Percutaneous removal of broken left ventricular lead guide sheath during biventricular pacemaker implantation using intraluminal wire technique

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Introduction
We herein describe an unusual complication during biventricular pacemaker implant wherein the distal part of the guide sheath used for left ventricular (LV) lead placement broke during the removal stage and got retained in situ completely, with no part visible outside the body. The technique used for successful percutaneous removal of the broken sheath fragment is described.

Case report
We present a case of a 55-year-old patient with a clinical diagnosis of nonischemic dilated cardiomyopathy (LV ejection fraction = 28%, NYHA class II) with left bundle branch block (QRS duration: 160 ms). With regard to the low overall presumed risk of primary sudden cardiac arrest or ventricular tachycardia along with the affordability issues, a shared decision-making process was undertaken involving patient, consulting physician, and interventional cardiologist that led to the selection of implanting a biventricular pacemaker (CRT-P) in this patient. LV lead implantation was largely uneventful except for some increased resistance during traversal of the sheath forward, with final coronary sinus (CS) cannulation achieved with a little more than usual difficulty, in view of the resistance in guide sheath movement. At the end of the procedure when all the leads were in place, the final step of slitting and removal of the LV lead guide sheath (8.7F, 45 mm Selectra extended hook telescopic CS lead delivery system; Biotronik, Lake Oswego, OR) was done as usual. The sheath was almost successfully slit and retrieved using standard technique (Selectra slitting tool), but examination of the retrieved sheath suggested it to be smaller in length, with some part possibly retained within the body. On detailed examination it was confirmed that 1 end of the guide sheath was retained inside the body at the entry point in the subclavian vein (Figure 1A) and its other end was in the right atrium (RA) (Figure 1B). The LV lead (Sentus ProMRI OTW quadripolar; Biotronik) at this stage was seen in the proximal CS with a big loop in the RA. The sheath had broken at a point approximately 3 cm beyond its entry into the subclavian vein.

At this stage there seemed no clear way to retrieve the retained guide sheath from the site of entry, as the proximal end of the broken sheath was embedded inside the subclavian vein with no part visible outside in the pacemaker...
pocket. The workhorse percutaneous transluminal coronary angioplasty (PTCA) wire (Hi-torque Whisper Extra Support; Abbott Vascular, Santa Clara, CA) used for implanting the LV lead was, however, still inside the LV lead, which was itself inside the broken part of the guide sheath. The LV lead was withdrawn, leaving the wire in the RA, and an attempt was made to slide a PTCA balloon on the retained wire and to lock the sheath from within with a fitting size balloon and pull it back, but the attempt did not work (Video 1). It was then planned to retrieve the sheath from the groin using a snare. To assist in this exercise a pigtail catheter was threaded from the pacemaker pocket over the PTCA wire (Figure 2A) and inside the broken guide sheath, following which the 0.014” PTCA wire was changed to a 0.035” exchange length hydrophilic J-tip wire (Terumo guidewire, Terumo Corp, Shibuya City, Tokyo, Japan) and the pigtail–0.035” system was directed into the inferior vena cava with the retained guide sheath following the same route. This approach facilitated hassle-free maneuvering and directing of the guide sheath that was now over the pigtail, which by its coiled tip could be maneuvered into different parts of RA into the inferior vena cava so as to meet the snare loop.

A 20 mm Amplatz Goose Neck snare (Medtronic plc, Minneapolis, MN) was next introduced from the right femoral vein that went past the 0.035” wire inside the retained part of the guide sheath and the pigtail (Figure 2B) and it was then actively threaded onto the distal tip of the retained guide sheath (Figure 2C, Video 2). The pigtail–0.035” wire system was pulled back until it got proximal to the distal end of the retained guide sheath and its tip was caught by the snare (Figure 2D), and the broken guide sheath was then pulled with the goose neck snare wire (Figure 2E) and could be brought out from the femoral vein (Figure 3, Video 3). Because the procedure had already extended to quite an extent owing to the complication of the broken guide sheath needing active removal, it was decided to call off the case at this stage and have the LV lead implanted through an open surgical approach using an external patch lead, although the wire access through the subclavian puncture site was still available (Figure 2F, Video 4). Following epicardial LV lead implantation, the patient made an uneventful recovery and was discharged a week later.

Discussion
This was our first experience with such a complication wherein the delivery sheath broke inside the body during retrieval and got completely stuck within, with no part visible from the pacemaker pocket. The usual complication faced during slitting and removal of the LV guide sheath is the accidental slipping out of the cutter or cutting of the sheath through and through and the process stalling halfway with part of the sheath inside and part outside, which necessitates completion of the removal process with some indigenization of the technique, which was not the case here. Our sheath probably broke because of getting stuck in the narrow space of the thoracic inlet between first rib and the clavicle, the reason for which was not very clear. It is possible that the track got periosseous and damaged the sheath during inward travel and was also responsible for the extra resistance faced during to-and-fro movement of the sheath. The resistance was, however, not extreme, as the problem was confirmed only in hindsight and not before. However, this resistance in the tract between clavicle and first rib where the puncture was made could have led to longitudinal deformation of the sheath, which was not so obvious fluoroscopically, and during removal the sheath broke at this particular point. The event was picked up at the first go only indirectly by observing that the retrieved sheath looked smaller in length, and not as much from the resistance or kinking issues that could have otherwise surfaced before, which did not happen.

In assessment of the total internal length of the retained sheath, it could be indirectly surmised that the breakage point was not at the venous access site hole but a little beyond by about at least 3 cm, affirmed by the observation

Figure 1  Proximal (A) and distal end (B) of broken fragment of the left ventricular guide sheath.
that when the proximal end of the broken part was at access site level the distal end of the sheath was in the RA and not inside the CS. An important point to note at this juncture was that intraluminal access to the broken sheath was maintained throughout the procedure, which not only helped in threading of the snare onto the sheath but also helped to maintain venous access to the puncture site, through which a second attempt to complete the procedure could have also been possible. However, in view of the extended procedure time and both patient and physician fatigue, such an attempt was not persisted upon, and surgical LV lead placement was advised. Percutaneous retrieval was, however, successful, with no major complications, and the patient could be successfully discharged with a final biventricular pacing.

Figure 2  A: Pigtail catheter threaded over 0.014” percutaneous transluminal coronary angioplasty wire through the broken guide sheath. B,C: Pigtail with 0.035” wire (Terumo glidewire, Terumo Corp, Shibuya City, Tokyo, Japan) in inferior vena cava caught by the loop of the goose neck snare (B), followed by its threading over the guide sheath (C). D: Guide sheath pulled out by the snare after retracting pigtail and Terumo wire. E,F: Guide sheath broken fragment removed (E), with vascular access still maintained by Terumo wire (F).

Figure 3  Left panel shows distal end of doubly bent left ventricular (LV) lead sheath fragment (marker A) caught using goose neck snare–catheter system (markers B, C) via 8F, 13-cm femoral vascular sheath (marker D). Right panel shows broken-off distal end (white solid arrow) of the proximal part of slotted LV lead sheath.
implant (Enitra 8 HF-T; Biotronik) completed. Literature search does show a few examples of retrieving broken components of central venous vascular sheath using noncompliant coronary balloon and intracardiac central venous chemotherapy port fragments broken off at the junction of the right innominate vein and superior vena cava, using a triple loop snare. However, we could not find any other similar case where the LV lead guide sheath had broken this way and got retained inside body, followed by a successful retrieval.

**Conclusion**

Although rare, long introducer sheaths used for endocardial LV lead implantation may get damaged at the puncture site in the subclavian vein, with subsequent traction resulting in breakage of the sheath. The key to extraction is adequate anchorage and support via intraluminal wire with or without a catheter, thereby facilitating their removal using a snare through the femoral approach.

**Appendix**

**Supplementary data**

Supplementary data associated with this article can be found in the online version at [https://doi.org/10.1016/j.hrcr.2020.08.018](https://doi.org/10.1016/j.hrcr.2020.08.018).

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