

RESEARCH LETTER

Left bundle branch area pacing guided by intracardiac echocardiography imaging



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Left bundle branch area pacing (LBBAP) has been increasingly adopted for bradycardia as well as cardiac resynchronization therapy indications owing to its physiological nature. Contrast injection can help with assessing the depth of the lead in the septum and ruling out interventricular septal vascular injury. There are limited data on the use of intracardiac echocardiography (ICE) imaging in LBBAP procedures. Therefore, we aimed to assess the procedural workflow and outcomes of ICE-guided LBBAP using a venous access obtained through the device pocket for ICE imaging.

The research reported in this article adhered to the Helsinki Declaration guidelines. The study was approved by the Mayo Clinic Institutional Review Board. Only patients who had previously consented to use their records for research purposes were included. The study included 7 patients with bradycardia pacing indications who underwent ICE-guided LBBAP between February 2023 and June 2023. This cohort was compared in a 1:1 ratio with 7 patients who underwent LBBAP without ICE guidance. Matching criteria included sex, baseline left ventricular ejection fraction, and type of device implant. The 8-F AcuNav ICE catheter (Biosense Webster, Irvine, CA) was introduced through an 8-F venous access obtained through the device pocket. Of the 7 patients with ICE-guided LBBAP, 2 underwent single-chamber pacemaker implantation. In these patients, 2 venous accesses were obtained: 1 for LBBAP lead placement and 1 for ICE imaging. In the remaining 5 patients, dual-chamber pacemaker implantation was performed with 2 venous accesses for LBBAP and atrial pacing. The venous access obtained for atrial lead placement was first used for ICE imaging. The ICE catheter was advanced into the right ventricle, and a 4-chamber view displaying the interventricular septum was obtained. This ICE view was maintained as the lead was screwed into the septum a few centimeters distal to the tricuspid valve leaflet insertion. The final lead position was accepted on the basis of previously published criteria.¹

KEY FINDINGS

- Intracardiac echocardiography (ICE) imaging is a complementary tool to fluoroscopy and electrograms that can guide lead placement in left bundle branch area pacing (LBBAP), particularly in patients with challenging anatomy.
- Delivery of the ICE catheter is feasible and safe through the subclavian venous access in the device pocket.
- In this non-randomized study, there was no difference in the success rate of LBBAP and need for lead repositioning between the ICE and the non-ICE group.

The baseline patient characteristics and procedural details are summarized in [Figure 1](#). The median (interquartile range) age at the time of pacemaker implantation was 71 (66–78) years, and 12 patients (85.7%) were male. Most patients had underlying conduction abnormalities. The non-deflectable C-315 His sheath (Medtronic, Minneapolis, MN) was the most commonly used delivery sheath. There was no significant difference in the success rate and need for lead repositioning between the ICE and the non-ICE group (success rate: 6 (85.7%) vs 6 (85.7%); $P = .99$ and lead repositioning: 2 (28.6%) vs 1 (14.3%); $P = .99$). The electrical characteristics of LBBAP were similar between the 2 groups, including mean paced QRS duration (130 ms vs 120 ms; $P = .37$) and mean peak left ventricular activation time (80 ms vs 80 ms; $P = .85$). In the ICE group, lead depth in the septum was assessed using both contrast injection and ICE imaging in 6 patients (85.7%). The mean lead depth was 9.95 ± 2.9 mm using sheath angiography vs 11.17 ± 2.5 mm using ICE imaging ($P = .48$). In patients with left bundle branch (LBB) capture ($n = 6$), the final position of the lead tip was deep septal in 3 (50%) patients and along the left side of the septum in 3 (50%) patients. There were no septal perforation or bleeding complications in any of the patients in this series. Although the duration of the procedure was similar between the 2 groups, the duration of fluoroscopy was longer in the ICE group because of more challenging anatomy in this group (12.6 minutes vs 8.2 minutes; $P = .02$).

KEYWORDS Conduction system pacing; Imaging; Intracardiac echocardiography; Left bundle branch area pacing; Outcomes (Heart Rhythm 02 2024;5:842–843)

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Baseline Patient Characteristics			
	ICE Group (n=7)	Non-ICE Group (n=7)	P value
Age (yrs)	76 (65, 80)	68 (66, 75)	0.90
Male sex, n (%)	6 (85.7%)	6 (85.7%)	1.00
Conduction disease abnormalities, n (%)	5 (71.4%)	4 (57.1%)	1.00
LVEF (%)	50 (44, 62)	55 (52.5, 57)	0.61
Procedural Details			
	ICE Group (n=7)	Non-ICE Group (n=7)	P value
Procedure time (min)	112.5 (109.5, 135)	92 (85, 111.5)	0.10
Fluoroscopy time (min)	12.6 (11.7, 13.7)	8.2 (7.4, 10.5)	0.02*
Lead repositioning, n (%)	2 (28.6%)	1 (14.3%)	1.00
LBB capture, n (%)	6 (85.7%)	6 (85.7%)	1.00
Paced QRS duration (ms)	130 (120, 137.5)	120 (115, 132)	0.37
Peak LVAT (ms)	80 (73, 81)	80 (78.5, 80)	0.85

Case Example

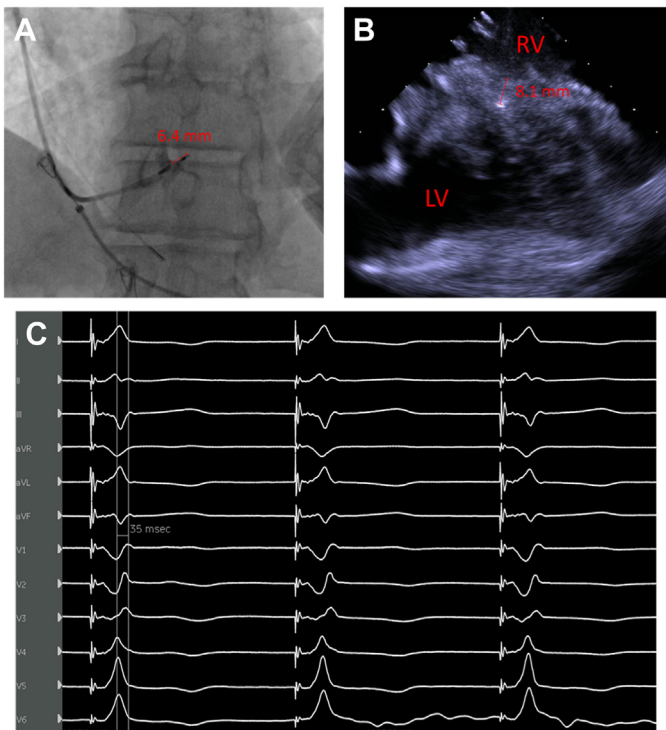


Figure 1 Baseline patient characteristics and procedural details. (A) Left anterior oblique view on fluoroscopy and (B) ICE imaging showing lead depth across the septum. C: Twelve-lead electrocardiogram of paced QRS morphology with a terminal r wave in lead V₁ and a V₆–V₁ interpeak interval of 35 ms. ICE = intracardiac echocardiography; LBB = left bundle branch; LV = left ventricle; LVAT = left ventricular activation time; LVEF = left ventricular ejection fraction; RV = right ventricle.

A comprehensive imaging evaluation in LBBAP procedures using ICE imaging is valuable for several reasons including assessment of the distance between the target site for pacing and the tricuspid valve annulus, direct visualization of the lead course through the septum, and continuous monitoring for potential complications including septal perforation and tricuspid valve leaflet impingement. To improve the procedural workflow, our case series illustrate the feasibility of delivering the ICE catheter through a venous access obtained through the device pocket. In patients receiving dual-chamber or cardiac resynchronization therapy device implantation, the venous access obtained for atrial lead placement can be first used for ICE imaging. In previous reports of ICE-guided LBBAP, delivery of the ICE catheter was through a femoral venous access.² Interestingly, capture of the LBB in some patients in our case series did not require advancement of the lead tip to the left septal surface, and a deep septal position was sufficient. This highlights the extensive and variable branching pattern and arborization of the LBB and/or the ability to capture the LBB at a distance even if the lead tip is not at the left septal surface.

In conclusion, ICE imaging is a complementary tool to fluoroscopy and electrograms that can guide lead placement and reduce complications, particularly in patients with challenging anatomy. Delivery of the ICE catheter is feasible through the device pocket.

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Patient Consent: Only patients who had previously consented to use their records for research purposes were included.

Ethics Statement: The research reported in this article adhered to the Helsinki Declaration guidelines. The study was approved by the Mayo Clinic Institutional Review Board.

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