Repositioning and Extraction of Stylet-Driven Pacing Leads with Extendable Helix used for Left Bundle Branch Area Pacing.

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Abstract

Abstract: Conventional stylet-driven leads with extendable helix can be implanted successfully for Left Bundle Branch Area Pacing (LBBAP) with a low acute complication rate. However, removal and repositioning techniques of these leads haven't been yet described. We report 2 cases in which lead repositioning after a first unsuccessful attempt to LBBAP was associated with fracture of the helix rotating mechanism and failure to fully extract the pacing lead.

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Abstract

Conventional stylet-driven leads with extendable helix can be implanted successfully for Left Bundle Branch Area Pacing (LBBAP) with a low acute complication rate. We report 2 cases in which lead repositioning after a first unsuccessful attempt to LBBAP was associated with fracture of the helix rotating mechanism and failure to fully extract the pacing lead.

Case description Two patients referred for LBBAP were implanted with a conventional stylet-driven (SD) lead with an extendable helix (Biotronik Solia S60, SE & Co, Berlin, Germany) delivered through a dedicated preshaped sheath (Selectra 3D, Biotronik, limited market release). Before implantation, the lead was prepared by exposing the helix. Using the stylet insertion tool, an additional 10 clockwise (CW) rotations was applied. This pretensioning of the inner coil was maintained by further pushing the stylet insertion tool onto the proximal silicon sealing ring of the lead. This maneuver is essential to maintain the pre-applied torque on the screw extension mechanism and avoid unwinding of the extendable helix during transseptal screwing of the lead.[1,2] LBBAP was subsequently attempted following the technique previously described by Huang et al.[3] In both cases, recording of His potential, mapping of the right ventricular (RV) septal implant site, and screwing the lead transseptally towards the left side of the interventricular septum using outer lead body rotations was easy. In patient one, a narrow paced QRS of 102 ms was obtained but no LBBB capture was clearly demonstrated and pacing thresholds remained high (2.0 V with a pulse duration of 1 ms). Therefore, an attempt to reposition the lead was undertaken. With the stylet fully inserted to the tip of the pacing lead, counterclockwise (CCW) rotations of the connector pin were first applied to release tension on the inner coil and retract the exposed helix. However, the helix failed to retract. An attempt to unscrew the helix by CCW rotation of the entire lead also remained unsuccessful. The implanter decided to test lead anchoring by gently pulling on the lead. This maneuver immediately resulted in the misalignment of the helix. With further efforts to extract the lead using lead rotations, traction and counter-traction with the sheath, the helix elongated and finally abruptly snapped (See Figure 1A). This patient was finally implanted with a biventricular pacemaker without further complications. Computed tomography confirmed the deep insertion of the residual helix fragment into the interventricular septum (See Figure 1B).

LBBAP in patient two was attempted using a similar implantation technique. As in patient one, no QRS changes indicative of LBBAP were obtained, and pacing threshold was high (>2.5 V with a pulse duration of 1 ms). Lead repositioning was attempted by CCW turning of the outer lead body without fixation of the connector pin. This maneuver resulted in rupture of the fixation mechanism and the distortion of the helix (See Figure 2). Further attempts to extract the lead by CCW turning of the connector pin or outer lead body were ineffective. The lead was abandoned in the septum and a second lead was implanted in the right ventricular apex.

Discussion

Recent growing interest for tissue conduction pacing has incited pacemaker companies to develop their own dedicated implantation tools and solutions. The Select Secure 3830 lead (Medtronic Inc., Minneapolis, MN, USA) is characterized by a unique narrow caliber Lumen-Less (LL) isodiametric design with an exposed helix and is implanted using a dedicated preshaped sheath (C315HIS, Medtronic Inc.). Recently, Zanon et al. described the feasibility of LBBAP using conventional SD leads with an extendable helix, also delivered through a dedicated preshaped sheath (Selectra 3D, Biotronik, limited market release). De Pooter et al. demonstrated comparably high implant success rates in LBBAP with both types of leads. Both publications describe the preparation and implantation technique of SD leads for LBBAP but no specific recommendations are provided on how to troubleshoot difficult implantations, with reference in particular to their removal and repositioning.

Extendable / retractable helix pacing lead for LBBAP:

Compared to LL leads, SD pacing leads benefit from better support, stability and steerability during transseptal screwing for LBBAP and allow for a more customized implant approach in the setting of anatomic variations. However, careful pre-tensioning of the inner coil and locking of the connector pin is required before use (See Figure 3A and 3B). As transseptal screwing is associated with more distal grip and recoil of the outer lead body and helix, inadequate preparation of the lead may result in unwanted retraction of the helix during CW outer lead body rotations. For the same reason, full helix retraction is critical before attempting lead removal by CCW turning of the outer lead body. As illustrated by our second case, insufficient locking of the connector pin to the outer lead body during this maneuver may further extend the helix and eventually fracture the helix rotating mechanism. (Fig 3C) As illustrated by our first case, any premature traction on the lead with the helix incompletely retracted may result in helix misalignment or deformation. Although both implanters were experienced with tissue conduction pacing, they were relatively naïve to the use of an SD lead for LBBAP. In his recent paper, De Pooter et al. reported an average of 2 attempts per patient to reach the left side of the ventricular septum. No issues during lead repositioning were reported. With experience, the following suggestions can be made before unscrewing SD leads in LBBAP: 1) Verify full insertion of the stylet to the tip of the lead and obtain maximum support before retraction by maintaining the delivery sheath firmly against the RV septum 2) Much more than the minimum number of connector pin rotations to expose the helix are usually necessary to fully retract the helix 3) If the helix can not be retracted, avoid CCW rotation of the outer lead body without validated fixation of the connector pin by means of the stylet insertion tool (Fig 2D). 4) After removal and before repositioning, carefully inspect the screwing mechanism.

Ideal lead for LBBAP:

Although SD leads with extendable helix may offer some advantages in terms of steerability and septum penetration, the fragility of the screwing mechanism requires great precaution during repositioning and raises concerns regarding long-term extractability. In our opinion, ideal leads for LBBAP should combine a robust SD isodiametric narrow caliber design with an exposed active helix fixation.

Conclusion:

The present paper highlights the potential difficulties encountered during acute repositioning of stylet driven leads used for LBBAP and questions their long-term extractability.

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Figure 1.

Patient 1: (**A**) Antero-posterior fluoroscopic projection showing the fractured helix (white arrow) with residual fragments in the interventricular septum (black frame). **B** . Computed tomography segmentation showing the broken helix deeply inserted into the inter-ventricular septum (white arrow).

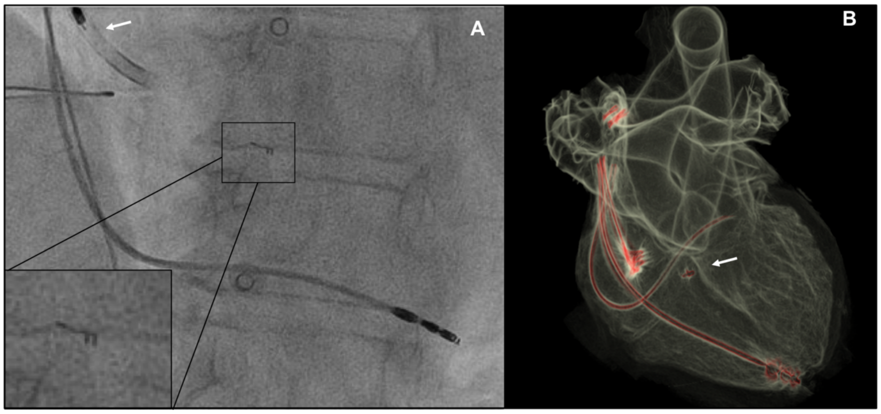

Figure 2.

Patient 2: Right Anterior Oblique fluoroscopic projection (30°) showing the distortion of the helix.

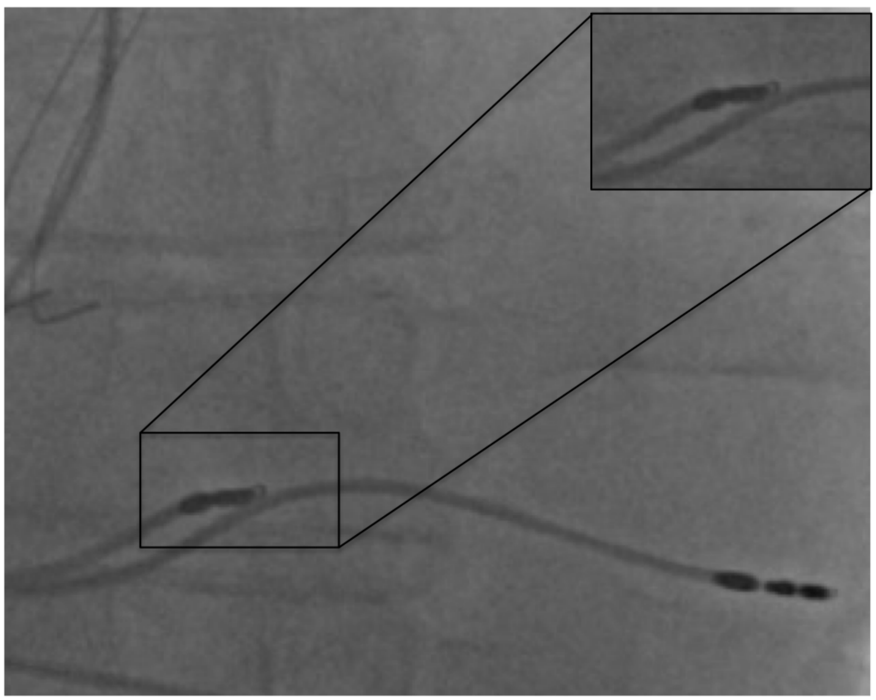

Figure 3.

3(A) Technical representation and legend of a stylet-driven lead.

3(B) Steps to prepare the helix for LBBAP: After exposition of the screw, pre-tensioning of the inner coil is provided by clockwise rotations (CWR) of the stylet insertion tool. The torque on the inner coil is later maintained by plugging the stylet insertion tool onto the first silicon sealing of the electrode.

3(C) Manual counter-clockwise rotations (CCWR) of the outer lead body without appropriate fixation of the connector pin. Illustration of the paradoxical effect of further helix extension or inner coil over-tensioning (with eventual rupture of the rotating mechanism).

3(D) With adequate fixation of the connector pin, CCW torque applied to the outer lead body is progressively transmitted to the screw and allows for lead removal.