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Unusual Venous Access for Device Implantation

Authors' Contribution:
Study Design A
Data Collection B
Statistical Analysis C
Data Interpretation D
Manuscript Preparation E
Literature Search F
Funds Collection G

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Case series
Patient: Male, 80 • Female, 67 • Male, 48
Final Diagnosis: Management of difficult venous access for implantable cardiac devices
Symptoms: Heart failure
Medication: —
Clinical Procedure: —
Specialty: Cardiology

Objective: Unusual clinical course
Background: Cardiac implantable electronic devices (CIED) are mainstay therapy for a variety of patients with bradyarrhythmia as well as those at risk of sudden cardiac death and heart failure. At present, commonly used venous access are axillary, cephalic cutdown, and subclavian puncture. However, there are situations when these approaches cannot be employed because cannulation is not possible due to small size, spasm, absence, or occlusion of the vein. One of the alternative approaches is through an internal or external jugular vein. A jugular vein approach can be also used for upgrading CIED knowing that CIED is not commonly associated with venous occlusion.
Case Report: We present 3 cases which used unusual venous access for placement of CIED using a jugular vein approach.
Conclusions: Recognizing patients who have difficult venous access for CIED and using alternative approaches, like a jugular vein approach, for device insertion is important to avoid unnecessary medical and technical complications.

MeSH Keywords: Cardiac Resynchronization Therapy Devices • Defibrillators, Implantable • Vascular Access Devices

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Background

Cardiac implantable electronic devices (CIEDs) are mainstay therapy for a variety of patients with bradyarrhythmia as well as those at risk of sudden cardiac death and heart failure. Although technical progress has been made allowing some devices to be implanted without dwelling intravascular leads (subcutaneous defibrillator and leadless single chamber pacemaker), the majority of CIEDs will still require vascular access for lead placement. About one million patients worldwide receive CIEDs annually [1]. Before 1979, cephalic cutdown was usually used for transvenous pacing [2]. The dexterity of an operator to obtain the cephalic vein access was essential for this procedure because it demanded deep dissection. At present, commonly used venous access approaches are axillary, cephalic cutdown, and subclavian puncture [2,3]. However, there are situations when these approaches cannot be employed because cannulation is not possible due to small size, spasm, absence or occlusion of the vein. These can be particularly challenging in patients with prior device implantation with a crowded or occluded vein, and patients with prior vein manipulation, vein access, or stenting. Other veins can be used for lead placement, but they pose unique challenges. Alternative approaches in such situations include dilatation of a chronically occluded veins, venoplasty, femoral vein, or surgical approach. Here we are presenting 3 cases where we used unusual venous access for placement of CIED, using a jugular vein approach.

Case Reports

Case 1

An 80-year-old male patient with a past medical history of chronic heart failure with reduced ejection fraction, an implantable dual chamber cardioverter defibrillator (ICD), hypertension, and chronic kidney disease was admitted because of an episode of appropriate ICD shock. The ICD was implanted in 2007. Battery depletion was evident on the interrogation as well as markedly elevated right ventricular pacing threshold. During his hospitalization, echocardiogram revealed an ejection fraction of 25% and left bundle branch block (LBBB) with QRS duration of 152 ms. The decision was made to proceed with an upgrade to the biventricular ICD and RV lead revision.

Venography of the right and left upper extremities was performed, which revealed bilateral total occlusion at the level of the subclavian veins (Figure 1A). Right internal jugular vein access was considered; however, this access failed even with the use of ultrasonography guidance. External jugular vein access was contemplated as a last resort. The right external jugular vein was accessed with Seldinger technique and by using ultrasound guidance; and new right ventricular (RV) and the coronary sinus (CS) leads were inserted successfully. The leads were tunneled to the previous left subcutaneous pocket (Figure 1B). The old ICD device was explanted, and a new biventricular ICD device was implanted. The procedure was performed successfully without any complication.

Case 2

A 67-year-old female patient with a past medical history of chronic heart failure with reduced ejection fraction, with implanted ICD (Figure 2A), permanent atrial fibrillation, end-stage renal disease on hemodialysis, and type 2 diabetes mellitus was admitted due to acute exacerbation of heart failure. Electrocardiogram (ECG) showed LBBB. Transthoracic echocardiogram revealed the ejection fraction of 30–35%; therefore, the decision was made to proceed with upgrade to resynchronization system.

The right internal jugular vein was used because of the occlusion of right and left subclavian veins. Using posterior approach and Seldinger technique under ultrasound guidance, the right internal jugular vein was successfully cannulated. A CS lead was inserted with satisfactory sensing and pacing threshold, and the parameters were confirmed. Subsequently, the CS lead was tunneled to the left subcutaneous pocket. A new biventricular (BIV)-ICD device was implanted. The patient tolerated the procedure very well and recovery was uneventful (Figure 2B, 2C).

Case 3

A 48-year-old male patient with a past medical history of chronic heart failure with reduced ejection fraction, with implanted single chamber ICD, stroke with residual right hemiparesis, and multiple gunshot wound that led to exploratory laparotomy with partial colon resection was admitted with acute exacerbation of congestive heart failure. Medical treatment was optimized; however, there was no improvement in his condition. Given the presence of LBBB and ejection fraction of 10% on echocardiography, a decision was made to proceed with an upgrade to biventricular defibrillator.

Right and left upper extremity venography was performed, which revealed a severe subclavian stenosis and a patent cephalic vein (Figure 3A). Left cephalic vein access was obtained with a cutdown technique. However, the glide wire did not advance through the cephalic vein, and repeat venography revealed total occlusion of the subclavian veins (Figure 3B). Using ultrasonography guidance, the right internal jugular vein was utilized for lead placement. The vessel was accessed with a single puncture. Right atrial and CS leads were inserted and tunneled to the right infraclavicular pocket. A biventricular ICD

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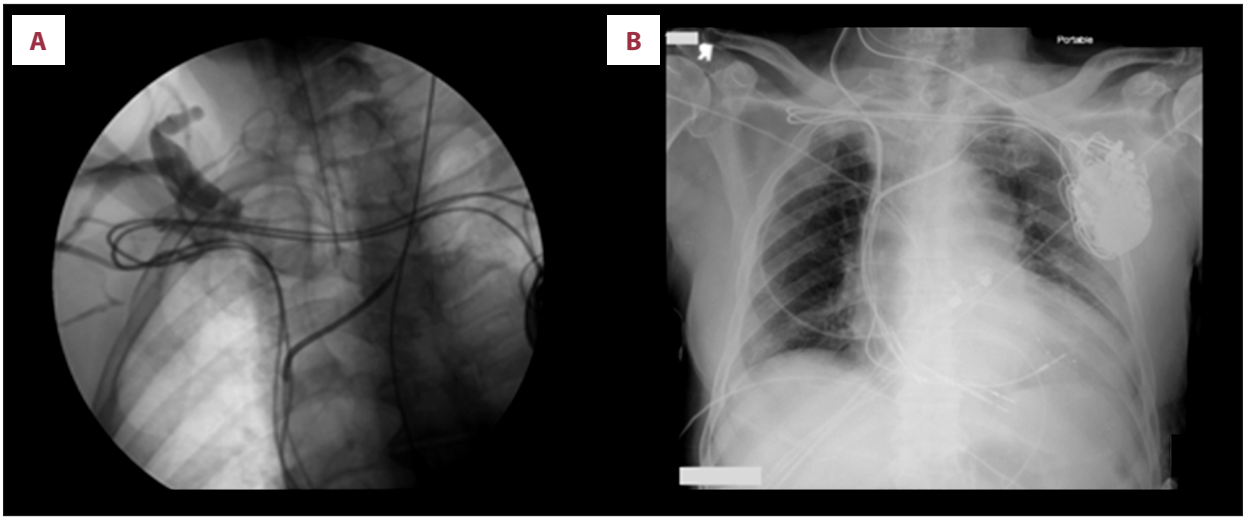

Figure 1. Case 1: (**A**) Venography of the right upper extremity showing total occlusion of subclavian vein. (**B**) Chest x-ray posteroanterior (PA) view: Biventricular pacemaker placed via right external jugular vein with right ventricle (RV) and coronary sinus (CS) leads tunneled to the left subclavian pocket.

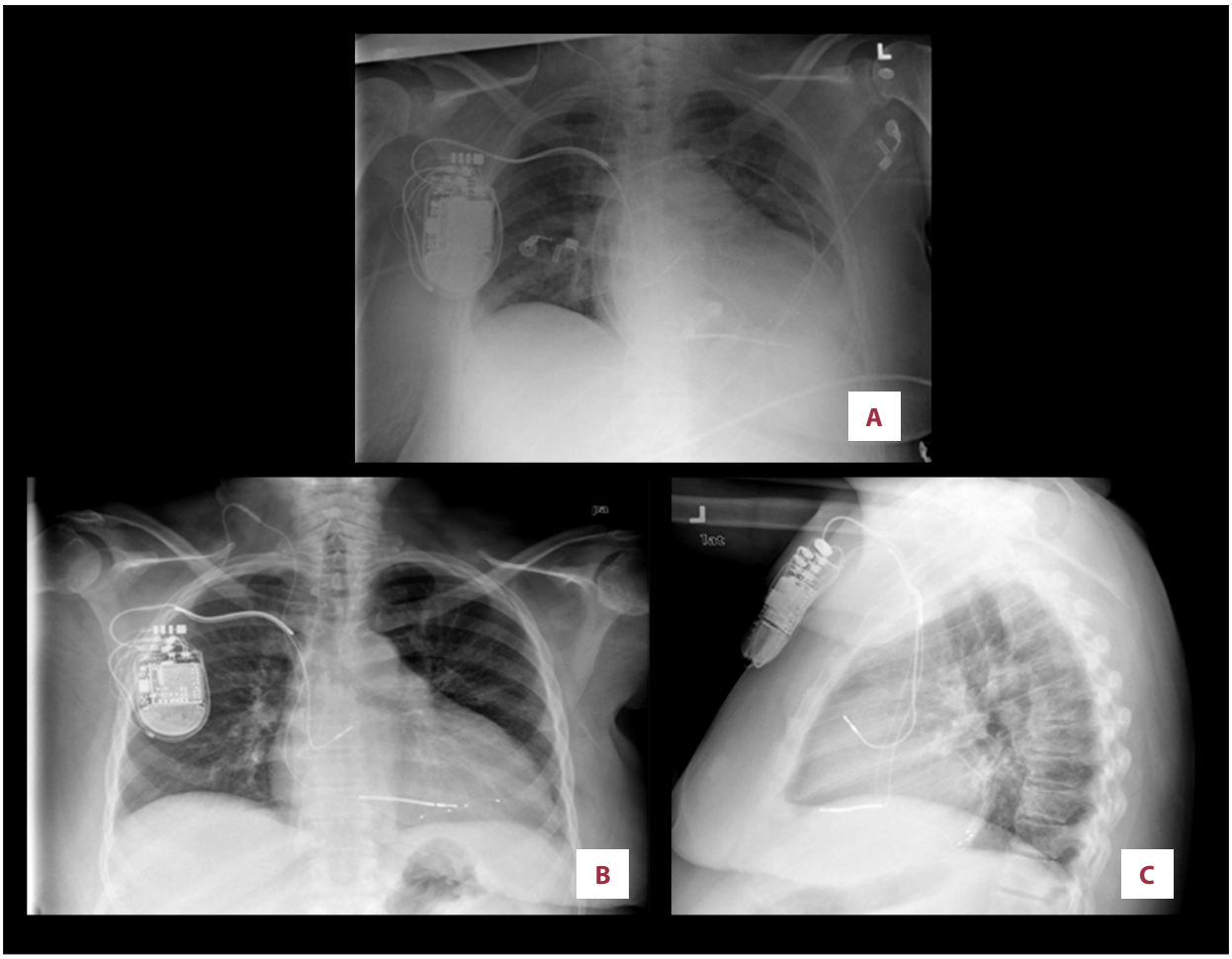

Figure 2. Case 2: (**A**) Dual chamber ICD before the upgrade; (**B, C**) Chest x-ray posteroanterior (PA) and lateral view; biventricular ICD in place with the left ventricular lead inserted via right internal jugular vein.

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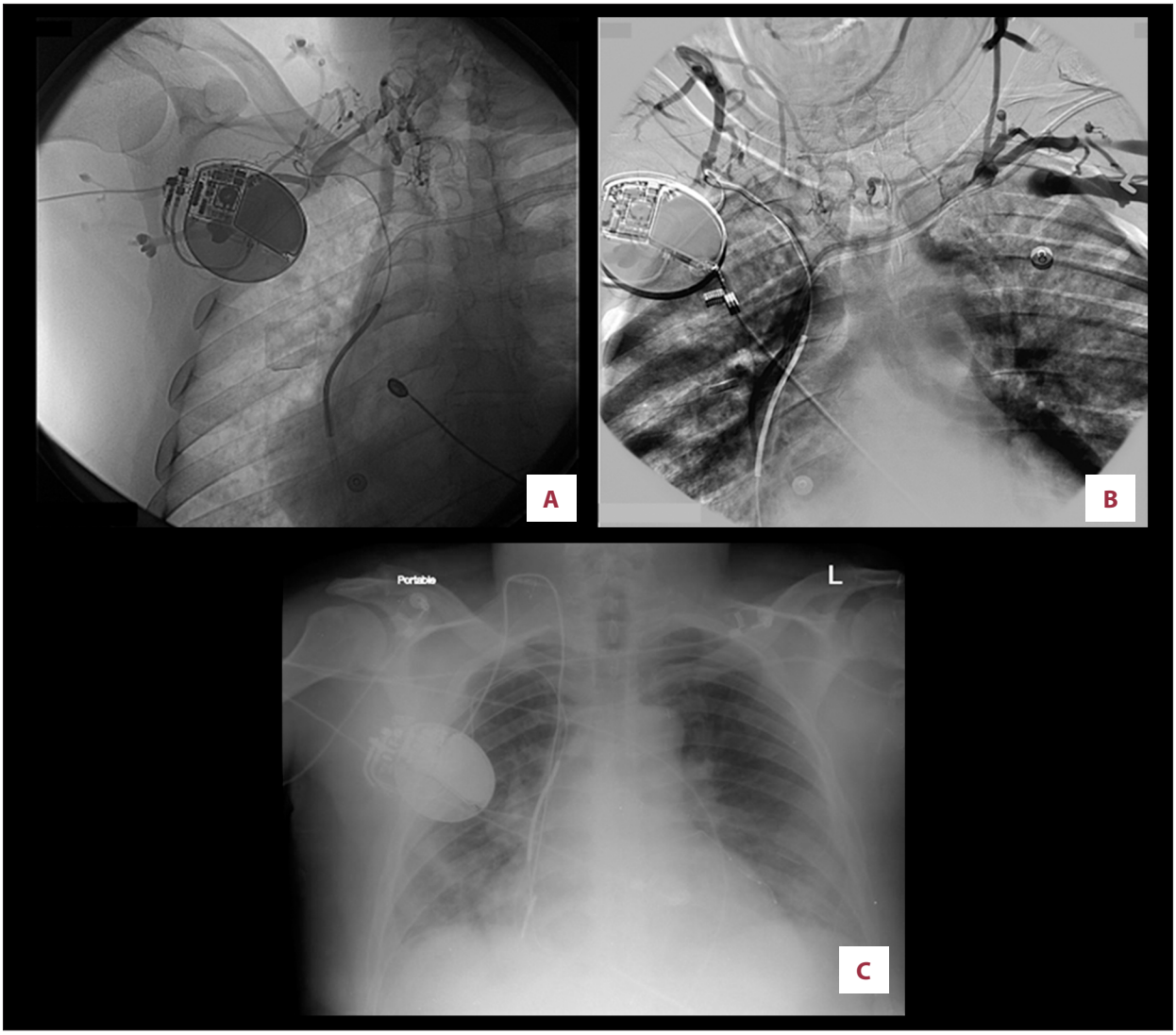

Figure 3. Case 3: (**A**) Venography of right upper extremity showing severe stenosis of the right and left subclavian veins. Note portacath access port present on the left. (**B**) Repeat venography revealed total occlusion of the subclavian veins. (C) Chest x-ray posteroanterior (PA) view: biventricular defibrillator placed via right internal jugular vein with right atrial (RA) and coronary sinus (CS) leads.

device was attached to the leads and implanted (Figure 3C). The patient tolerated the procedure well and no complications were encountered.

Discussion

We have presented a series of cases to substantiate the viability of the external and internal jugular veins in biventricular ICD implantation. Venous occlusion is common in patients with implanted pacing devices particularly those with multiple comorbidities. The incidence of asymptomatic high-grade stenosis-occlusion is 20% to 30% and of symptomatic cases is 1% to 3% [4]. All of our patients had right and left subclavian occlusions. The jugular veins are captivating alternative access sites. In an external and internal jugular approach, incisions above the clavicle and between posterior border of the sternocleidomastoid muscle and anterior trapezius muscle are necessary. Seldinger technique is usually used for the lead insertion. The right external jugular vein is commonly the preferred access because it is less tortuous. Its size should easily accommodate contemporaneous pacing leads [5].

During a jugular venous approach, manipulation of the guide sheath, diagnostic catheter, occlusion balloon or pacing wire may cause the coronary sinus to be dissected or perforated, which may result in minor asymptomatic staining of the coronary sinus and in rare cases, may result in pericardial effusions

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and tamponade [6]. In the case of an external jugular vein, like the cephalic vein, it has no significant complications as bleeding, air embolism, and pneumothorax [6,7]. However, there is a dislodgment of the endocardial electrode with the use of external jugular vein, which would be eliminated using the internal jugular vein. The internal jugular vein also has the advantages of being readily accessible, passing the catheter electrode easily through the vein, and decreasing motion on the catheter electrode [8].

CIED implantation is associated with an increased incidence of venous occlusion around the site of intervention. The risk varies between 9–26% of the cases, with either partial or complete occlusion, and it is higher in patients with chronic kidney disease and end stage renal disease who are on hemodialysis [9–11]. Therefore, the need for different approaches in such cases is imminent. There are multiple alternative approaches in cases with total axillary and subclavian veins occlusion. McCotter et al. [12] described an alternative approach through advancing a guide wire across the occluded segment then dilatation or venoplasty performed. Alternatively, inside-out central venous access can be obtained via femoral approach. Through femoral vein, a catheter can be advanced crossing right atrial cavity to reach the proximal point of the occluded vein. Then, the occluded segment is accessed with a guided needle which runs through tissue planes inside or outside the vessel. A guide wire needle is advanced until it penetrates the skin at subclavian area. Using the guide wire, a rigid dilator is advanced through the occluded vein segment. Then the leads are advanced through the created tunnel [13]. Gonna et al. [14] described another approach for left ventricular lead placement percutaneously using femoral access, by pulling the leads through until it reaches the pectoral area. Ultrasound-guided vascular access is increasingly being used and reported, with lower risk of complications, lead damage, and minimizing the need for radiation and ipsilateral venous access [15]. Recently, using a leadless intracardiac pacing system was shown to be safe and effective [16,17]. However, it cannot be used for cardiac resynchronization therapy. On the other hand, surgical placement of the leads is an alternative, however, it is more invasive.

The disadvantage of using jugular veins is the increased lead mobility and the exposure to mechanical trauma. Moreover, this approach requires lead tunneling, including tunneling above the clavicle which exposes the leads to not only repetitive flexion but also possible external compression. Nevertheless, in cases where standard access sites are not possible, the jugular veins should be considered.

Conclusions

Recognizing patients with difficult venous access for CIED and using alternative approaches, like a jugular vein approach, for device insertion is important to avoid unnecessary medical and technical complications.

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