Annals of Clinical Case Reports

Case Report
Published: 28 Jan, 2025

Extraction of Micra Leadless Pacemaker and Upgradation of Pacing-Induced Cardiomyopathy: A Case Report

Ying Zhang[1#], Ke Li[1#], Ao Li Chen[1], Min Li[1], Wei Yang[1], Xueying Chen[2] and Zongjun Liu[2]**

[1]Department of Cardiology, The Shanghai Putuo District Central Hospital, Hospital of Shanghai University of Traditional Chinese Medicine, China

[2]Department of Cardiology, Zhongshan Hospital of Fudan University, Shanghai Institute of Cardiovascular Diseases, National Clinical Research Centre for Interventional Medicine, Shanghai, China

[#]Both authors equally contributed to the study

Abstract

Pacing-induced cardiomyopathy (PICM) has been reported to be a major contributor to decreased left ventricular ejection fraction in patients with chronic high-burden right ventricular pacing. Unlike transvenous pacemakers (TVPS), leadless pacemakers (LPs) are associated with a lower risk of PICM. Recent evidence suggests that an upgrade to cardiac resynchronization therapy defibrillator (CRT-D) may prevent the occurrence of PICM.

In recent years, the LP has been optimized to a form CRT-D, but whether its removal is necessary has not been clarified. In China, few studies have documented the removal and retrieval of LP, and there is no consensus regarding the appropriate extraction methods. Here, we present a case report describing the upgrade of a LP to a CRT-D while concurrently removing the existing LP. Our case offers a novel technique for LP extraction utilizing two steerable introducers.

Keywords: Leadless pacer, Micra, Case report, PICM, CRTD

OPEN ACCESS

Correspondence:
Xueying Chen, The Department of Cardiology, Zhongshan Hospital of Fudan University, Shanghai Institute of Cardiovascular Diseases, National Clinical Research Centre for Interventional Medicine, Shanghai, China,
E-mail: chen.xueying@zs-hospital.sh.cn
Zhongjun Liu, The Department of Cardiology, The Shanghai Putuo District Central Hospital, Hospital of Shanghai University of Traditional Chinese Medicine, China,
E-mail: liuzongjun1548@shutcm.edu.cn

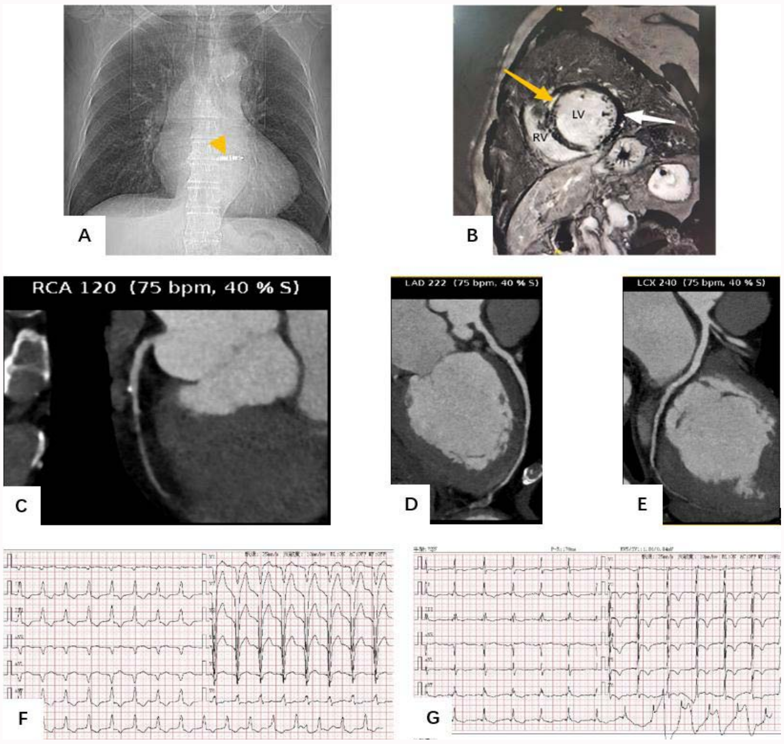
Received Date: *12 Jan 2025*
Accepted Date*: 27 Jan 2025*
Published Date*: 28 Jan 2025*

Citation:
Zhang Y, Li K, Li Chen A, Li M, Yang W, Chen X, et al. Extraction of Micra Leadless Pacemaker and Upgradation of Pacing-Induced Cardiomyopathy: A Case Report. Ann Clin Case Rep. 2025; 10: 2719.
ISSN: 2474-1655.

Introduction

According to current guidelines concerning the treatment of high-degree heart blocks and symptomatic bradycardias, TVP placement is widely applied in the management of bradyarrhythmia. Patients with high-burden right ventricular pacing are at risk of developing PICM [1,2]. PICM is generally defined as a drop in the left ventricular ejection fraction due to chronic, high-burden RV pacing without other causes (e.g. ischemia). The incidence of PICM following TVPs placement is high, estimated to be in the range of 14%-36% [1,2]. Compared to traditional pacemakers, the Micra device results in a higher success rate, decreases complications associated with pouches and electrodes, reduces trauma, lowers the risk of infection, and shortens the duration of postoperative bed rest [3]. In addition, Long-Pulse Pacing has a lower risk of PICM, and is the traditional approach for the management of right ventricular pacing (RVP). Although the exact risk reduction of LPs compared with TVPs has not been determined, cases of persistent PICM have been observed. Currently, this issue has not been resolved. in this article, we present a detailed removal and subsequent upgrade of a LP to a CRT-D. The procedure utilized two steerable introducers to facilitate the safe and efficient extraction of the LP in a short duration.

A 72-year-old male patient was admitted to our hospital with a 2 weeks history of chest discomfort and subsequent dyspnoea. The patient reported having a history of hypertension for 6 years and takes antihypertensive drugs orally, with well-controlled blood pressure. He had no family history of cardiomyopathies. Two years ago, the patient underwent LP implantation at our hospital to treat third-degree atrioventricular block (IIIAVB) (historical data see Table 1). On admission at our hospital, an electrocardiogram detected atrial heart rate during ventricular pacing (Figure 1F). Chest radiography revealed a slightly enlarged cardiac silhouette without vascular redistribution and micra leadless pacemaker implant in the mild high septal position (Figure 2). Biochemical tests showed plasma brain natriuretic peptide concentration of 1457 pg/mL, serum creatinine concentration of 110 umol/L, and C-reactive protein concentration of 4.59 mg/L. Transthoracic echocardiography demonstrated diffusely reduced biventricular wall motion (LVEF 23%) with diffuse myocardial oedema in the LV [interventricular septum (IVS) thickness: 10 mm, LV posterior wall thickness: 10 mm] without significant valvular disease. Further examination results are presented in Table 1. Coronary Computed Tomography Angiography revealed mild stenosis of



RCA: Right Coronary Artery; LAD: Left Anterior Descending Coronary Artery; LCX: Left Circumflex Coronary Artery

Figure 1: (A) Chest radiography illustrating the Micra leadless pacemaker implant in the mild high septal position (Yellow arrow). (B) Cardiac magnetic resonance imaging showing left ventricle enlargement and late gadolinium enhancement at right ventricle septal–endocardial (Yellow arrow). (C,D and E) Coronary Computed Tomography Angiography indicating mild stenosis of coronary. (F) EKG at admission demonstrating atrial detection of the heart rate during ventricular pacing. (G) EKG after upgrade from LPs to CRT-D showing complete right bundle branch block.

Timeline:

Time	Event
Around 2022	Gradually developed dizziness, stuffiness.
05-Sep-22	ECG: Third-degree atrioventricular block
08-Sep-22	Implantation of a Micra leadless pacemaker
09-Aug-24	Patient was admitted due to suspected PICM and shortness of breath
Day 10-18	Began anti-heart failure medication therapy
19-Aug-24	Implantation of a CRTD and extraction of a Micra leadless pacemaker
23-Sep-24	At 1-month follow-up, the LVEF increased from 23 to 36%, and the patient's condition improved from New York Heart Association (NYHA) class III to NYHA class I

coronary arteries (Figure 1CD and E). Cardiac magnetic resonance imaging confirmed the absence of endocardial fibrosis (Figure 1B).

The pacemaker program controller found that the pacing rates of the ventricle were 97.9%. Patients with high-burden right ventricular pacing are at risk of developing PICM. In the present case, on admission, a series of diagnostic tests were performed which excluded the presence of hereditary cardiomyopathy, ischemic cardiomyopathy, and myocardial fibrosis. The patient was pathologically diagnosed with Pacing-induced cardiomyopathy. Following treatment with freeze-dried recombinant human brain natriuretic peptide, olvaptan and levosimendan, the cardiac function improved on the tenth day. The patient expressed a preference for the removal of the leadless pacemaker. The physician made concerted efforts to improve left ventricular ejection fraction by transitioning from conventional right ventricular pacing to CRT-D through biventricular pacing.

Procedural Details

The procedure was performed in the cardiovascular catheter room of the Putuo Hospital, Shanghai University of Traditional Chinese Medicine. The LBBP operation was conducted following protocols described in literature [4-6]. The pacing lead (Model 3830; SelectSecure, Medtronic Inc., Minneapolis, MN, USA) was advanced through the delivery sheath (C315His; Medtronic Inc.) via the left axillary vein. The paced electrocardiogram (ECG) and intracardiac electrogram were recorded using the TOP-2001 Recording System (HongTong Electronic Medical Device Technology, China). Subsequently, the lead was placed 1–2 cm distal to the His bundle location and in the direction of the RV apex under a fluoroscopic right anterior oblique (RAO) 30-degree image. When the paced QRS complex transitioned from an LBBB to an RBBB morphology, the lead was firmly screwed into the interventricular septum. The capture

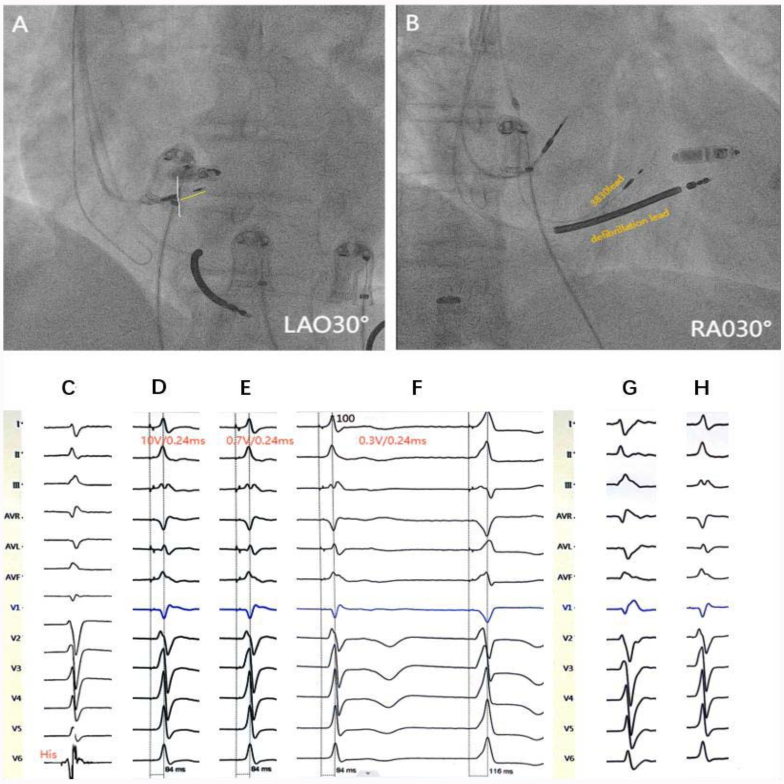


Figure 2: (A) The sheath angiography illustrating the right ventricular septum (indicated by the white dotted line) and the implant depth (presented by the yellow line). (B) The positions of the leads are shown. (C and D) His bundle pacing is achieved at an output of 10 V/0.24 milliseconds, which corrects the left bundle branch block (LBBB).

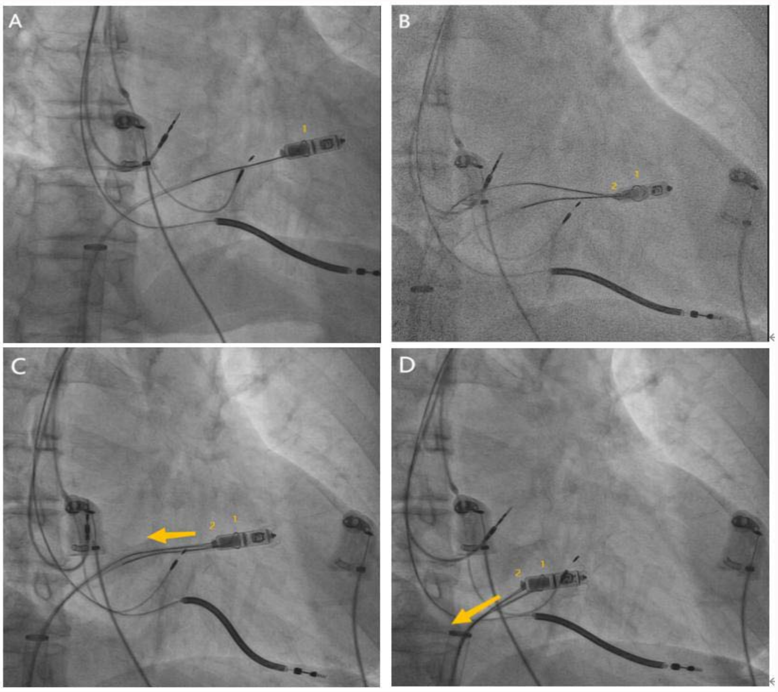


Figure 3A-D: Left anterior oblique view: 1. One snare holds the Micra body 2. One snare holds the fixation tine: 3. The direction of retrieving (Yellow arrow).

of the LBB was confirmed by observing the RBBB paced morphology and existence one of the following signs: (1) selective LBBP; (2) An abrupt shortening of the stimulus to left ventricular activation time (Sti-LVAT) with increasing output or remaining short and constant at the final site [5, 7-9]. Subsequently, the defibrillation lead was positioned at the apex part of the heart. The positions of the leads are presented in Figure 2A and B. For device extraction, the 23F leadless pacemaker sheath (Micra introducer, Medtronic, Minneapolis, USA)

Table 1: Baseline clinical parameters.

Clinical parameter	Value^{s}1	Values[2]	Values[3]	Normal range
Laboratory test				
NT-proBNP (pg/mL)	66.7	1457	87.5	<100
Albumin (g/L)	38	38	42	40-55
Blood urea nitrogen (mmol/L)	8.2	9.9	7.8	3.2-7.1
Creatinine (μmol/L)	107	106	101	58-110
Echocardiography				
Tricuspid regurgitation	None	None	None	None
LAD (mm)	35	43	36	19-40
LVPW (mm)	8	10	11	06-11
LVESD (mm)	33	53	43	20-37
LVEDD (mm)	58	61	57	35-66
LV ejection fraction (%)	70	23	36	54-74
Interventricular septum (mm)	9	10	11	06-11
Mitral regurgitation	None	Mild	Mild	None
RV segmental akinesia	None	Yes	Yes	None
CMRI				
RA diameter (mm)		55		24-59
RV diameter (mm)		30		15-34
RVOT (mm)		28		21-35
RV paradoxical movement		Yes		None
RV ejection fraction (%)		29.4		51-71
Late gadolinium enhancement		None		None

Values[1]: September 2022; Values[2]: August 2024; Values[3]: September 2024; NT-proBNP; N-terminal pro-brain natriuretic peptide; RA: Right Atrial; RV: Right Ventricular; LVESD: Left Ventricular End-Systolic Diameter; LVEDD: Left Ventricular End-Diastolic Diameter; RVOT: Right Ventricular Outflow Tract

Figure 4: Explanted Micra, snared through two stearable introducers which were located in the Micra sheath.

was inserted via the right femoral vein (see Figure 3A for the position of the leadless pacemaker). All procedures were performed in a right anterior oblique 30-degree view. Two snares were inserted into the sheath. During the procedure, the pacemaker was observed to synchronize with the contractions of the cardiac muscle. To minimize the risk of displacement and subsequent migration of the leadless pacemaker into the right ventricle, after multiple repositioning's, a large curve steerable introducer was inserted into the right ventricular to hold the Micra capsule and maintain the stability of Micra (Figure 3A). Due to the oscillatory motion of the Micra in synchrony with the heart's beating, the locking snare was frequently dislodged, requiring repeated recapture. In addition, another steerable introducer was placed to the Proximal Retrieval Feature (right side, Figure 3B). The force was modulated by manipulating the FlexFix and observing the perceived relaxation in the hand. As the operator attempted to retrieve the leadless pacemaker by gently pulling the tether, a sudden release sensation was felt, indicating that the Micra had dislodged from its myocardial anchorage. The device was finally retrieved successfully into the leadless pacemaker delivery sheath and extracted (see Figure 3C and, Figure 4). The extraction procedure took 38 minutes, and the radiation dose administered was 136 mGy. No pericardial effusion occurred.

Selective left bundle branch pacing (LBBP) is performed at outputs of 10.0 V/0.24 milliseconds and (E) 0.7 V/0.24 milliseconds, both yielding a stimulus to the left ventricular activation time of 84 milliseconds. (F) Nonselective LBBP was performed at an output of 0.3 V/0.24 milliseconds, with a stimulus to the left ventricular activation time of 116 milliseconds. (G) Electrocardiographic assessment of the cardiac cavity after extraction of the leadless pacemaker. (H) Paced QRSd of 116 milliseconds during LBBP fusion with intrinsic right bundle branch

Discussion

Due to the diminutive size of the Micra pacemaker, the presence of right ventricular trabecular block, and the absence of a specialized device for retrieval, the extraction of the Micra pacemaker poses significant challenges. In the present case, during the retrieval of this Micra device, it was observed that the operational efficacy of the 23F Medtronic introducer sheath was inferior to that of the adjustable sheath. When the Micra pacemaker is captured, it is usually captured to the fuselage, and the trap should be moved to the Micra recovery device. Because the Micra oscillates with the beating of the heart, the locking snare is often dislocated due to the oscillation of the Micra and needs to be recaptured. Therefore, we propose a technique that involves the placement of two snares to concurrently capture and stabilize the Micra pacemaker, thereby mitigate the risk of dislocation. Secondly, from a safety perspective, we recommend prioritizing CRTD implantation procedure. This approach mitigates the risks associated with the "empty window" period of a leadless pacemaker. In our case subject, short-term clinical follow-up indicated that CRTD had achieved a favorable clinical response, with improvement in symptoms and left ventricular function supported by transthoracic echocardiography evidence at one month (see Table 1). To mitigate the incidence of PICM, we advocate for the implementation of leadless left bundle branch area pacing.

References

1. Kiehl EL, Makki T, Kumar R, Gumber D, Kwon DH, Rickard JW, et al. Incidence and predictors of right ventricular pacing-induced cardiomyopathy in patients with complete atrioventricular block and preserved left ventricular systolic function. Heart Rhythm. 2016;13(12):2272-8.

2. Bansal R, Parakh N, Gupta A, Juneja R, Naik N, Yadav R, et al. Incidence and predictors of pacemaker-induced cardiomyopathy with comparison between apical and non-apical right ventricular pacing sites. J Interv Card Electrophysiol. 2019;56(1):63-70.

3. Darlington D, Brown P, Carvalho V, Bourne H, Mayer J, Jones N, et al. Efficacy and safety of leadless pacemaker: A systematic review, pooled analysis and meta-analysis. Indian Pacing Electrophysiol J. 2022;22(2):77-86.

4. Huang W, Su L, Wu S, Xu L, Xiao F, Zhou X, et al. A Novel Pacing Strategy

with Low and Stable Output: Pacing the Left Bundle Branch Immediately Beyond the Conduction Block. Can J Cardiol. 2017;33(12):1736.e1-1736.e3.

5. Chen X, Wu S, Su L, Su Y, Huang W. The characteristics of the electrocardiogram and the intracardiac electrogram in left bundle branch pacing. J Cardiovasc Electrophysiol. 2019;30(7):1096-1101.
6. Padala SK, Ellenbogen KA. Left bundle branch pacing is the best approach to physiological pacing. Heart Rhythm O2. 2020;1(1):59-67.
7. Huang W, Chen X, Su L, Wu S, Xia X, Vijayaraman P. A beginner's guide to permanent left bundle branch pacing. Heart Rhythm. 2019;16(12):1791-1796.
8. Su L, Wang S, Wu S, Xu L, Huang Z, Chen X, et al. Long-Term Safety and Feasibility of Left Bundle Branch Pacing in a Large Single-Center Study. Circ Arrhythm Electrophysiol. 2021;14(2):e009261.
9. Chen X, Jin Q, Bai J, et al. The feasibility and safety of left bundle branch pacing vs. right ventricular pacing after mid-long-term follow-up: a single-centre experience. Europace. 2020;22(Suppl_2):ii36-ii44.