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Deformation of stylet-driven leads & helix unraveling during acute explant after conduction system pacing☆

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His bundle (HB) and left bundle branch (LBB) pacing have become well-accepted forms of conduction system pacing (CSP), with the majority of CSP performed using the SelectSecure 3830 lumen-less lead (Medtronic, Minneapolis, MN) and growing reports of implantation with stylet-driven leads [1,2]. Experience with removal of leads in the HB and LBB locations is further reduced to the lumen-less lead [3,4] as there is little published information regarding, and remaining concern of damage from, removal of stylet-driven leads engaging the conduction system.

The images presented [Fig. 1] are from two patients who underwent unipolar mapping to localize the HB region using stylet-driven, active-fixation leads with dedicated septal guiding catheters. Case 1: Ingevity+ 7842 lead delivered by Site Selective Pacing 9183 catheter (Boston Scientific, Marlborough, MA) with helix fixated perpendicular to the septum via 7 clockwise clip-on wrench turns. Case 2: Tendril 2088 TC lead delivered by Agilis HisPro DS3H010 steerable catheter (Abbott, Chicago, IL) with helix prepared and extended within the sheath, followed by advancement during 8 clockwise lead body turns. Stable septal fixation was achieved on first attempt and selective His capture was confirmed [**1A**]; however, immediate implant parameters were suboptimal in both instances and the decision was made to revise. With catheter parallel to lead and abutting the septum, counter wrench turns in case 1, analogously counter lead body turns in case 2, were attempted to explant the lead yet both techniques resulted only in malformation of the electrode coil helix [**1B, 1D**]. Additional measures, including: 1) bonus counter wrench turns, 2) stylet manipulation to transmit torque, 3) gentle retraction, 4) manual counter rotation of lead body and catheter – failed to release the helix. Finally, consistent and forceful traction resulted in dislodgement of the leads followed by transient AV block seen in case 1 and brief interventricular conduction delay in case 2; no sustained conduction disturbances were apparent in either. Despite unraveling of the helixes, no components of the leads were abandoned and mechanical extraction tools were not required. Visual inspection of the leads ex vivo confirmed adherent myocardial tissue [**1C, 1E**]. The 7842 lead was returned to the Quality Assurance laboratory; final analysis reported "the helix mechanism could not be tested due to the extremely stretched helix; the deformation of the helix impacted functionality." The tissue sample attached to the 2088 TC lead was sent for histological correlation [**1F**].

Challenges with active-fixation helix retraction have been previously encountered in other locations of myocardium, nonetheless, our images and description are unique and represent the first report portraying acute explant of Ingevity+ and Tendril stylet-driven leads engaging the conduction system. While HB and LBB pacing represent an evolution for resynchronization therapy and new delivery tools are on the horizon, vigorous safety testing is needed before uniform adoption of CSP utilizing all available pacing leads.

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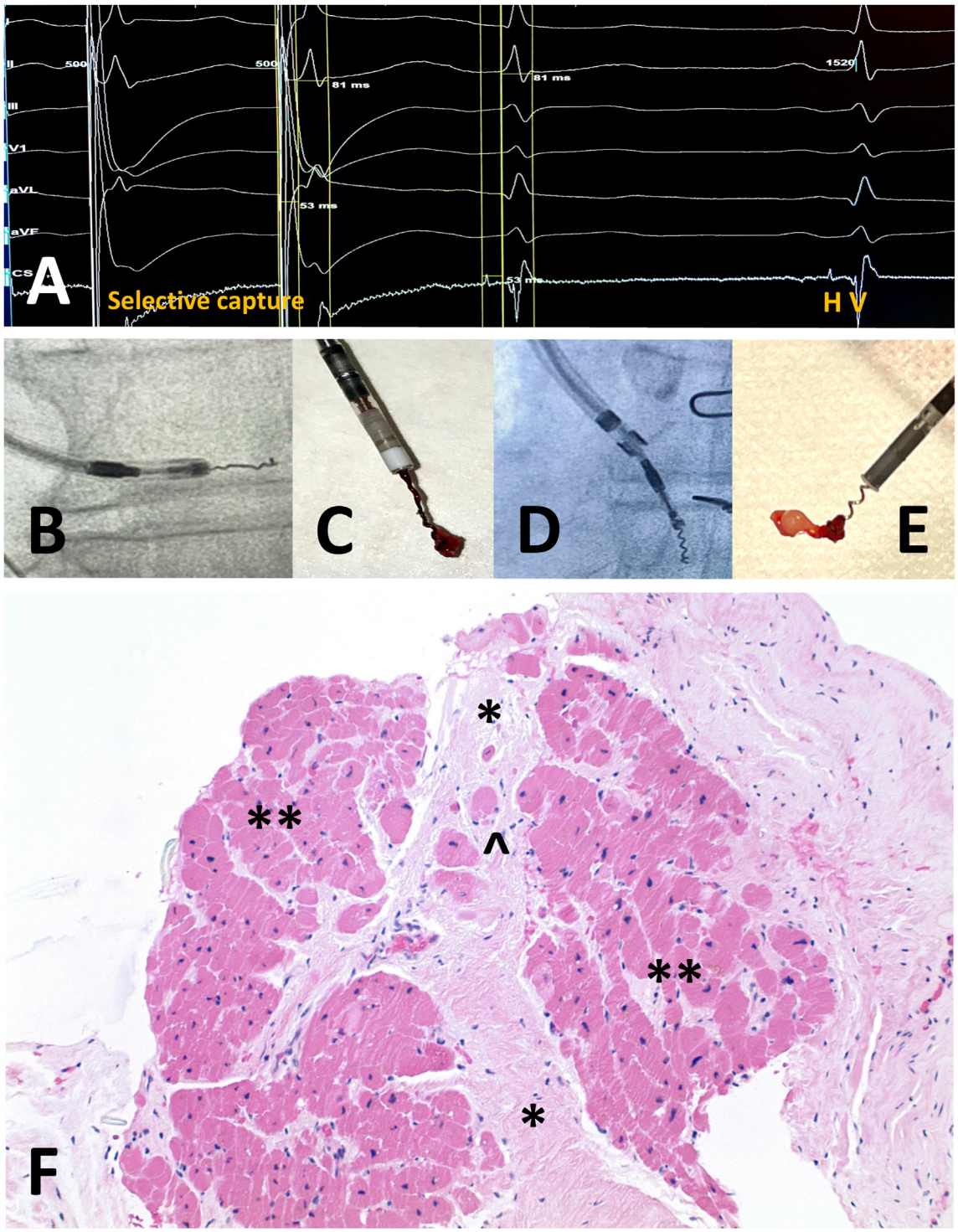

Fig. 1. Explant of stylet-driven conduction system pacing leads.
SDPL = stylet-driven pacing lead; H&E = hematoxylin and eosin.
Fixation of a stylet-driven pacing lead (SDPL), achieving (A) selective conduction system pacing; His bundle potential is recorded on the SDPL. Due to suboptimal thresholds, attempts to revise result in unraveling of the (B) Ingevity+ and (D) Tendril helices; the leads remained fixated to the septum withstanding counter wrench turns, manipulation of the stylet, gentle retraction, and manual rotation of the SDPL and sheath. (C, E) Ex vivo view of the malformed SDPL helices and attached myocardial tissue following forceful traction and explant of the leads. (F) Histological correlation under H&E stain, of the Tendril lead biopsy (E): band-like region of hypocellular fibrotic tissue (*) surrounded by myocardial cells (**); note the area of myocardium (^) surrounded by fibrotic tissue, which may represent penetrating portions of conduction system cells encapsulated by the central fibrous body.

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