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CASE REPORT
Electrophysiology

Antidromic snare technique for re-implantation of a coronary sinus lead into the same cardiac vein after transvenous lead extraction: a case report

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Background After coronary sinus (CS) lead extraction in patients with cardiac resynchronization therapy (CRT), occlusion of the branch vessel from which CS lead was extracted is a major obstacle to re-implantation, particularly if that vessel is the only optimal vessel for resynchronization.

Case summary A 75-year-old female who underwent CRT implantation 11 years prior presented with worsening dyspnoea, right ventricle-only pacing rhythm, and increased CS lead pacing threshold. Because she was a CRT responder, we decided to replace the malfunctioning CS lead. After successful extraction, the vessel from which CS lead was extracted was not visualized, and guidewire re-insertion attempts failed. No other branch vessels suitable for re-implantation were observed. Fortunately, distal portion of the target vessel was viewed by a retrograde flow of contrast. A guidewire was advanced retrograde into the target vein via a connecting vessel, and the distal end of the guidewire was snared around CS ostium and then pulled out of the sheath. A new CS lead was inserted through the distal end of the guidewire and successfully implanted antegrade into the same target vein using a veno-venous loop of the guidewire ('anti-dromic snare technique'). The patient was discharged 2 days after the procedure without complications.

Discussion Antegrade re-implantation of CS lead may not be possible after extracting CS leads with long dwell times, possibly due to extraction-induced vessel occlusion. If the occluded vessel is the only proper vessel for CS lead re-implantation, the anti-dromic snare technique could be a safe and effective bail-out strategy.

Keywords Cardiac resynchronization therapy • Coronary sinus lead • Extraction • Snare • Case report

ESC curriculum 5.11 Cardiac resynchronization therapy devices • 6.1 Symptoms and signs of heart failure • 6.2 Heart failure with reduced ejection fraction

Learning points

- Coronary sinus (CS) lead extraction may lead to occlusion of the CS branch vessel, preventing re-insertion of a guidewire into the same vein. This may be due to extraction-induced dissection of the vessel and thrombus formation, especially if the CS lead has a long dwelling time with dense fibrous adhesion to the branch vessel.
- The anti-dromic snare technique could be a safe and effective solution for re-implantation of a CS lead into the same cardiac vein with extraction-induced occlusion if the occluded vessel is the sole proper branch for CS lead re-implantation. But, the snare technique is only applicable in patients with connecting vessels between the target vein and the nearby vein.

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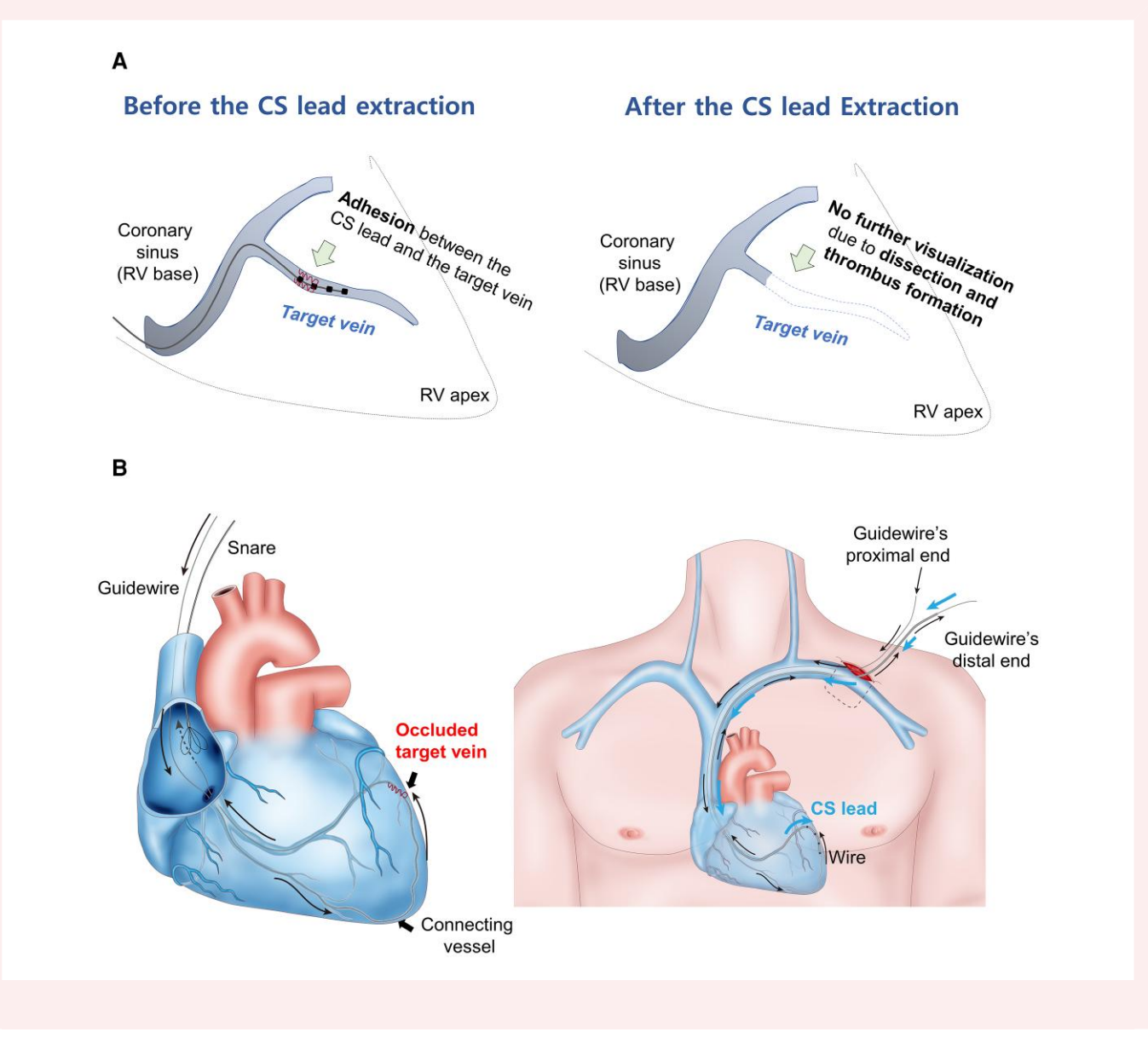
Introduction

Cardiac resynchronization therapy (CRT) has become a standard treatment in patients with left ventricular (LV) systolic dysfunction and dyssynchrony.[1] As the number of CRT implantations has increased, the number of cases requiring extraction of coronary sinus (CS) lead is also increasing.[2] CS leads can often be removed by manual traction alone since they usually have a small diameter and no fixation system.[3] After extraction, re-implantation of a new CS leads into the same vein is frequently necessary, particularly in patients who have no other optimal target vein. However, occlusion of the branch vessel is a major obstacle to re-implantation.[4,5] The anti-dromic snare technique for CS lead implantation was reportedly very useful when the target vessel was dissected, stenotic, or tortuous.[6,7]

Herein we present a case of re-implantation of a CS lead using the anti-dromic snare technique into the occluded vessel after CS lead extraction.

Summary figure

Anti-dromic snare technique for re-implantation of a coronary sinus lead into the same cardiac vein occluded after transvenous lead extraction. (*A*) Target vein occlusion after transvenous coronary sinus lead extraction; an illustration of the possible mechanism of non-visualization of the branch vessel. (*B*) Antidromic snare technique for re-implantation of a coronary sinus lead into the same cardiac vein. CS, coronary sinus; RV, right ventricle.



Case presentation

A 75-year-old female with a CRT-defibrillator (CRT-D) presented with worsening dyspnoea and right ventricle (RV)-only pacing rhythm on 12-lead electrocardiography. She was noted as having normal and regular heart sounds without a murmur and mild lower limb oedema. Eleven years prior, she had undergone CRT-D implantation due to symptomatic dilated cardiomyopathy with dyssynchrony due to typical left bundle branch block and showed significant improvement in QRS duration (153–125 ms) and LV ejection fraction (20–40%). However, device analysis revealed that the pacing threshold of the CS lead and impedance of the RV shock lead, which had remained stable for the past 11 years, had increased to 6.5 V at 1.0 ms and 200Ω, respectively. The CS lead pacing threshold was >6.0 V at every possible pacing configuration. Dislodgement or fracture of the CS lead initially implanted in the lateral cardiac vein on the LV basal segment was not definite on the chest x-ray (*Figure 1*). A dual-coil RV lead was visualized in the RV lower septum. Therefore, we decided to replace the malfunctioning CS and RV leads.

The old RV defibrillator lead was successfully extracted using a lead-locking stylet and TightRail dilator sheath (Spectranetics Corp., Colorado Springs, CO, USA) (see Supplementary material online, *Video S1*). After inserting a locking style, manual traction of the CS lead was not effective. Then, a 10-Fr polypropylene dilator sheath (Byrd Dilator Sheath Sets, Cook Vascular Inc., Vandergrift, PA, USA) was utilized. When the dilator sheath arrived at the right atrium, the CS lead was successfully extracted out of the coronary sinus with gentle traction force (see Supplementary material online, *Video S2*).

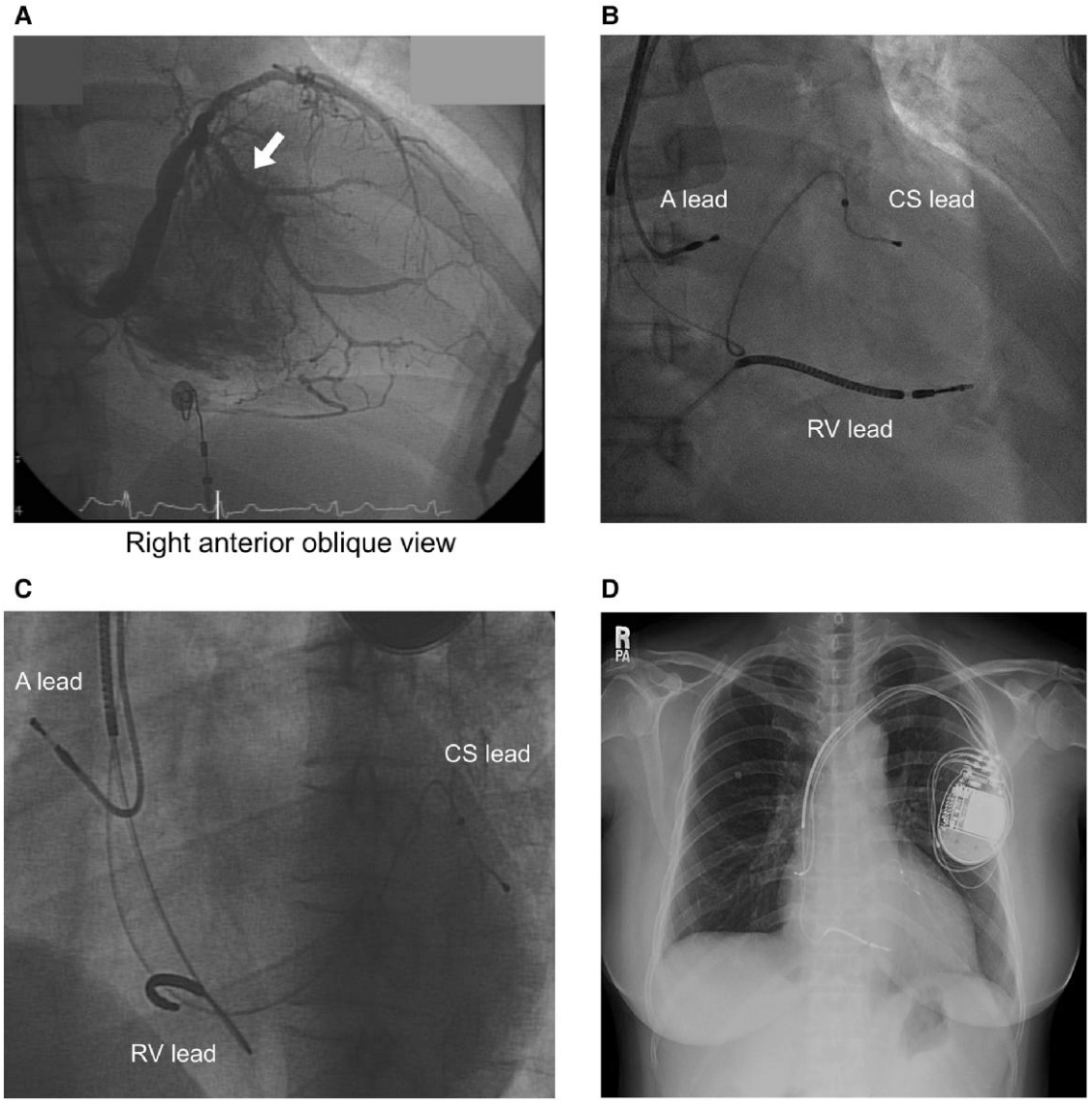


Figure 1 Fluoroscopy images during initial implantation of a cardiac resynchronization therapy-defibrillator 11 years before current presentation and chest x-ray image prior to the extraction procedure. (*A*) Venography showed a single appropriate branch vessel for cardiac resynchronization therapy implantation (white arrow). (*B*) Right anterior oblique view after implantation. (*C*) LAO view after implantation. (*D*) Chest x-ray image prior to the current extraction procedure. CRT-D, cardiac resynchronization therapy-defibrillator; CS, coronary sinus.

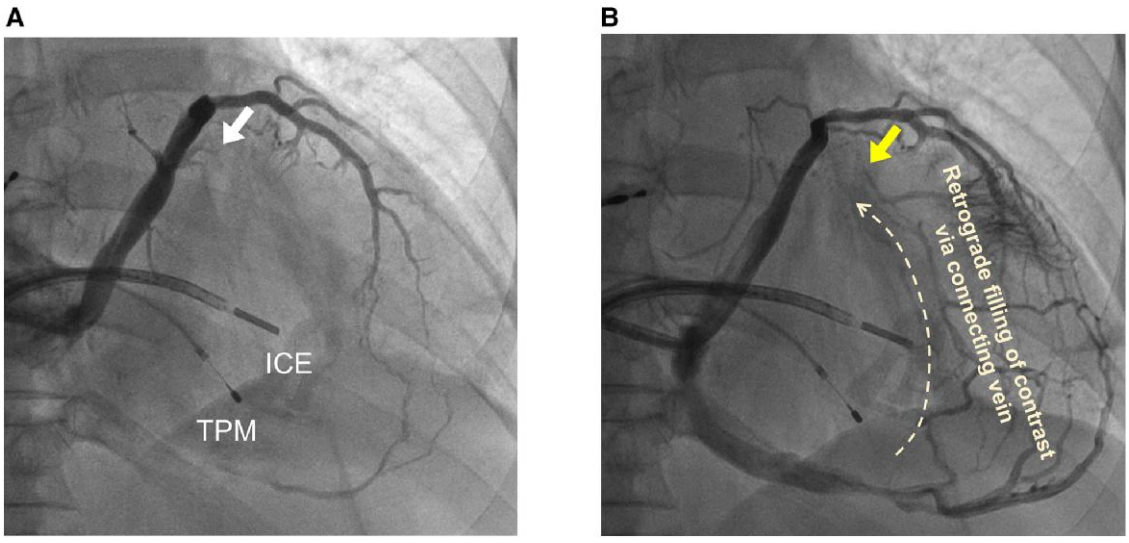


Figure 2 Venography of the cardiac venous system after coronary sinus lead extraction. (*A*) After coronary sinus lead extraction, the proximal portion of the vessel (arrow) in which the old coronary sinus lead was previously located was not visualized by contrast injection. (*B*) The distal portion of the target vessel (arrow) was visualized by the retrograde flow (dashed arrow) of contrast via the connecting vessel. CS, coronary sinus; ICE, intracardiac echocardiography, LV, left ventricle; RV, right ventricle; TPM, temporary pacemaker.

After CS lead extraction, however, the vessel in which the CS lead was previously located was not visualized by contrast injection (*Figure 2A*). Multiple attempts to reinsert a 0.014″×180 cm guidewire into the same target vein failed, suggesting extraction-induced dissection of the vessel (*Summary figure*). Moreover, no other branch vessels suitable for re-implantation of a new CS lead were observed. Fortunately, however, the distal portion of the initial target vein was visualized by retrograde flow of contrast via the connecting vessel (*Figure 2B*). Thus, we decided to perform the anti-dromic snare technique to overcome unsuccessful antegrade access to the same target vessel. First, a 0.014″×180 cm guidewire was inserted into the middle cardiac vein and advanced retrograde into the distal portion of the target vein via the connecting vessel (*Figure 3A*), guided by intermittent puffs of contrast. Then, the 0.014″×180 cm guidewire was further inserted back into the CS ostium (*Figure 3B*). The distal end of the guidewire was captured around the CS ostium using the EN Snare (Merit Medical, South Jordan, UT, USA), which was introduced via the sheath prepared for insertion of a new defibrillator lead (*Figure 3C*). The snared distal end of the guidewire was pulled out of the sheath. After trimming off the damaged distal portion of the guidewire, a new CS lead was inserted over the intact distal tip of the guidewire. Using a veno-venous loop of the guidewire, we were able to insert the new CS lead into the same target vein, overcoming some resistance, while both ends of the guidewire were under the control of the operator (*Figure 3D* and *E*). Subsequently, a new defibrillator lead was inserted at the apical mid-septum of the RV, with good separation between the CS and RV leads in the left anterior oblique (LAO) view (*Figure 3F*). After the procedure, the CS lead pacing threshold was 3.25 V at 0.5 ms, and RV shock lead impedance was 57Ω. The QRS duration was 125 ms, the same as before CS lead malfunction. The patient was discharged 2 days after the procedure with no complications. During a 6-month follow-up period, the CS lead pacing threshold (2.0–2.5 V at 0.5 ms) and RV shock lead impedance (65–75Ω) remained stable without requiring lead revision. Furthermore, shortness of breath improved to New York Heart Association Class I-II, and the echocardiogram performed at 6 months showed that the LV ejection fraction was well maintained at 42.4%, the same as before the lead malfunction occurred.

Discussion

CS lead extraction

In previous reports, CS lead extraction demonstrated a success rate >of 97%, and 70–91% of CS leads were successfully removed by simple manual traction.[5,8,9] However, older lead age, larger lead diameter, unipolar design, and non-infective indications were significantly associated with the need for mechanical or powered sheaths.[8–10] In the present case, the CS lead dwell time (11 years) was significantly longer than the mean duration (18–29 months) in previous reports.[5,8,9] Within this context, in the present case, mechanical dilation was required to dissect the adhesion around the subclavian vein and superior vena cava. Bongiorni *et al.* reported that fibrous adhesions were mainly located in the subclavian and innominate veins and the superior vena cava.[8]

Replacement of the CS lead using the anti-dromic snare technique

Dissection-induced endothelial damage, thrombus formation, and fibrous adhesions can cause total occlusion of the CS branch vessel after CS lead extraction (Summary Figure). In a study by Burke *et al.*, 50% of the branch vessels from which the CS lead was extracted were completely obstructed upon venogram, and these occlusions were observed in patients with a longer than 3 month indwelling time of the CS lead.[4]

Then, if the occluded vessel is the sole optimal vessel for CS lead re-implantation and the antegrade approach becomes challenging due to extraction-associated occlusion, such as in the present case, the anti-dromic snare technique could be a safe bail-out strategy. The

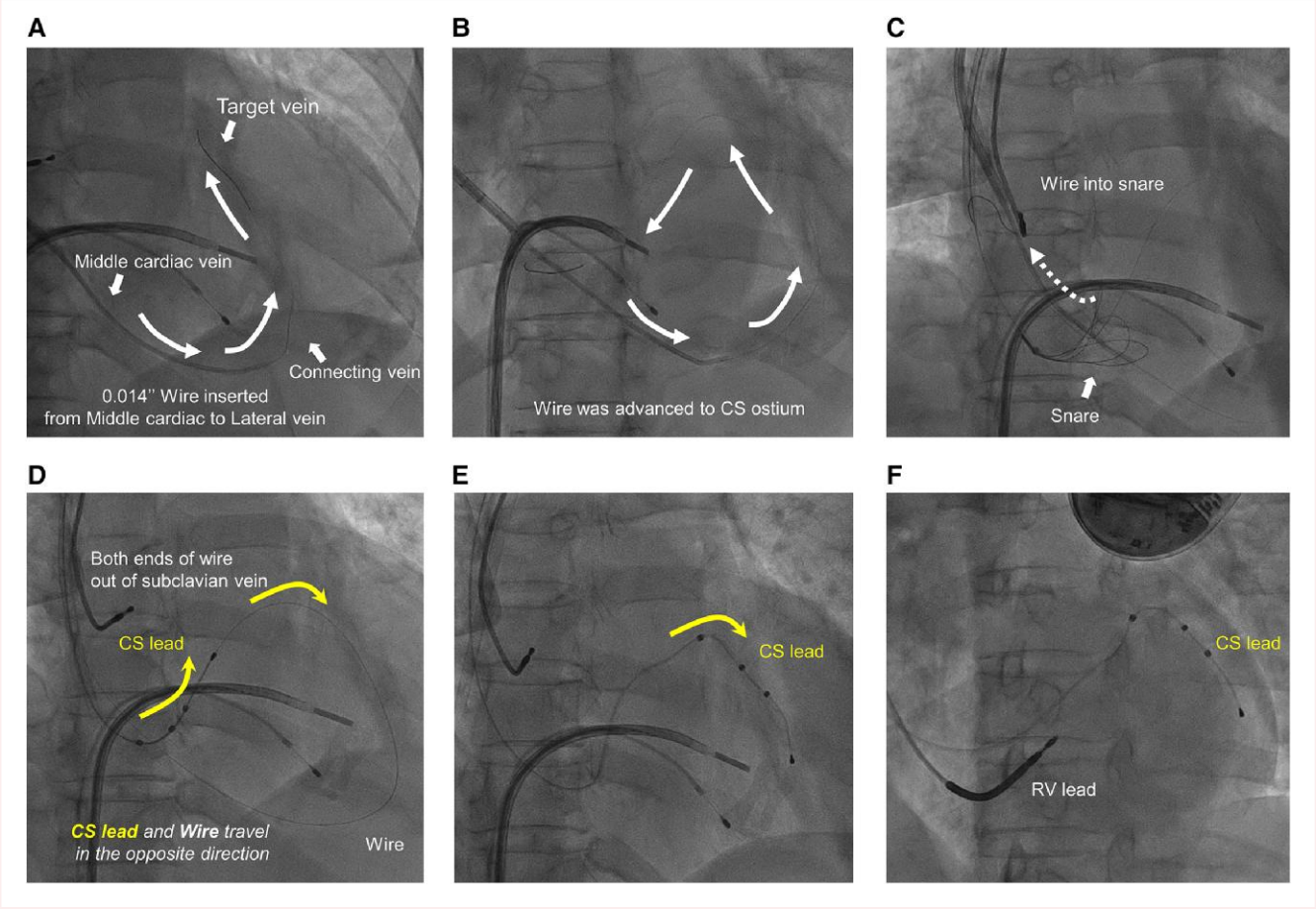


Figure 3 The anti-dromic snare technique. (*A*) A 0.014″ guidewire was inserted into the middle cardiac vein and advanced retrograde into the target lateral vein via the connecting vessel. (*B*) The guidewire was further inserted back into the coronary sinus ostium. (*C*) The distal end of the guidewire was captured around the coronary sinus ostium using a snare. (*D*) The coronary sinus lead was inserted through the distal end of the guidewire and then advanced into the target vein over the guidewire, while both ends of the guidewire were under the control of the operator. (*E*) The coronary sinus lead was implanted into the same target lateral vein in which the extracted old coronary sinus lead was positioned. (*F*) Final separation between the coronary sinus and right ventricle leads was satisfactory in the LAO view. CS, coronary sinus; RV, right ventricle.

anti-dromic snare technique facilitates identification of the true lumen of the target vein using the wire inserted retrograde, avoiding the risk of further dissection of the target vessel by multiple attempts of antegrade wiring. In addition, the veno-venous loop of the wire can provide extra support when re-implanting the CS lead antegrade across the dissection into the proper position (*Figure 3*). There might be concerns about vessel or lead damage while pushing the CS lead into the obstructed vein with excessive force. However, Kim et al. reported that vessel perforation, pericardial effusion, cardiac tamponade, and lead damage did not occur when the snare technique was used.[6] When the snare technique cannot be performed due to a lack of connecting vessels, epicardial lead implantation, or conduction system pacing could be alternative options.[11,12]

Conclusion

When re-implanting a new CS lead into the occluded target vein after extracting an old CS lead with a long dwell time, the anti-dromic snare technique could be a safe and effective bail-out strategy.

Lead author biography

Juwon Kim, MD, works as a clinical assistant professor in cardiology at Samsung Medical Center, Seoul, Korea. His interests are focused on clinical electrophysiology, cardiac implantable electronic devices, and conduction system pacing.

Supplementary material

Supplementary material is available at *European Heart Journal – Case Reports* online.

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Consent: The authors confirm that written consent for submission and publication of this case report including images and associated text has been obtained from the patient in line with COPE guidance.

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Data availability
The data that support the findings of this study are available from the corresponding author upon reasonable request.

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