

## IMAGES IN CARDIOLOGY

### Impasse During Cardiac Implantable Electronic Device Lead Extraction: Only Patience, Endurance and the Right Tools Can Bail You Out

Antonis S. Manolis, MD, Areti Koumeli, MD, Stergios Soulaïdopoulos, MD, Konstantinos Konstantinou, MD

First and Third Departments of Cardiology, Athens University School of Medicine, Athens, Greece

E-mail: [asm@otenet.gr](mailto:asm@otenet.gr)

#### Abstract

A case of complex and arduous percutaneous cardiac implantable electronic device (CIED) lead extraction is presented that illustrates several aspects of technical challenges that may emerge during the procedure requiring a change of strategy, appropriate tool selection, and operator and patient endurance. *Rhythm* 2018;13(4):78-80.

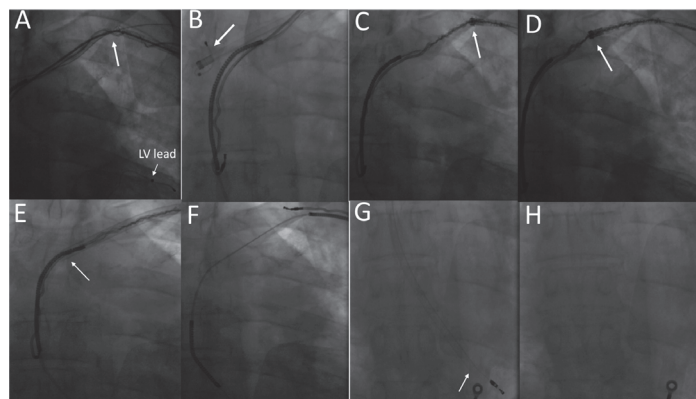
**Key Words:** cardiac implantable electronic devices; percutaneous lead extraction; CIED infection; implantable cardioverter-defibrillation; cardiac resynchronization therapy; heart failure

**Abbreviations:** CIED = cardiac implantable electronic devices; CRT = cardiac resynchronization therapy; CRT-D = CRT-defibrillator; LV – left ventric-le(-ular); RV = right ventric-le(-ular)

A 52-year-old gentleman with ischemic cardiomyopathy and severe left ventricular dysfunction fitted with a cardiac resynchronization therapy defibrillator (CRT-D) device was referred for percutaneous extraction of the cardiac implantable electronic device (CIED) system due to infection. The device had been implanted 8 years earlier with use of a bipolar left ventricular (LV) pacing lead positioned at a posterolateral tributary of the coronary sinus, a pace-defibrillating two-coil lead placed at the right ventricular (RV) apex and a J bipolar passive fixation lead placed at the right atrial appendage, all inserted via the left cephalic and subclavian veins. He had a first device exchange 4 years after the initial implant for battery depletion at the implanting center, but a subsequent device replacement procedure after another 4 years was carried out at a regional hospital. The procedure was complicated by pocket infection and pus discharge from the pocket. He was started on intravenous antibiotics and was referred to our center for percutaneous lead extraction. A transesophageal echocardiogram did not show any

vegetations on the leads. Blood cultures were reported negative. Pus cultures were positive for *S. epidermidis*.

During the extraction procedure, initial attempts were made to insert regular stylets into the leads to pave the way for the insertion of a locking stylet, but this could only be accomplished for the LV and right atrial leads. No stylet could be advanced into the defibrillating lead. Fluoroscopic view indicated that the leads were entangled together through their course in the subclavian vein (Fig. 1, Panel A, large arrow). With use of a locking stylet (Liberator, Cook Medical, Bloomington, IN, USA) and telescoping sheaths (Byrd dilator sheaths by Cook Medical), the LV lead could be successfully removed (Panel B). Then, the Evolution controlled rotation mechanical sheath (Cook Medical) was used to facilitate the extraction of the atrial lead, however, it was impossible to advance it beyond a short distance from the entry site into the left subclavian vein (Panels C and D, arrows). It was noted that the two leads (atrial and defibrillating lead) were conjoint, apparently with adhesions, and could not be separated from each other. Attempts were continued with use of the telescoping sheaths successively over each lead but to no avail. During these attempts the defibrillating lead was uncoiled and the proximal part of the insulation was detached and removed and only the inner wire was available for applying traction to the lead.



**Figure 1.**

At this juncture, it was impossible to plan for an alternate femoral approach to remove the leads as these were conjoint and could not be freed from above even if severed as they were adherent to the subclavian vein along its course and thus it would have been impossible to pull them from below. After reaching this impasse, the only available option, should the attempts from above have remained ineffective, would have been to resort to surgery. Before calling off the percutaneous attempts, a large (15F) sheath was employed (Panel E) to accommodate both leads and with labored and persistent attempts, the sheath could be slowly and painstakingly advanced over both the leads

and free them from the encircling adhesions. When the sheath reached the junction of the superior vena cava with the right atrium (Panel E, arrow), the whole mishmash of both leads could finally be extracted (Fig. 1, Panel F & Fig. 2). However, it was noted that the tip of the RV lead was still attached to the RV apex. Before cutting the wire of this fragment and resorting to the femoral approach, an attempt was made to introduce a long sheath over this remaining thin-wire attachment of the ventricular lead. It was finally possible to advance the sheath almost all the way to the apex (Panel G) and apply countertraction and successfully extract this fragmented lead (Panel H) which was only supported by a thin wire, thus obviating the need for a femoral approach. The patient tolerated this 5-hour long procedure well remaining hemodynamically stable throughout the procedure, suffered no peri-procedural complications and 4 days later he was transferred back to the referring hospital for completion of the antibiotic course and re-implantation of the CRT-D system.



**Figure 2.**

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Percutaneous CIED lead extraction has been routinely used to extract infected or dysfunctional or redundant leads and has supplanted the surgical approach.<sup>1,2</sup> The main or

mandatory indication for lead extraction is documented CIED infection in 50-70% of cases.<sup>3</sup> An array of tools is used to facilitate the extraction procedure.<sup>4,5</sup> However, the locking stylet and the telescoping sheaths remain the principal tools for lead extraction.<sup>5,6</sup> The procedure usually starts via a superior (subclavian) approach, however, when it fails and the leads have been freed from the adhesions along their endovenous (subclavian-superior vena cava) course, a femoral approach using snares can be employed to grasp a lead with a free-floating proximal end.

In the present case, the only lead that could initially be extracted was the LV lead using standard tools (locking stylet and mechanical telescoping sheath). However, the initial inability to free the other two leads (atrial and ventricular) which were stuck together (conjoined) and the lack of support by locking stylets which could not be introduced and/or advanced into these leads would have mandated resorting to surgery, as the femoral approach could not be considered as an alternative technique due to the adherence of both leads at several fibrotic binding sites along their endovenous course. The use of a mechanically-powered rotational sheath, although useful for the extraction of the LV lead, it rather complicated the extraction of the other two leads as the rotating force applied separately to each lead, which were unsupported by a locking stylet, led to the winding of one lead around the other resulting in the mishmash of the two leads that was observed after their final en bloc removal (Fig. 2).

A new strategy had to be devised at this point. The procedure was finally successful only when a much larger non-powered sheath was used which could accommodate both leads and with rotation applied manually in a clockwise alternating with a counterclockwise direction it was able to bluntly dissect the adhesions around both leads and ultimately facilitate their removal by traction. Nevertheless, even after the extraction of the main bodies of the two leads, it was noted that although the whole atrial lead had been extracted, the tip of the defibrillating lead had remained attached to the RV apex, necessitating further extraction attempts. Fortunately, the thin inner wire had remained connected to the tip of this lead, which proved very useful and facilitated extraction. A long telescoping sheath was managed to be introduced over the thin wire and advanced close to the lead tip at the RV apex (Fig. 1, panel G) enabling the application of countertraction which led to detachment of the lead tip from the endomyocardium and its successful removal, obviating the need to resort to the femoral approach, which would have been the next step.

In summary, extremely difficult cases of percutaneous removal of CIED leads of very long dwell time (8 years in

the present case) require the availability of the right tools, but only patience and endurance from the operator's end with a need for devising an effective strategy and technique to follow and deciding on which tool to use can bail one out and lead to a successful outcome. Amazingly, the patient endured and collaborated throughout this lengthy procedure, with sole use of local anesthesia and mild sedation.

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