Imaging in Cardiology: Complete Endocardial Lead Removal – a Dual Approach: Superior (Subclavian) and Inferior (Femoral)

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Introduction

Lead removal or extraction is generally indicated by pocket infection or erosion, but may also be necessary in case of abandoned or redundant leads [1]. In case of abandoned leads, a more conservative treatment may be preferred because of a more benign clinical course [2]. In each patient the risk of removal, either transvenous or surgical, has to be weighed against the degree of necessity. Several techniques have been employed. The first option is to start with simple yet gentle and firm manual traction [3] and the last resort is open-heart surgery. Many tools have been developed and used in the transvenous extraction of permanent implanted leads, such as Cook's locking stylet [3], the VascoExtor extraction stylet [4], dilator sheaths [3], and snares [5]. The list of very special extraction tools contains devices such as the "Needle's Eye" [6], Dormier baskets [7], the Dotter retriever and pigtails [8], and forceps [5]. At our institutes we start with simple pulling using manual traction in combination with an inserted guide wire, fluoroscopy, and continuous observation of the intracardiac ECG, derived from the tip of the electrode. The next step is use of the locking wire, or the VascoExtors, which has the disadvantage that once inserted and locked into the extractable electrode, the whole (electrode and locking wire) has to be removed. The last resort of superior intervention is the additional use of a sheath for countertraction [3]. In addition to the superior approach, the inferior approach via the femoral vein can be used for complete removal of the leads. This paper reports on a complicated case of lead removal where the dual approach (superior and inferior) has been applied.

Case Report

A 71-year-old woman was referred from a general hospital for removal of her old atrial and ventricular leads in conjunction with an elective pacemaker replacement. The battery of the pacemaker was almost depleted. Four years earlier she had received a DDD pacemaker with an atrial lead (model 432-04, Intermedics, USA) and a ventricular lead (model 430-10, Intermedics). We conjecture that the subclavian vein was punctured during the implantation of both leads. The ventricular lead was traumatized after two years, and a new but identical ventricular lead was inserted. Recently, the atrial lead showed complete sensing and pacing failure. Radiographic examination of the thorax showed a clear break in the atrial lead coil (Figure 1). When observed in detail it was clear that the ventricular lead also had a distinct break in the coil. This was confirmed by traction on both leads after opening of the pocket and retrieving the distal parts of the leads (Figure 2). The atrial lead was cut off and a standard guide wire was introduced into the lumen of the inner coil. This prevented the coil from collapsing while traction was exerted. Gentle, progressive traction was applied to the lead body in combination with the guide wire, while the intracardiac ECG from the lead tip was observed continuously. This provided information about the amount of traction force applied to the tip. The intracardiac ECG showed negative T-waves before pulling, and progressive ST segment elevation could be seen during the manual traction, in conjunction with ventricular extrasystolic beats or more pronounced ventricular arrhythmias when forceful traction was applied. The

ST segment elevation was a sign that the traction force was applied to the tip and that the traction force did not dissipate in the lead body and its various lead encapsulations. Once the lead tip was removed from the myocardial wall, ST segment elevations suddenly disappeared, and the intracardiac R-wave dropped in amplitude or was replaced by an atrial signal. The complete removal of the lead is dependent on the strings of fibrous tissue, which can be found at the tricuspid valve, the right atrial free wall, the vena cava superior wall, and the subclavian wall. Because of the nonisodiametric design of many leads, especially leads with passive fixation, the distal part of the lead can be trapped in a ring of fibrous tissue. When under fluoroscopy the distal lead body cannot be moved further during traction and when pulling resistance is met (i.e., words the distal lead body is trapped in a ring of fibrous tissue), the superior approach will be stopped. Preferable the right-, otherwise the left-femoral vein is or will be punctured and a special "capturing device" is introduced into the right atrium (Figure 3). From the superior side the lead will be pushed or pulled until the tip of the lead is in the right atrium and its tip is free from the right atrial or superior cava vein wall. The lead tip can and will be captured with the snare loop (Figures 4 and 5). The atrial lead will be retracted to the femoral vein and then the lead body will be firmly pulled against the sheath of the 8 F introducer. In this case, the snare loop held the lead body in its grip at the proximal ring (Figure 6), which hampers the folding of the lead body. The grip of the snare loop has to be loosened and the grip on the lead has to be repositioned to a more flexible part of the body (Figure 7). The atrial lead was removed in toto and a new screw-in lead (Elox, Biotronik, Germany) was implanted. This lead has an isodiametric design, which enables lead removal with the superior approach alone.

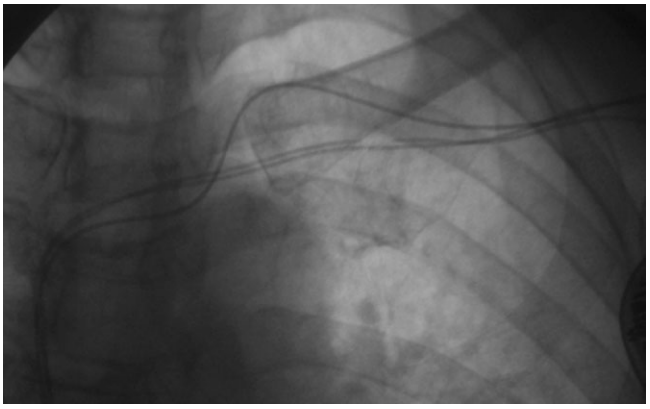

Figure 1. Detail of thoracic X-ray in anteroposterior view. The break in the fractured atrial lead is clearly visible. This fracture is close to the entrance of the lead into the subclavian vein. The old fractured ventricular lead (lower part, in the middle, just under the clavicle).

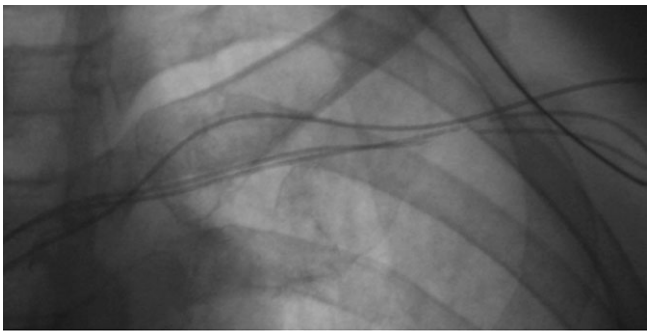

Figure 2. The pocket of the pacemaker is opened and the distal parts of the leads are straightened. Mild traction on both leads clearly reveals the break in the atrial and ventricular lead.

Discussion

The dual-side approach for removal of pacemaker leads has not been described in this manner before. Many authors use the femoral or inferior approach for the additional removal of retained catheter and lead segments [9-13]. In other cases the femoral approach is the primary approach irrespective of the tools used in the lead removal [14]. Bracke, et al. use the inferior approach in combination with the laser sheath as the primary approach or as a backup alternative in case of failure of the primary approach [15]. In their report 26% of all leads are finally removed via the femoral vein. Byrd et al. reports that the inferior approach was used in 12% of patients in whom leads were inaccessible to the superior approach [3]. However, they used a 16 F workstation, as they mentioned the introducer sheath. The lead and the capture device go through the introducer, where we remove the lead and 8 F introducer at the same time. If a second procedure is necessary, the femoral vein can again be punctured without problems. Complete lead removal can be achieved with relatively standard tools by using the dual (superior and inferior) approach. The superior approach is needed for dislocation of the lead tip from its fixation point, and once

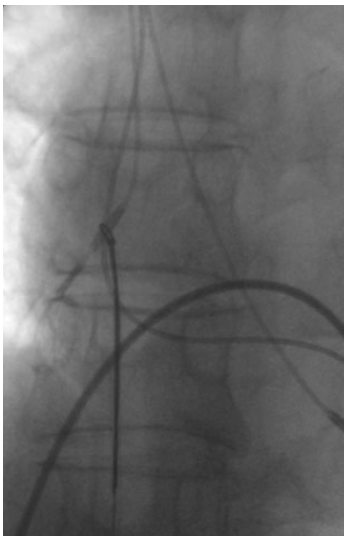

Figure 3. From the right femoral vein the Cook "capture device" is introduced into the right atrium. Note the circular "capture" loop. This loop will close when the steel cable is retracted into the long sheath.

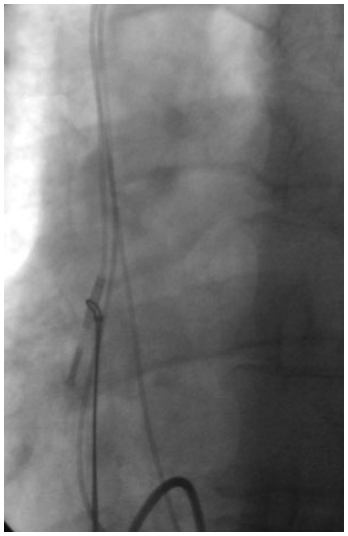

Figure 4. The distal lead end is captured in the loop and firmly grabbed.

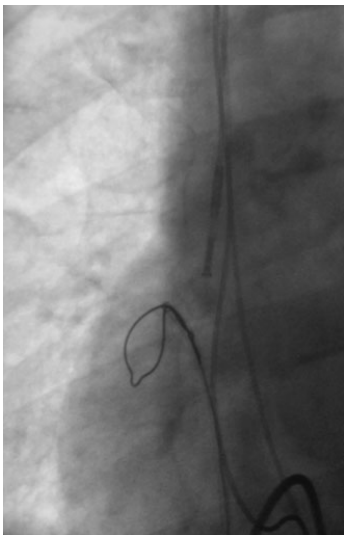

Figure 5. Gentle pulling on the long sheath of the capture device, while the snare is also locked in his position, must confirm the stability of the capture device. Note that the lead is captured at the large proximal ring electrode.

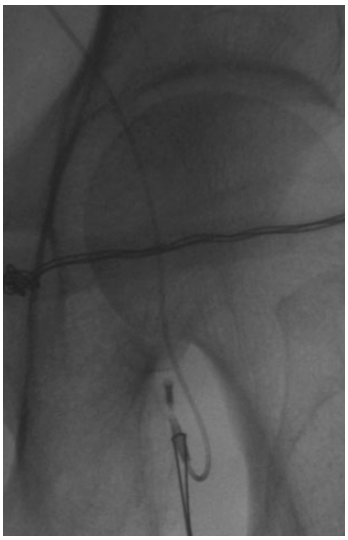

Figure 6. The proximal (isodiametric) part of the lead or the superior part is cut off in the pocket to reduce the length of the lead to be removed through the groin. Note that the snare has opened its loop a little for repositioning the grip on the lead body.

Figure 7. The snare is now repositioned around the flexible lead body, because the lead body has to be folded into the introducer sheath positioned in the left femoral vein. The introducer sheath and the folded lead body will be extracted from the body together. Hemostasis is achieved in a few minutes.

it is freely moving around in the right atrium or right ventricle, the distal lead body can be retrieved by a snare loop device introduced via the femoral vein.

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