compared with Riata and Riata ST leads.[3] A coating with silicone-polyurethane copolymer (Optim) may prevent exteriorized cables.[4,5] In a study by Jenney and colleagues,[5] Optim insulation was clearly superior in abrasion resistance to silicone. However, the Optim layer does not cover the silicone elastomer insulation under the shock coils. Recent reports have described insulation failure of the Durata lead.[6–9] To prevent tissue ingrowth, the cross section of the outer wire of the shock coil is not round but flat and thin. The thickness of the flat wire of the Durata lead was 0.076 mm, whereas the diameter of the round wire of the Riata lead was 0.18 mm. The Durata shock coil may have been too fragile to withstand the friction with the coexisting lead. Valentino and colleagues[2] reported that a Durata lead had a segment of the disrupted RV coil where the indwelling pace-sense lead crossed. Severe abrasions can be accompanied by conductor fracture or metal compression.[2,10]

Although splitting of the RV shock coil was observed 3 months prior, resistance of the shock coil as well as the RV sensing and pacing threshold remained within the normal range. In another report, the shock coil impedance, pacing impedance, and RV pacing threshold were stable after disrupting the RV shock coil.[2] In our patient, spike potentials on the T wave were observed before the conductor fracture of the ICD lead. Similar spike potential has been reported in a patient with a Durata lead, as a result of inside-out insulation failure.[8] The ring-electrode cable could abrade against the distal coil, penetrating the ethylene tetrafluoroethylene coating and shorting the coil, resulting in the oversensing and inappropriate therapy.[8] In our case, the spike potentials on the T wave may have been caused by contact with the coexisting lead during systole.

During the procedure of upgrading to an ICD, lead removal may be considered in patients with RV pacing leads that are functional but are not being used after implantation of the defibrillation lead. However, the extraction of functioning pacemaker leads is not generally recommended in the literature.[11] Therefore, when upgrading the implant, the operator has to confirm in multiple views that the defibrillation lead is not in contact with the remaining pacemaker lead to avoid friction between leads.

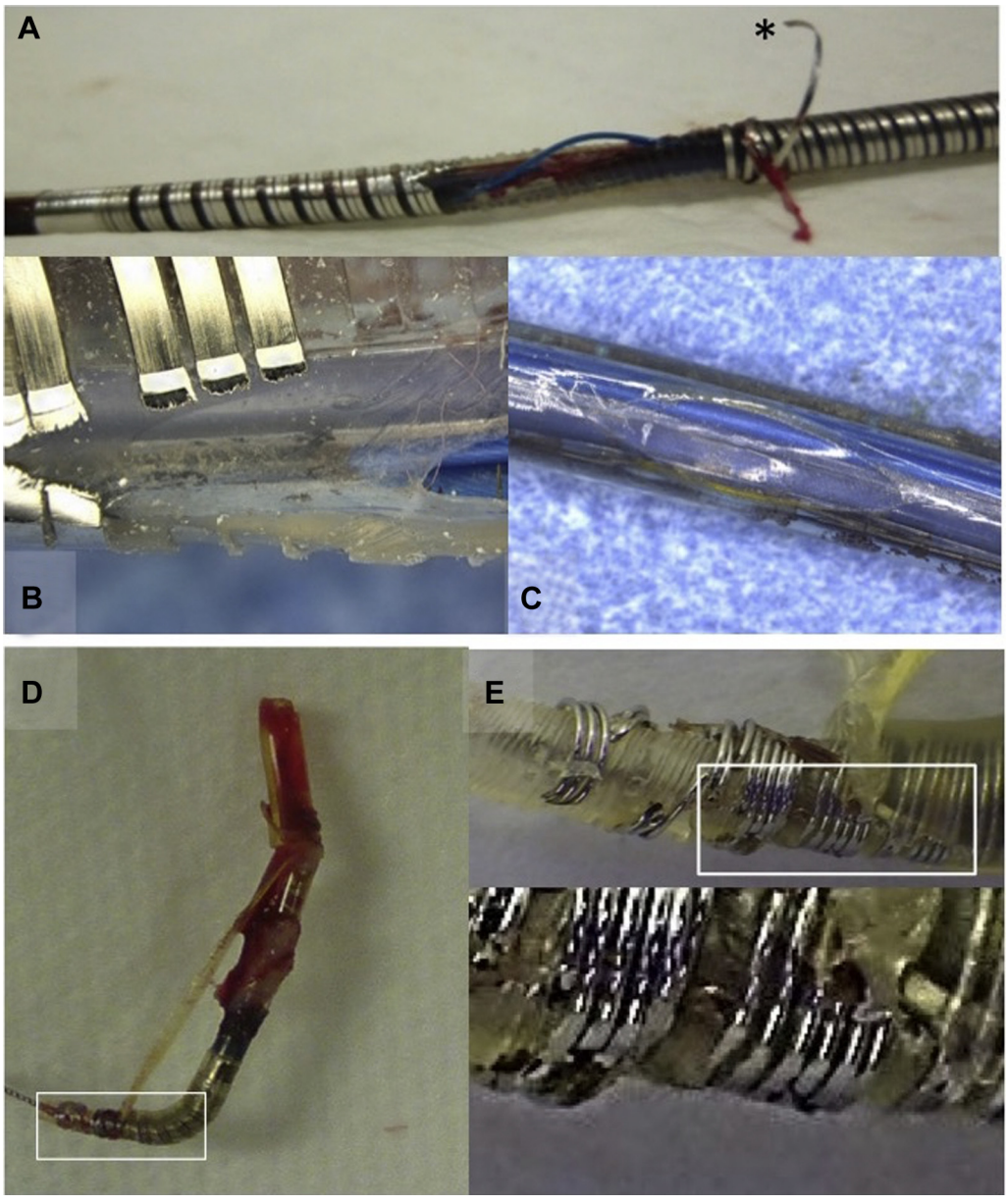

Figure 3 The defibrillation lead and the pacemaker lead. **A:** The extracted shock lead is shown. The broken end of the right ventricular (RV) shock coil protruded from the lead body (*). **B, C:** External abrasion through the RV shock coil and breaching of the ring electrode lumen is noted at 4.5 cm and 8.2 cm from the distal tip. **D:** The insulation and ring electrode cables were broken at 5.0 cm from the distal tip of the pacemaker lead. Flattened conductors owing to friction between leads were apparent in the ring electrode cables of the pacemaker lead (E) as well as the residual RV shock coil (B).

Appendix

Supplementary data

Supplementary data associated with this article can be found in the online version at http://dx.doi.org/10.1016/j.hrcr.2017.03.006.

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