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CASE REPORT

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# Effective and safe lead extraction using the bidirectional rotational Evolution® sheath in a child with congenital heart disease

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## Abstract

We reported a challenging transvenous lead extraction procedure for lead failure in a child with congenital heart disease. Our report demonstrates that the new hand-powered bidirectional rotational Evolution RL (Cook Medical, USA) mechanical extraction sheath is an effective and safe tool for the extraction of chronically implanted leads in children.

**KEYWORDS**
children, congenital heart disease, evolution RL, lead extraction, lead failure

## 1 | INTRODUCTION

Several large series have investigated the different transvenous lead extraction (TLE) techniques and their safety and efficacy in adult patients with and without congenital heart disease (CHD).[1,2] However, data on lead extraction in pediatric and (CHD) patients remain limited.[3,4] The new Evolution mechanical sheath (Evolution RL, Cook Medical, USA) is an effective and safe tool for the extraction of chronically implanted leads when advanced techniques are required in adults.[5] However, data on safety and efficacy of the new Evolution sheath in children with CHD undergoing TLE are still lacking.

## 2 | CASE REPORT

We reported a case of an 11-year-old boy referred to our center for TLE because of failure of the PM lead (Medtronic Capsure MRI SureScan 5086, active fixation). At 2 years old, he underwent surgical correction of a complete atrioventricular (AV) septal defect complicated by complete AV block. A single-chamber transvenous PM was implanted through the right subclavian vein, because of persistent left superior vena cava.

Nine years later, during a routine device interrogation, a significant increase in pacing threshold and decrease in pacing impedance of the lead were observed. Chest radiography revealed the entrapment of the lead between the right clavicle and the first rib, suggesting a possible loss of the lead insulation (Figure 1, Panel A). Contrast venography showed important adherences at the right subclavian and superior vena cava (Figure 1, Panel B). We tried to puncture the right subclavian or axillary vein, but the guidewire (including hydrophilic wire) failed to advance through the vein because of an obstruction. Due to the young age, the ipsilateral vein obstruction, the presence of persistent left superior vena cava, we decided to extract the lead and to implant a new lead.

The procedure was performed in a hybrid operating room under general anesthesia, arterial blood pressure monitoring, and transesophageal echocardiographic guidance. In addition, a stiff guidewire from the right femoral vein to the right internal jugular vein for potential use of the bridge occlusion balloon (Spectranetics, Colorado Springs, CO) in case of vascular lacerations was deployed. Before the procedure, contrast venography showed important adherences at the right subclavian and superior vena cava (Figure 1, Panel B). After the pocket was opened and the generator removed, it was immediately clear that it was impossible both to retract the

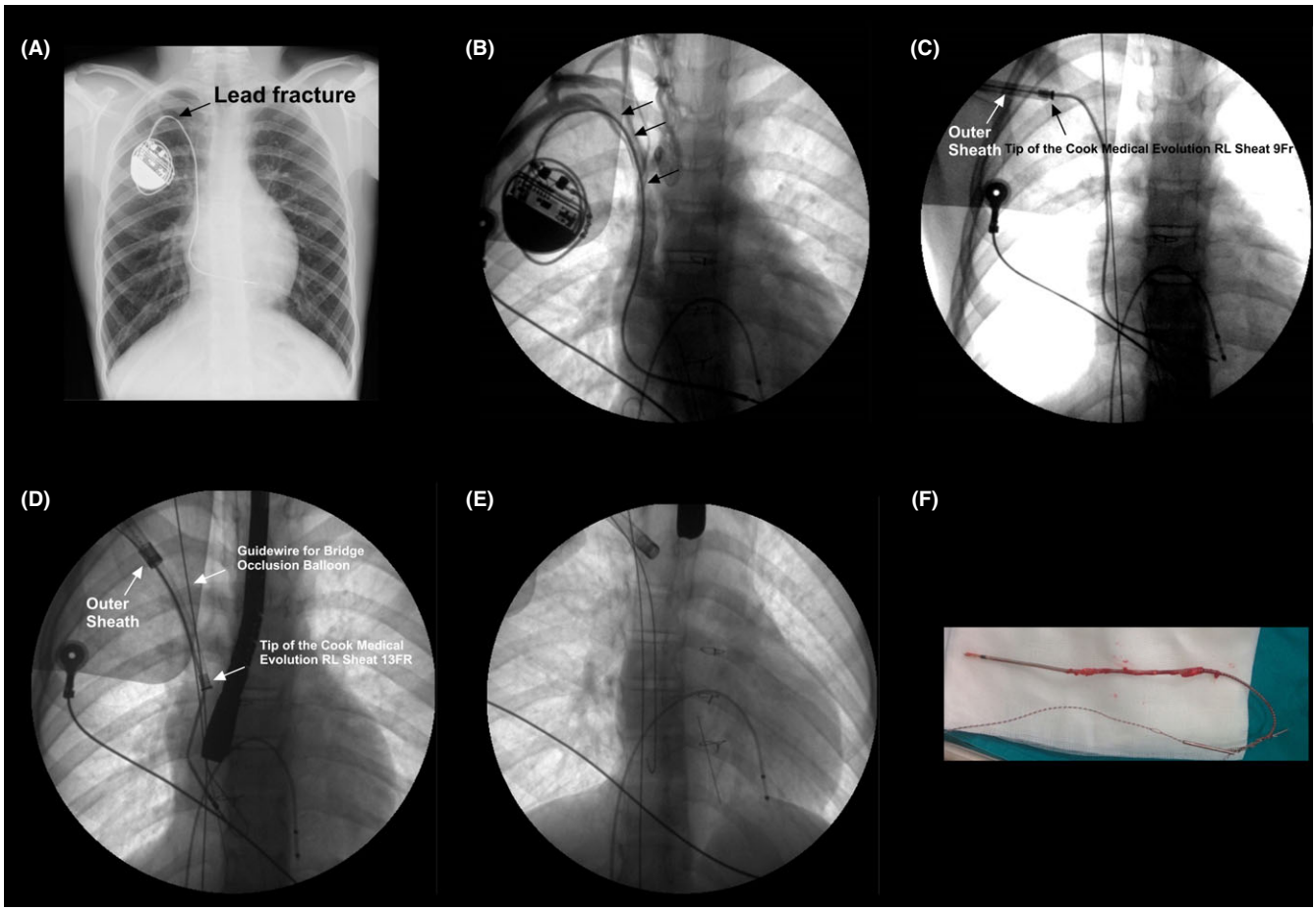


**FIGURE 1** Chest radiography showed the entrapment of the lead between the right clavicle and the first rib, suggesting a possible loss of the lead insulation, arrow (Panel A). Contrast venography showed important adherences at the right subclavian and superior vena cava, arrows (Panel B). An 9Fr Evolution RL mechanical dilator sheath and an outer sheath were advanced into the right subclavian vein (Panel C). An 13Fr Evolution RL sheaths with an outer sheath were advanced over the lead, and it was withdrawn through the sheath in the absence of any complications (Panel D-E). Extracted lead. Of note, the presence of important fibrous material adherent to the lead (Panel F)

active fixation screw and to advance the locking stylet to the lead tip, because of the lead fracture under the right clavicle. Thus, after prepping the lead with an extender (Bulldog, Cook Medical, Bloomington, IN, USA), an 9Fr Evolution RL, an 9Fr RL Shortie mechanical dilator sheaths (Cook Medical, USA), and an outer sheath were advanced into the right subclavian vein, but failed to advance further, because of tenacious fibrotic adherences in the superior vena cava (Figure 1, Panel C). After several attempts and adjustments, using first an 11Fr and then an 13Fr Evolution RL sheaths, we were finally able to advance to the vena cava, to free the lead of any scar tissue, and to withdraw it through the sheath without complications (Figure 1, Panel D-F). A guidewire was placed down the Evolution shortie sheath through the same vein for new PM implantation. Echocardiography showed no tricuspid valve regurgitation and no pericardial effusion. A new single-chamber PM was then implanted, from the right subclavian vein. After 3 months of follow-up, the patient was asymptomatic, the incision healed cleanly, and the PM was functioning properly.

## 3 | DISCUSSION

Over the past decade, transvenous PM and defibrillator implantations in pediatric and CHD patients have markedly increased. These devices are often placed at a young age, and with improved survival, the life span of the patient often exceeds that of the device. Patients with CHD experience higher rates of lead malfunction and infection when compared with older individuals with structurally normal hearts.

Despite improvements to extraction techniques, transvenous lead removal is still a challenging procedure, especially when leads are chronically implanted, and is associated with potential procedural failure, morbidity, and life-threatening complications.[1,2] Chronically implanted leads develop fibrous adhesions around surrounding structures and thus require different extraction sheaths, such as mechanical sheaths, laser sheaths, or electrosurgical dissection sheaths.[1,2]

A recent large study by Fender et al.[3] reported information regarding TLE in CHD patients compared with a control group. With

the use of almost all techniques available for TLE, they concluded that lead extraction can be safely performed in patients with CHD and despite anatomic abnormalities and longer implantation times, the difficulty of lead extraction in patients with CHD is comparable with controls.[3] Checchin et al. also reported that in pediatric and CHD population older lead age, ventricular leads, and polyurethane insulation were independent predictors of the decreased likelihood of an extraction by simple traction.[4] These are established independent predictors of most difficult procedures also in the population without CHD. These results suggest that TLE can be safely performed in patients with CHD.

The new Evolution sheath (Evolution RL, Cook Medical, USA) with its bidirectional rotational mechanism and redesigned tip is an effective and safe tool for the extraction of chronically implanted leads when advanced techniques are required.[5] However, data on safety and efficacy of the new Evolution sheath in children with CHD undergoing lead extraction are still lacking.

In our case, a guidewire was placed down the Evolution shortie sheath through the same vein for new lead implantation. Probably, it has a repeated risk of lead fracture, as the new lead was implanted through the same course of the previous lead which was fractured by the friction at the right clavicle. However, in our experience, this procedure is not the same as how to puncture the vein at the same point as before. Moreover, lead extraction to regain venous access of an occluded vein preserves the contralateral side for potential future use and minimizes overall lead burden, especially in children.

Although this is only a single clinical case, our report demonstrates the safeness and feasibility of challenging lead extraction using the Evolution RL mechanical lead extraction sheath in children with CHD and chronically implanted leads. Large prospective studies should be conducted in the future to verify our findings and compare the clinical success, safety, and cost-effectiveness of different TLE devices.

## CONFLICTS OF INTEREST

Authors declare no Conflict of Interests for this article.

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