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Implantable Cardioverter-Defibrillator Lead Extraction by Conventional Traction and Counter-Traction Technique

Jong Sung Park, MD, Hui-Nam Pak, MD, Moon-Hyoung Lee, MD, Sung Soon Kim, MD, and Boyoung Joung, MD
Division of Cardiology, Severance Cardiovascular Hospital, Yonsei University Health System, Seoul, Korea

ABSTRACT

A 46-year-old man presented to our institution with inappropriate implantable cardioverter-defibrillator (ICD) shock delivery. The ICD (single chamber, dual shock coils) was implanted for sustained monomorphic ventricular tachycardia with unstable hemodynamics and underlying systolic left ventricular dysfunction. ICD interrogation revealed recurrent episodes of ICD shock due to noise sensing and increased impedance of right ventricular-lead. With the impression of lead fracture, ICD lead extraction was performed. The fractured ICD lead was completely removed by traction of locking stylet and counter-traction of polypropylene dilator sheath. A new lead was inserted and the patient was discharged without complications after 2 days. To our knowledge, this is the first report on ICD lead extraction by conventional traction and counter-traction technique in Korea. (**Korean Circ J 2011;41:164-166**)

KEY WORDS: Implantable cardioverter defibrillators; Medical device failure; Device removal.

Introduction

Implantable cardioverter defibrillator (ICD) implantation is performed at many centers in Korea,^{1,2)} however, ICD lead extraction has not yet been reported. We report our experience of ICD lead extraction using locking stylet and polypropylene dilator sheath in a patient with recurrent inappropriate shocks due to lead fracture.

Case

A 46-year-old man presented to our institution for evaluation of repeated, inappropriate, ICD shocks. He underwent aortic valve replacement 23 years ago. ICD (single chamber, dual coils, Vitruso DR[®] D164AWG, Medtronic Inc., Minne-

apolis, MN, USA) was implanted for sustained monomorphic ventricular tachycardia associated with unstable hemodynamics and underlying systolic left ventricular dysfunction. The ejection fraction of 30% was recorded two years ago at another hospital. During ICD implantation, ventricular fibrillation was induced by T-shock and successfully terminated by biphasic shock at 10 J. ICD interrogation revealed 33 episodes of shock delivery due to noise sensing. The impedance of ICD lead increased abruptly over 2,500 ohms (Fig. 1). However, a definite break point of ICD lead was not detected on chest X-ray. ICD therapy was switched off based on a clinical diagnosis of ICD lead fracture, and the patient was transferred to our hospital. The ICD lead (Sprint Quattro[®] 6944, Medtronic Inc.) was tined, and the diameter of lead tip and shaft (comprising shock coil) was 2.7 mm. ICD lead extraction was performed with support from the cardiac surgery team. Following routine preparation for generator removal, skin was opened and ICD generator was disconnected from the leads. The disconnected lead was tested again to exclude connection problem between ICD lead and the generator, which showed high impedance over 2,500 ohms. Lead extraction was performed after confirming ICD lead fracture. A locking stylet (Liberator[®] Locking Stylet 016-032, Cook Vascular Inc., Vandergrift, PN, USA) was inserted into the central core of the ICD lead to prevent lead disruption. The stylet was advanced and locked at the tip of the ICD lead. A 12 Fr (4 mm) polypropylene di-

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Correspondence: Boyoung Joung, MD, Division of Cardiology, Severance Cardiovascular Hospital, Yonsei University Health System, 250 Seongsan-no, Seodaemun-gu, Seoul 120-752, Korea
Tel: 82-2-2228-8460, Fax: 82-2-2227-7732
E-mail: cby6908@yuhs.ac

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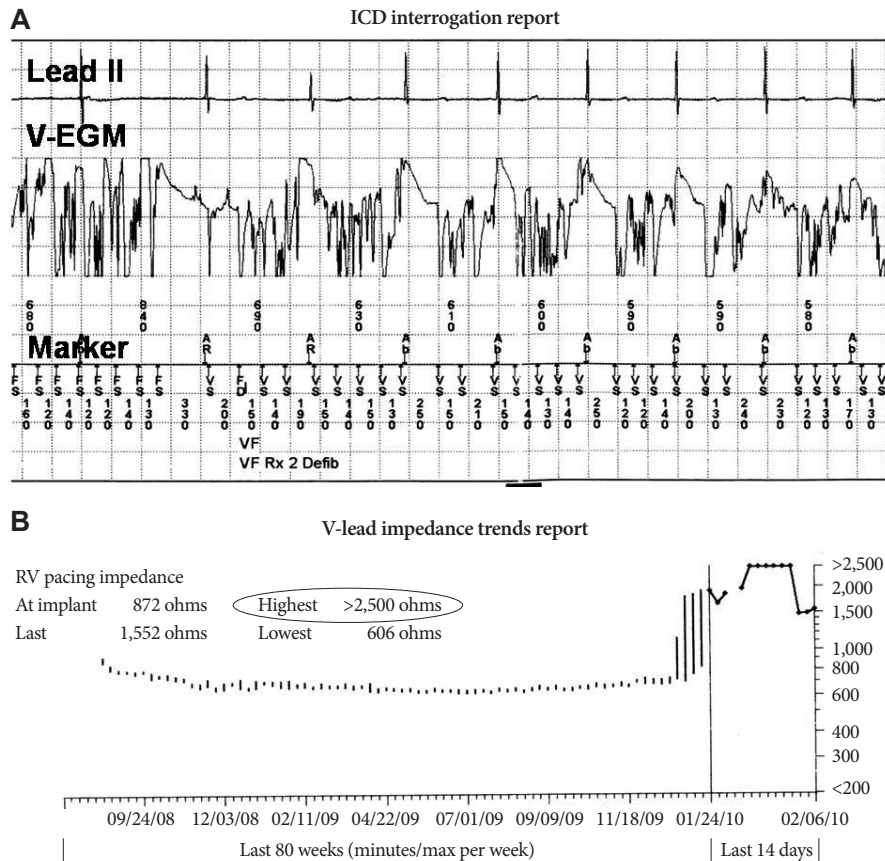


Fig. 1. Intracardiac ventricular electrogram shows fast and irregularly irregular ventricular activities (VS) unmatched by normal ventricular activities (regular QRS complexes on surface electrocardiography). A: noise sensing caused by lead fracture was interpreted as ventricular fibrillation by ICD. B: impedance of ICD lead increased abruptly from baseline 650 ohms to >2,500 ohms within 3 weeks, suggestive of lead fracture. ICD: implantable cardioverter-defibrillator, V-EGM: ventricular electrogram, Marker: marker channel.

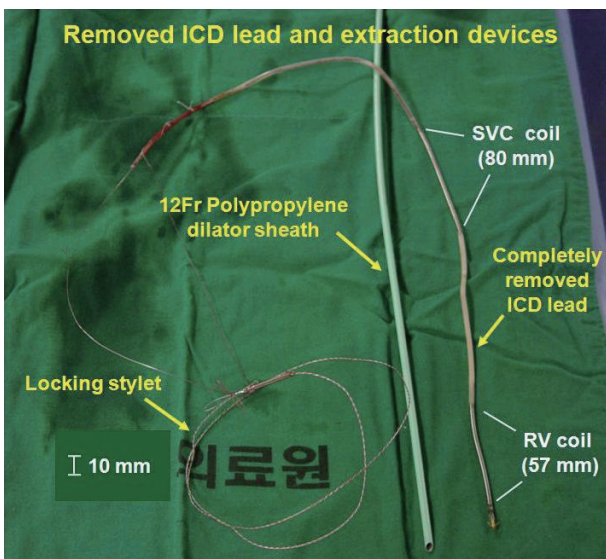


Fig. 2. The fractured ICD lead (tined type, diameter: 2.7 mm) was completely removed by traction and counter-traction technique using locking stylet and a 12 Fr (diameter: 4 mm) polypropylene dilator sheath. ICD: implantable cardioverter-defibrillator.

lator sheath (Byrd® Dilator Sheath Sets, Cook Vascular Inc.) was inserted over the ICD lead for counter-traction. Mild traction force was applied to the locking stylet to straighten

the alignment of the ICD lead and the dilating sheath. The dilator sheath was advanced with bidirectional (clockwise and counter-clockwise) rotation to dissect adhesive fibrous bands formed around the ICD lead. When the dilator sheath was placed 1-2 cm below the tip of right ventricular (RV)-lead, the locking stylet was pulled gently with gradually increasing traction forces. Counter-traction force was applied by the dilator sheath to prevent myocardial inversion. The ICD lead and dilator sheath were successfully removed without evidence of lead fragments remaining in the right ventricle (Fig. 2). Hemodynamic monitoring and fluoroscopic examination of the cardiac silhouette were repeated during the procedure. There was no evidence of major complications, such as hemo-pericardium, hemothorax, and myocardial inversion. After confirming successful ICD lead extraction, a new ICD lead was inserted into right ventricle followed by skin closure.

Discussion

Pacemaker or ICD RV-lead extraction is a high risk procedure with a morbidity of 1.4-2.5%.^{3,4)} Fibrous tissues encapsulate implanted leads and cause adhesion to major veins, the right atrial or the ventricular wall.⁵⁾ Major complications such

as hemopericardium, hemothorax and death occur during fibrous tissues dissection around the implanted leads.⁶⁾ Incomplete lead removal or procedure failure is another clinical problem that occurs in 7-13.2% of cases.^{3,4)} If an infected lead is retained, the risk of treatment failure with antibiotics will be very high.⁷⁾ Even non-infected lead fragment may cause embolic complications.^{8,9)} Therefore, various extraction techniques have been tried to improve the success rate of complete lead removal. They include direct traction with rotational forces,¹⁰⁾ traction with locking stylet,¹¹⁾ counter-traction with dilating sheath,^{3,4)} femoral workstation,¹²⁾ laser sheath,¹³⁾ and electrosurgical sheath.¹⁴⁾ Traction and counter-traction using locking stylet and dilating sheath is a conventional technique for pacemaker and ICD lead extraction. It has been proven to be effective and safe in clinical trials.^{3,4)} Although newly developed techniques such as electrosurgical or laser sheath are in clinical use, they have not been introduced in Korea, and the conventional technique using locking stylet and dilator sheath is still useful if performed by experienced operators.¹⁴⁾ The authors tried 25 pacemaker and one ICD lead extractions associated with lead malfunction or infection since 2004. Of the 26 cases, 24 cases were successfully managed with the conventional traction and counter-traction technique using locking stylet and dilator sheath. In the two failed attempts, the operators could not advance the dilator sheath to the ICD lead tip due to severe fibrous adhesion at the subclavian vein and in the superior vena cava. Of the 24 successful cases, open heart surgery was performed in one case due to cardiac tamponade following complete pacemaker ventricular lead extraction. ICD lead extraction is known to have higher complication rate than pacemaker lead extraction.⁶⁾ However, it can be removed successfully with the same techniques. To our knowledge, this is the first ICD lead extraction case reported in Korea.

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