Unusual extraction of an active fixation ventricular pacing lead with outer coil fracture in a child

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Aim In this report we describe an asymptomatic paced child with outer coil fracture of the bipolar screw-in steroid eluting ventricular lead without insulation defect, loss of ventricular capture and unexpected increase in lead impedance in the bipolar VVIR pace configuration.

Method and result A previously unpublished method was performed to retract the helix and the lead. As a result, the fractured lead was successfully retrieved.

Conclusion We suggest that, this unusual extraction method can be tried as an alternative approach in the removal of an active fixation ventricular pacing lead with impaired mechanical function possibly due to fracture.

Key Words: Pacing in children, screw-in electrode, pacing lead extraction, subclavian view approach for transvenous pacing.

Introduction

Lead fracture with loss of pacing occurs infrequently in children. In a patient who is pacemaker dependent, lead fracture may result in haemodynamic compromise or may even be fatal. So, extraction of the fractured lead and implantation of a new electrode is urgently required. Standard percutaneous extraction tools and previously published techniques\(^1\)\(^–\)\(^5\) can be used for successful and safe removal of the fractured screw-in lead. On the other hand, when the extending and retracting mechanical function of the lead is impaired, the removal of the fractured lead can be a problem. In this report we describe a child with outer coil fracture of the bipolar screw-in steroid eluting ventricular lead and a different method to retract the helix and lead.

Case report

A 3.5-year-old girl underwent total correction of a complete atrio-ventricular septal defect when she was 2.5 years old. Three weeks after the operation, implantation of a permanent VVIR pacemaker was performed for postoperative complete atrio-ventricular block. Bipolar active fixation steroid eluting endocardial lead (Tendril DX 1388T, Pacesetter, St Jude Medical Inc., CA, U.S.A.) was inserted into the right ventricular apex via the right subclavian vein: following satisfactory testing of the lead function it was connected to the generator (Pacesetter Regency SR+ 2400L, St Jude Medical Inc., MN, U.S.A.). The patient was discharged from hospital on the third day after implantation. After implantation, we did not observe any abnormalities in the sensing and pacing data recorded in the first week, first, third, sixth and ninth month. At the 12th month of implantation, we observed loss of ventricular capture and unexpected increase in lead impedance in the bipolar VVIR paced configuration at routine follow-up without any significant symptoms. Reprogramming to higher pulse duration and amplitude could not achieve pacemaker capture. Telemetry measurements revealed normal unipolar ventricular pacing threshold and lead impedance. The chest radiography demonstrated discrete thinning of the ventricular lead connected to the pulse generator as it traversed the inferior border of the medial end of the clavicle (Fig. 1). Consequently, implantation of a new ventricular lead was planned. At operation, the old pacemaker pocket in the right subpectoral muscle area was reopened under ketamine and local anaesthesia. The generator was removed from the pocket and

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The electrode loops were dissected from the adherent tissues carefully without damage to the electrode. The lead was pulled out slightly and was straightened. Inspection of the lead confirmed that the outer coil was fractured without insulation defect. The distance of the fractured portion of the lead from the subclavian vein entrance was 1–2 cm. A stylet was inserted into the lumen of the lead and advanced through the lead while it was straight. Although the stylet passed through fractured portion of the lead, it could not be advanced completely to the distal end. In spite of this we tried to retract the helix by using the clip-on tool and, subsequently, the thumbscrew. Although the connector pin was rotated counter-clockwise more than eight times while holding the lead body stationary in one hand, the helix could not be retracted. Thereupon, we cut the lead with scissors from the distal end of the fractured portion while holding the lead body. From the proximal end of the remaining lead a 1·5 cm part of the outer insulation and outer coil were dissected away without damage to the inner insulator and inner conductor coil. Later, a stylet was inserted into the lumen of the lead and advanced through the lead as far as possible. The uncovered inner insulation and inner coil were grasped by the clip-on tool and rotated counter clockwise under fluoroscopic guidance. The helix was then completely retracted and the lead was removed successfully with gentle traction. We did not observe any complication. A catheter was percutaneously introduced via the right femoral vein and advanced into the right subclavian vein through caval veins. Right subclavian venography revealed no occlusion. A new bipolar active fixation steroid eluting ventricular lead (Tendril DX 1388T, 46cm, Pacesetter, St Jude Medical Inc., CA, U.S.A.) was implanted in the right ventricular apex via the right subclavian vein and connected to the old generator following satisfactory testing. An extrathoracic approach for percutaneous subclavian venipuncture described by Magney et al.\(^6\) was used to avoid probable soft tissue entrapment (crush fracture) with this implantation.

**Discussion**

Techniques of cardiac pacing have advanced remarkably since the late 1950s, when the first asynchronous single-chamber permanent pacemakers were placed in patients. Although there have been many major achievements in cardiac pacing, several pacing leads have been recalled for unacceptably high rates of failure in the past decade; lead fracture is still one of the ongoing problems for the patients and physicians. The design of new leads has helped to prolong the life of pulse generators and reduce the incidence of lead fracture and insulation problems. Additionally, new techniques for removing dysfunctional or infected leads have been developed that make extracting a lead safer\(^{[1-5,7-11]}\).

Lead fractures (coil fractures or insulation damage) have often been observed to occur at stress points\(^{[12-15]}\) and they have been attributed to entrapment in the soft tissues of the costoclavicular region in patients with leads inserted by the classical intrathoracic subclavian approach. The possible reasons for lead fractures such as thoracic outlet syndrome, anomalous fibromuscular bands between the clavicle and the first rib, repetitive and frequent arm movements, and lead manipulation...
during pulse generator replacements, have been demonstrated in adults. In our 3-5-year-old patient, lead fracture in the outer coil occurred in the costoclavicular region, between the clavicle and the first rib (Fig. 1) suggesting crush fracture.

Different extraction techniques such as traction alone, femoral grasping approach, sheaths and locking stylets can be used to remove active fixation leads after the retraction of the helix[1–5,7–11]. In our patient we tried to extract the fractured lead by unscrewing and traction. Even though the connector pin was placed properly and was rotated counter clockwise more than eight times the helix could not be unscrewed. We thought that this was due to blood penetration or fibrotic tissue intrusion in to the helix mechanism. Later, although we tried counterclockwise rotation of the lead body that may sometimes be sufficient successfully to detach the fixation mechanism and lessen the possibility of damage to cardiovascular structures during removal, we still could not detach the lead. Finally, we tried to extract the fractured lead by rotating (counter clockwise) the inner coil from the cut-end with the help of a clip-on tool. This method allowed the unscrewing of the helix and lead extraction. As a result, we suggest that this unusual extraction method can be used in the removal of an active fixation ventricular pacing lead with impaired mechanical function, when other methods fail.

References