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CASE REPORT

INTERMEDIATE

CLINICAL CASE

Left Bundle Branch Area Pacing From a Femoral Approach in a Patient Without Superior Access

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ABSTRACT

Limited venous access and lateral left ventricular scar are impediments to traditional cardiac resynchronization therapy. We present a case where placement of an implantable cardioverter-defibrillator from a femoral approach while using left bundle branch area pacing led to clinical improvement. (**Level of Difficulty: Intermediate.**) (J Am Coll Cardiol Case Rep 2023;9:101748) © 2023 The Authors. Published by Elsevier on behalf of the American College of Cardiology Foundation. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).

HISTORY OF PRESENTATION

A 64-year-old man with a mixed cardiomyopathy, left bundle branch block, ventricular tachycardia, and upper and lower deep vein thrombosis was admitted for progressive heart failure.

LEARNING OBJECTIVES

- To identify a patient who would benefit from conduction system pacing.
- To appreciate the unique challenges and solutions of performing conduction system pacing from a femoral approach.

PAST MEDICAL HISTORY

The patient earlier underwent failed attempts to place a biventricular implantable cardioverter-defibrillator (BiV ICD) from above and below because of complete occlusion of the bilateral thoracic veins (**Figure 1**) and the inferior vena cava (**Figure 2A**), respectively. He previously underwent left ventricular (LV) pseudoaneurysm repair, with a recent left heart catheterization showing stable coronary disease. He was deemed a poor surgical candidate for a completely epicardial pacing system and was unable to be discharged from the hospital because of his tenuous clinical status. The patient developed complete heart block and underwent

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ABBREVIATIONS AND ACRONYMS

BiV = biventricular

CS = coronary sinus

ICD = implantable cardioverter-defibrillator

LBBAP = left bundle branch area pacing

LV = left ventricular

RV = right ventricle

venoplasty of the inferior vena cava (Figures 2B to 2D) followed by implantation of a leadless right ventricular (RV) pacemaker (Micra AV, Medtronic), further worsening his heart failure and requiring initiation of intravenous milrinone.

DIFFERENTIAL DIAGNOSIS

The clinical history, presentation, and timing of his symptoms suggest that his heart failure was attributable to multiple etiologies. The differential diagnosis includes ischemic cardiomyopathy, ventricular dyssynchrony caused by RV pacing, lack of stable atrioventricular synchrony caused by a leadless permanent pacemaker, and progression of nonischemic cardiomyopathy from other causes.

INVESTIGATIONS

Echocardiography showed an LV ejection fraction of 19% with severe functional mitral regurgitation. Computed tomography showed a partially repaired and calcified lateral LV pseudoaneurysm measuring 6.0 × 2.3 cm (Figure 3). The patient's creatinine level had increased to 3.1 mg/dL.

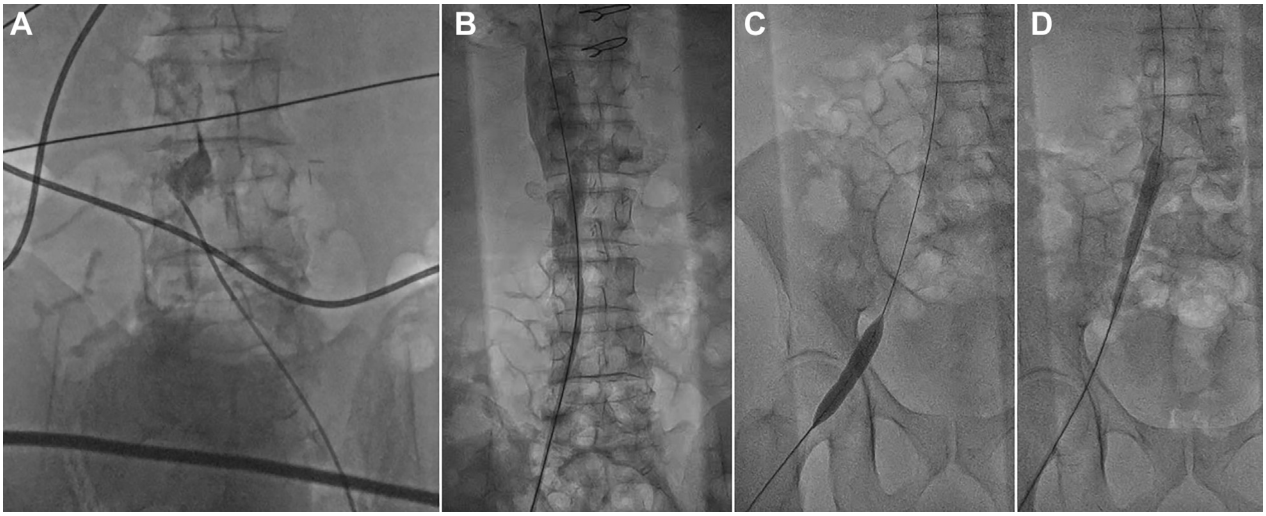
MANAGEMENT

The patient was referred for implantation of a femoral BiV ICD using left bundle branch area pacing (LBBAP). He was placed under general anesthesia, and his groin was prepped to the level of the umbilicus. Right common femoral venous access was obtained from the inguinal crease, and 2 wires were placed (Figure 4A). A 4-cm horizontal incision was made 1.5 cm above the inguinal crease, and the wires were grasped and pulled through the incision (Figure 4B). A 9-F sheath was inserted followed by a coronary sinus (CS) catheter (Attain Command Extended Hook Extra Large, Medtronic) that was guided to the RV (Figure 5A). A 130° inner catheter (Attain Select II, Medtronic) was placed within the outer sheath anterior and inferior to the His bundle and positioned perpendicular to the ventricular septum (Figures 5B and 5C). A pacing lead (3830 SelectSecure, 74 cm, Medtronic) was inserted, and to gain more usable lead length, the suture sleeve was removed, and 2 cm of the proximal end of the inner sheath was cut (Figures 4C and 4D). The lead was screwed into the RV septum until fixation beats were appreciated (Figures 5D to 5G). The unipolar QRS complex morphology showed a qR pattern in V_1 with a width of 222 ms and an LV activation time of 105 ms in V_6 (Figure 6), a pacing threshold of 0.75 V at 0.5 ms, and sensing of 12 mV. In bipolar configuration, anodal capture resulted in a QRS interval of 196 ms with an anodal threshold of 2.5 V at 0.5 ms and a cathodal threshold of 0.75 V at 0.4 ms. The sheaths were split (Figure 5H), and a new suture sleeve was fixated. The second access point was "double wired," and a CS cannulation catheter (Worley Jumbo, Merit Medical) was placed. A dual-coil ICD lead (6947 Quattro MRI, 65 cm, Medtronic) was inserted as close to the apex as possible and ultimately secured to the mid septum (Figure 5I) with excellent parameters. A 7-F sheath was placed over the final wire, and an atrial lead (5076 CapsureFix Novus MRI, 85 cm, Medtronic) was secured to the right atrial appendage with excellent parameters (Figure 5I). A second anchoring suture sleeve was placed on the LBBAP and right atrial leads in a "U-loop" configuration (the RV lead did not have sufficient length) and was directed toward the pocket to provide further stability (Figure 7A).

A subcutaneous pocket was created (Figure 7B), and the generator was placed superior to the suture sleeves and secured with a silk tie (Figure 7C and D). The pocket was irrigated, and an absorbable antibiotic envelope (TYRX, Medtronic) was placed before closure with 2 layers of absorbable sutures

FIGURE 1 Composite Image of Peripheral Contrast Venography Showing Bilateral Occlusions

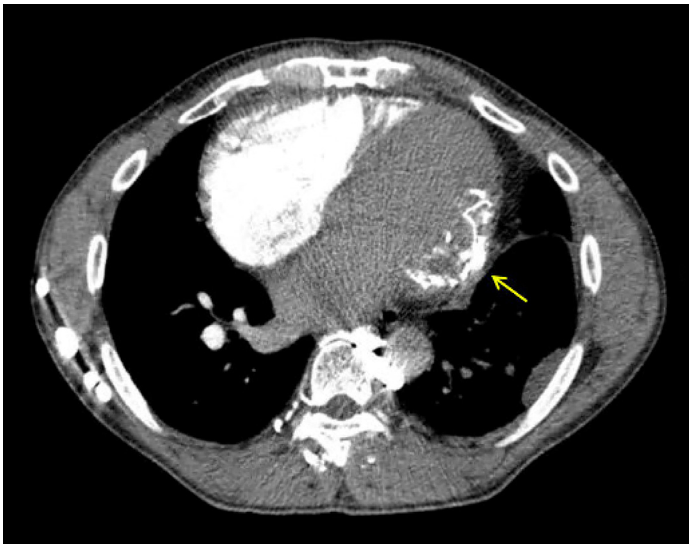
FIGURE 2 **Percutaneous Recanalization of the Inferior Vena Cava**



(A) Contrast venography shows complete occlusion of the inferior vena cava. **(B)** The occlusion has been crossed with a wire. **(C, D)** Successful venoplasty.

and medical adhesive (DERMABOND, Ethibond) (Figure 7E). Upon initiation of cardiac resynchronization therapy (Figure 6), the systolic blood pressure immediately increased by 20 mm Hg, and milrinone was able to be decreased on postoperative day 3 with improvement of the patient's creatinine level from 3.1 mg/dL to 1.7 mg/dL at discharge.

FIGURE 3 **Computed Tomography of the Chest Showing Left Ventricular Myocardial Calcification**



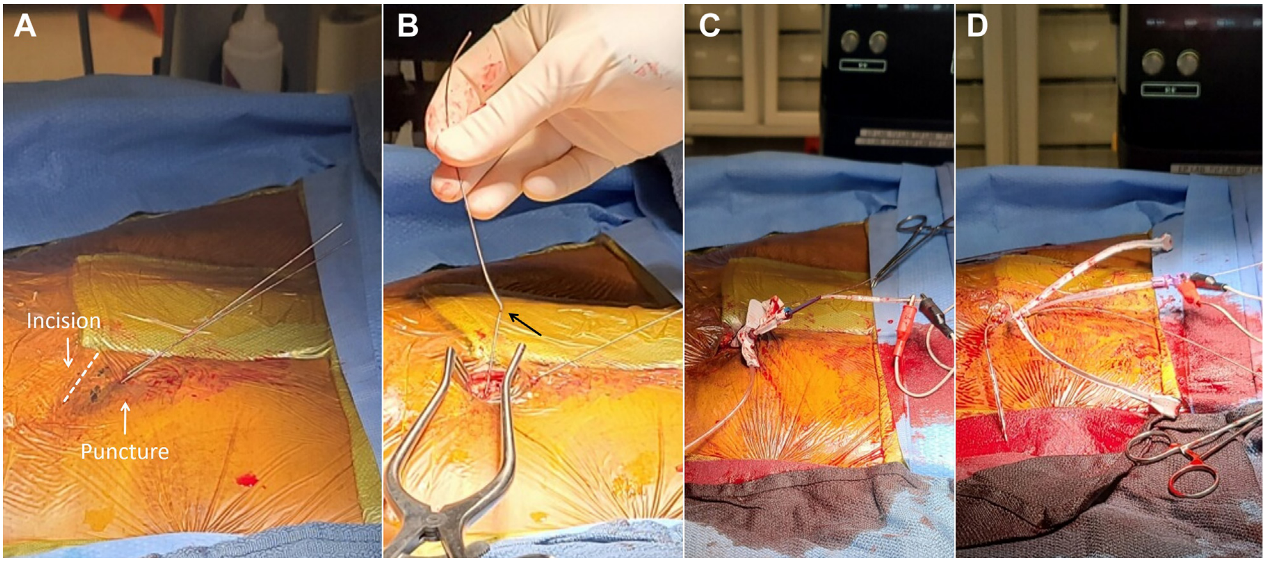
Note the associated pseudoaneurysm measuring 6.0 × 2.3 cm **(yellow arrow)**.

DISCUSSION

LBBAP is an emerging alternative to traditional cardiac resynchronization therapy,[1] with this case the first to our knowledge from a femoral approach. Femoral cardiac implantable electronic device implantation has been previously described[2,3] but has been used sparingly because of surgical and leadless options. Traditional CS leads from a femoral route have also been described[4]; however, this strategy was unappealing in our patient because of the presence of a large lateral LV scar.

The risk of lead dislodgement from a femoral approach was shown to be high in 2 prior case series.[5,6] We left significant lead slack to reduce the

FIGURE 4 **Femoral Surgical Procedure**



(A) Venous puncture within the inguinal crease followed by an incision 1 to 2 cm superior. **(B)** Wire is grasped **(black arrow)** and pulled through the pocket. **(C)** Lead tested through an outer coronary sinus and modified inner coronary sinus sheath. **(D)** Right ventricular delivery sheath is split and removed.

chance of dislodgement, including a “U-loop” anchoring suture above the inguinal crease to prevent movement. The defibrillation threshold was not tested because of the patient’s tenuous hemodynamics and is thus unknown. Programming with a “cold can” was used to optimize the shock vector, but the effects of other configurations are not clear, including the use of an abdominal “hot can” with or without the use of a subcutaneous coil.[7] Importantly, the patient’s height of 66 inches likely facilitated the use of tools that might not be amenable to taller patients.

FOLLOW-UP

Chest, abdomen, and pelvis x-ray films showed the device to be in a stable position (Figure 8). Unfortunately, the patient died suddenly at home 3 months after the procedure with no interrogation or autopsy data available for review.

CONCLUSIONS

BiV ICD implantation with LBBAP lead placement is feasible for patients who do not have upper extremity access.

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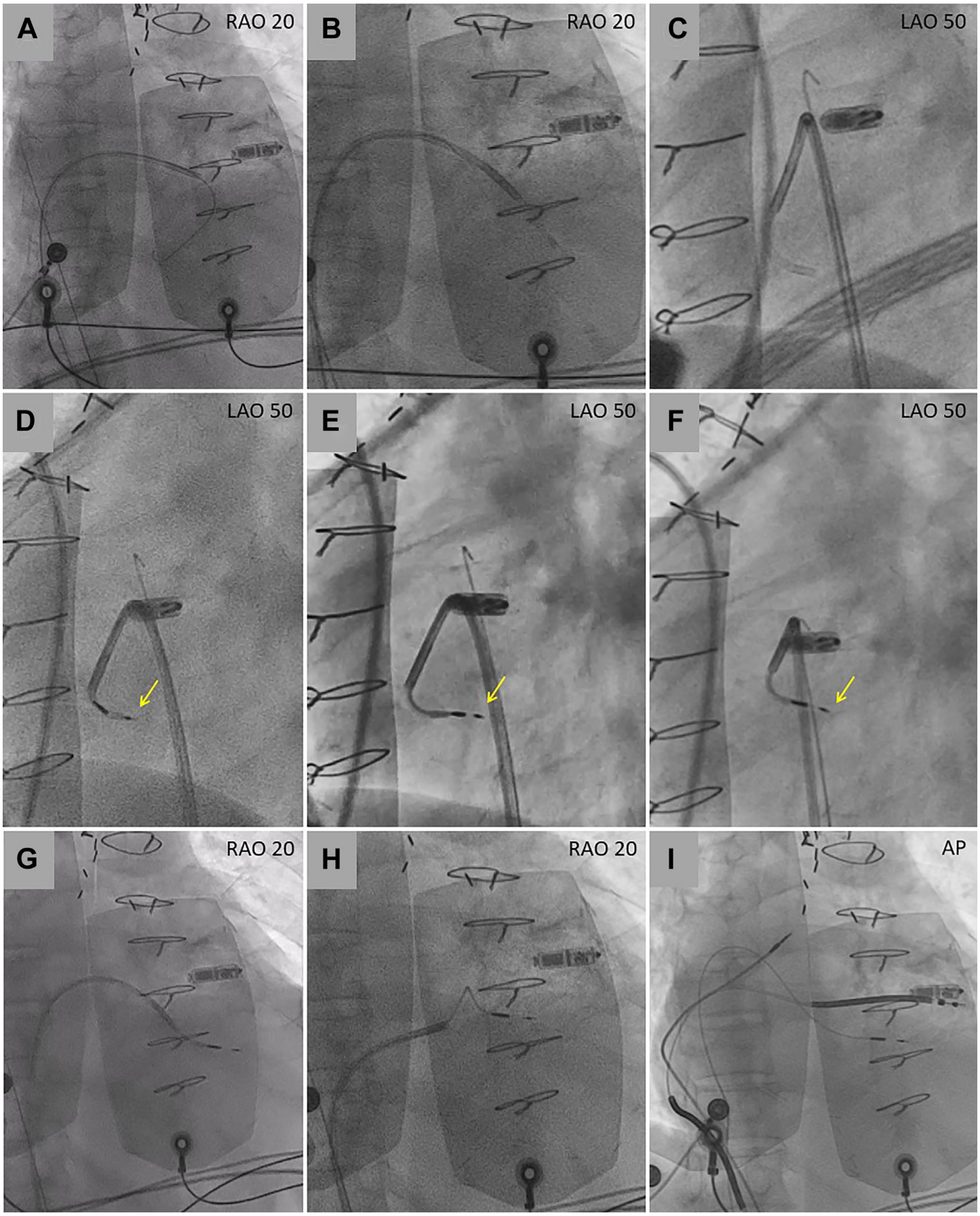
FIGURE 5 **Biventricular Implantable Cardioverter-Defibrillator Implantation From a Femoral Access Point Using Left Bundle Branch Area Pacing**



(A) A coronary sinus outer sheath is guided to the right ventricle **(B)** RAO and **(C)** LAO fluoroscopic angulations show the inner within the outer coronary sinus sheath positioned perpendicular to the septum. **(D to G)** The left bundle branch area pacing lead is screwed into the right ventricular septum. **(H)** The outer sheath is prepared to be slit after the inner sheath was removed. **(I)** Final biventricular implantable cardioverter-defibrillator system. AP = anterior posterior; LAO = left anterior oblique; RAO = right anterior oblique.

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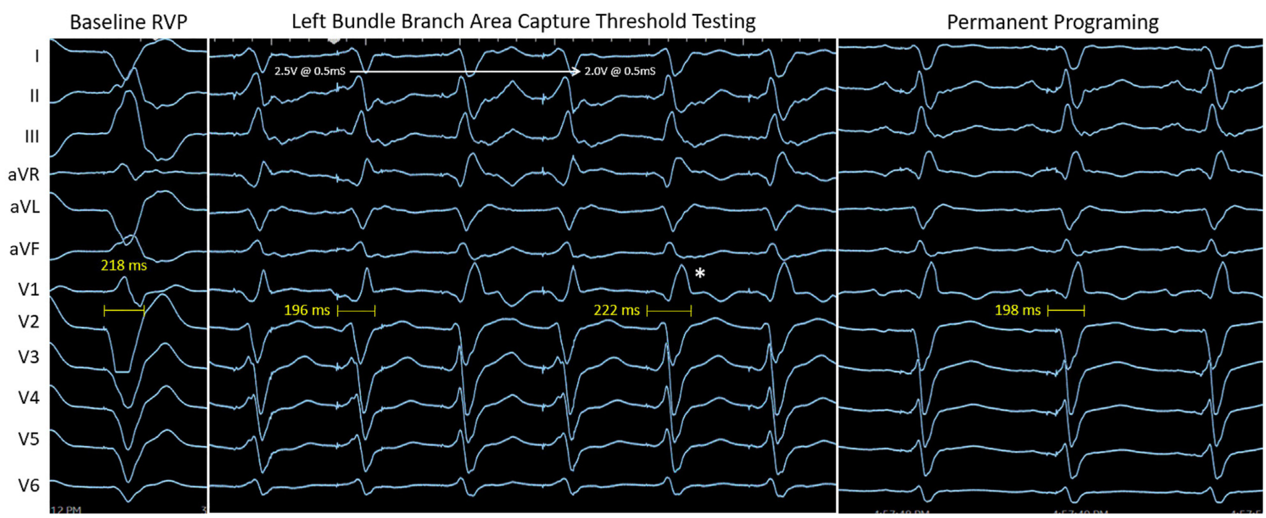
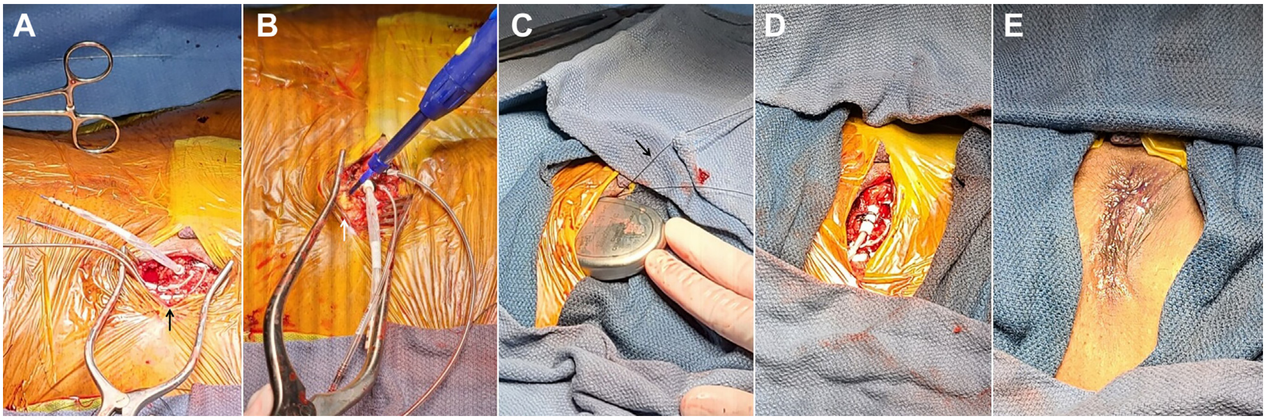
FIGURE 6 A 12-lead electrocardiogram of various pacing configurations



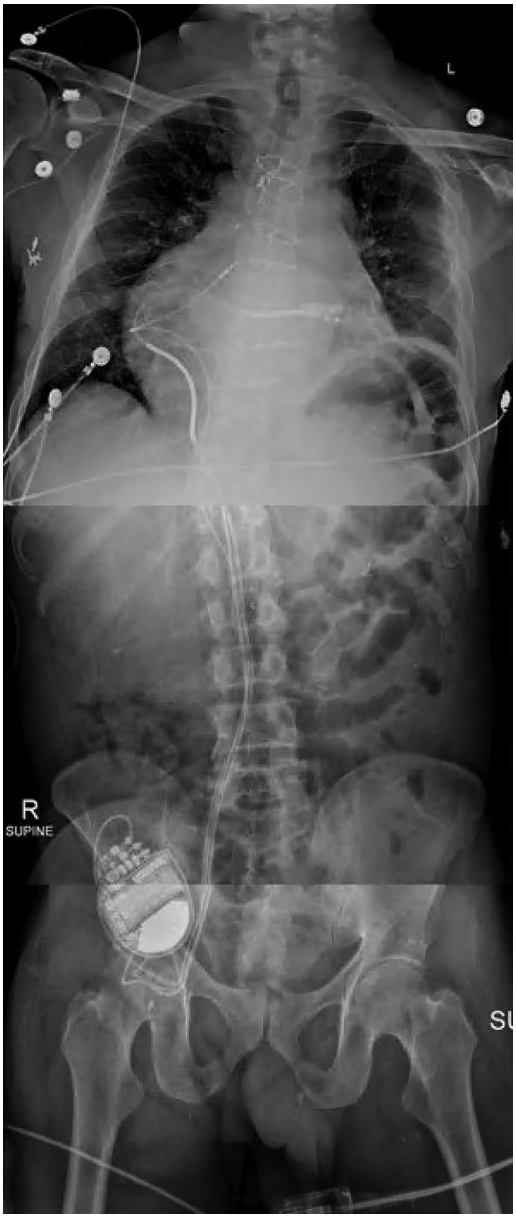
(Left) Baseline right ventricular pacing (RVP). **(Middle)** Left bundle branch area pacing threshold testing with loss of anodal capture **(asterisk)** and widening of the QRS interval. **(Right)** The resultant QRS from fusion between LBBAP (40 ms early) and RVP.

FIGURE 7 Lead stabilization and pocket creation



(A) A second suture sleeve was placed in a "U-loop" fashion to reduce lead tension **(black arrow)**. Note the that the implantable cardioverter-defibrillator lead was not long enough to place a second suture. **(B)** The subcutaneous plane was identified **(white arrow)**, and **(C)** the generator was placed. A nonabsorbable suture **(black arrow)** secures the generator to the pocket floor. **(D)** The generator sits superior to the lead suture sleeves. **(E)** The pocket is closed with absorbable suture and medical adhesive.

FIGURE 8 Composite Chest, Abdominal, and Pelvic Radiograph Shows Final Lead and Generator Positions



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KEY WORDS cardiac resynchronization therapy, femoral device, left bundle branch area pacing, left bundle branch block, venous occlusion