

Left bundle branch area pacing with stylet driven lead in third-degree atrioventricular block following Morrow surgery



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Introduction

Hypertrophic cardiomyopathy (HCM) is a rare genetical myocardial disease characterized by a pathologic increase in left ventricular thickness not explained by abnormal loading conditions.¹ One of the major complications in HCM is left ventricle outflow tract obstruction (LVOTO) caused by an anomalous systolic anterior mitral movement. Despite emerging pharmacologic therapy,² such as a potential alternative to reduce symptomatic LVOTO septal myectomy (SM), surgical resection of small sections of muscle tissue in the proximal ventricular septum remains one of the most effective treatments. The Morrow procedure has some complications, including physical damage of the left bundle branch (LBB), requiring pacemaker implantation approximately in 2%–12% of cases.^{3,4} Left bundle branch area pacing (LBBAP) is emerging as a feasible technique for achieving physiologic pacing to ensure left ventricle (LV) electrical synchrony. However, its effectiveness and safety in patients with surgically induced damage of conduction system remains uncertain. We present a case of successful LBBAP in a patient with complete atrioventricular block (AVB) after Morrow surgery.

Case report

A 64-year-old woman was seen for follow-up for obstructive HCM and mitroaortic severe stenosis with cardiac surgery indication, when she was urgently admitted to emergency department for resting dyspnea and atypical thoracic pain occurring during high-frequency atrial fibrillation (AF) episode. She underwent early cardioversion after admission with external DC-shock; a 12-lead electrocardiogram (ECG) showed sinus rhythm, with normal atrioventricular and interventricular conduction and T wave inversion in

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KEY TEACHING POINTS

- Left bundle branch area pacing (LBBAP) in patients with hypertrophic cardiomyopathy (HCM) and undergoing septal myectomy is feasible and can be performed also with a stylet-driven lead (SDL).
- Patients with HCM and thickened interventricular septum requiring deep screwing could benefit from greater support given by SDL and uninterrupted stimulated electrocardiograph monitoring is helpful not to exceed toward the left ventricle.
- After Morrow surgery, restoring left ventricle synchronous contraction with LBBAP does not negatively affect left ventricle outflow tract obstruction, although adequate atrioventricular delay is yet to established.

lateral leads. Laboratory tests revealed a moderate rise in Tn-Hs (38 vs 49 pg/mL), and invasive angiography excluded epicardial coronary artery stenosis. Transthoracic echocardiography (TTE) highlighted preserved ejection fraction (EF, 58%), left atrium dilation (53 cm²), and pathologic thickening (17 mm) of interventricular septum (IVS) with hemodynamic outflow tract obstruction (mean gradient, 70 mmHg). Transesophageal echocardiography (TEE) confirmed high-grade valvular calcification with severe mitral and aortic stenosis; therefore, it was decided to proceed immediately to cardiac surgery. The next day, the patient underwent mitral valve replacement (biological CE, Magna 27 mm) aortic valve replacement (biological Edwards, 21 mm), left auricle closure (Atriclip), and SM. After cardiac surgery, she developed complete AVB with total dependency from external temporary epicardial stimulation, requiring a permanent pacemaker (PM) implantation. Considering the young age and the predictable high ventricular pacing percentage, we programmed conduction system pacing (CSP).

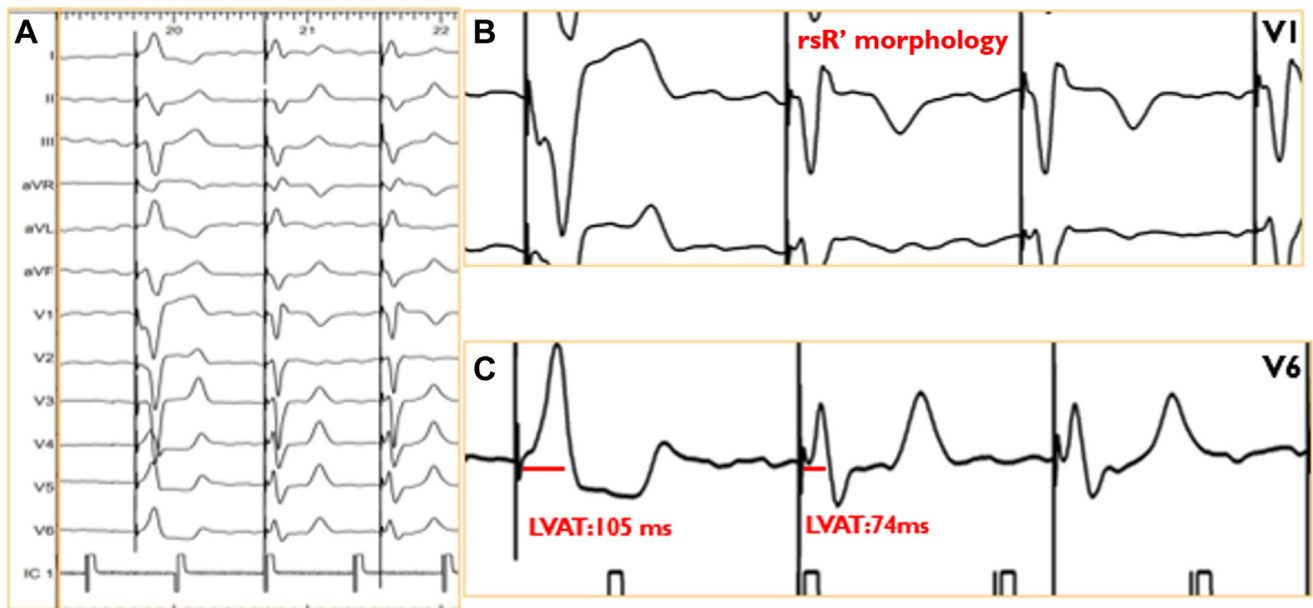


Figure 1 Electrocardiograph modification during unipolar pacing indicative of left bundle branch capture. **A:** Sharp reduction of QRS duration (185 vs 135 ms). **B:** R' appearance in lead V1 with a right bundle branch block pattern. **C:** Abrupt reduction of LVAT in lead V6 (74 vs 105 ms). LVAT, left ventricular activation time.

Pacemaker implantation

LBBAP was performed following a previously described implantation technique.⁵ First, an atrial lead was placed in the right ventricle to obtain backup pacing. A stylet-driven lead (SDL) Biotronik Solia S60 with a fixed-curve sheath (Selectra 3D 55-42-Biotronik) was advanced up to the IVS in the LBB area. In the right anterior oblique (RAO) 30° fluoroscopic view, the pacing lead (Solia S 60) was moved toward the tricuspid valve to the right ventricular apex to obtain a valuable septal position. Left anterior oblique (LAO) 30° view confirmed correct lead position with perpendicular orientation toward the IVS before starting screwing.

During lead advancement into the IVS, we observed QRS morphology modification indicative of LBBAP. The main evidence of LBB capture is highlighted in **Figure 1**: (1) paced QRS in V1 showed r' appearance moved toward the end of the QRS, resulting in a paced right bundle branch block

pattern; (2) left ventricular activation time from pacing stimulus to R peak wave in V6 has an abrupt shortening from 105 ms to 74 ms; (3) V6-V1 R interpeak wave resulted in 60 ms; (4) stimulated QRS shortened significantly from 185 ms to 135 ms. Ventricular lead parameters were valuable, with low unipolar threshold (0.5 V at 0.4 ms), and unipolar impedance was 510 Ω. After lead placement, contrast was injected to ensure perpendicular septal orientation of the lead (**Figure 2**). Atrial lead was therefore retracted from ventricular back-up and screwed in the right auricle, and finally a dual-chamber pacemaker (Biotronik Evity-DR) was connected.

The ventricular lead was appreciable in a TTE four-chamber apical view (**Figure 3**), observing deep

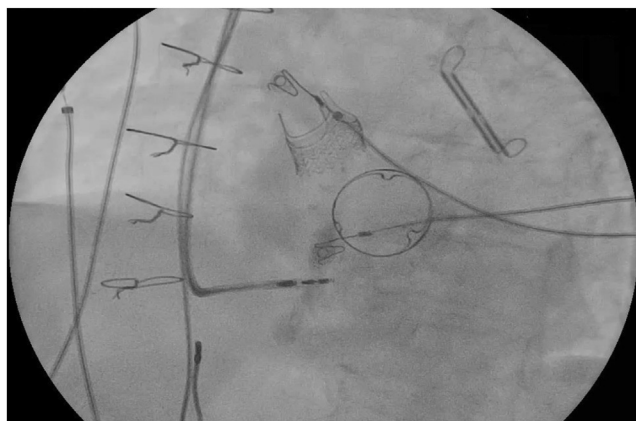


Figure 2 Left anterior oblique view (30°). Contrast injection confirms perpendicular penetration of stylet-driven lead in the interventricular septum.

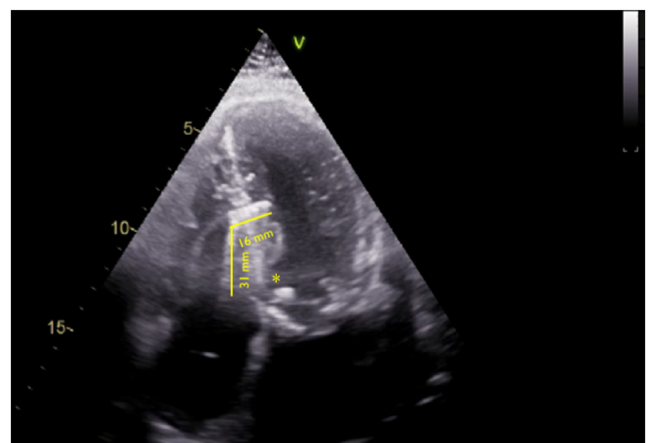


Figure 3 Echocardiogram, apical-4-chamber view, shows lead position in the right ventricle. Left bundle branch area pacing (LBBAP) lead reached 16 mm of interventricular septum (IVS) penetration and with a 31-mm distance from the tricuspid annulus. Septal myectomy involved the basal region of IVS (*) and did not affect lead position.

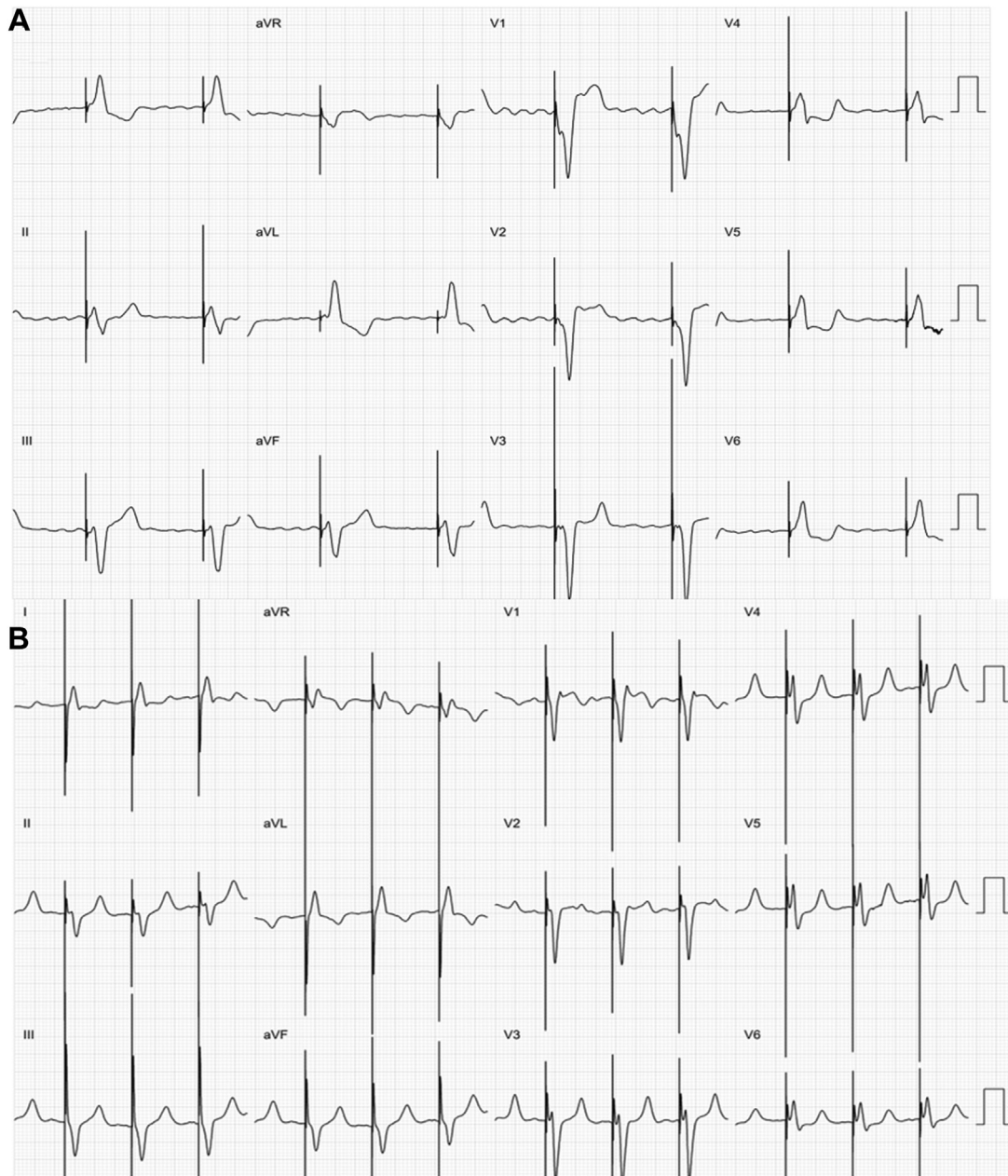


Figure 4 Pre- (A) and post- (B) LBBAP implantation 12-lead electrocardiograms. QRS duration shortened from 185 ms to 135 ms, and rsR' pattern was appreciable in the V1 lead.

interventricular septum penetration (16 mm) and optimal distance from the tricuspid valve (31 mm). EF and LV dimension were preserved (EF, 60%; end diastolic volume, 75 mL). No significant transprosthetic gradient or regurgitation were observed (mean transaortic gradient, 14 mm Hg; mean transmitral gradient, 5 mm Hg). After 10 days of hospital care, the patient was discharged to a cardiac rehabilitation center. At 6-month follow-up, clinical improvement had occurred (NYHA class I). An ECG showed intrinsic atrial activity guiding a sharp, paced QRS and features indicative of LBBAP pacing with CSP delivered 100% of the time. Pacemaker electrical parameters are reliably good (ventricular unipolar impedance: 351 Ω ; threshold 1 V at 0.4 ms). TTE

confirmed preserved EF with synchronous LV contraction, correct lead position, and the absence of transvalvular or outflow tract gradient ([Supplemental Video 1](#)).

Discussion

We documented the safety and feasibility of LBBAP performed with an SDL in an HCM patient after SM. One previous case report described an infra-Hisian site of a block suitable for LBBAP correction that was performed using only a lumenless lead (LLL).⁶ To our best knowledge the presenting case is the first using SDL showing optimal acute and 6-months follow-up results.

A previous study has mentioned that CSP is feasible in HCM patients, and that it could be reached using either LLL or SDL techniques.⁷ Although none of these patients underwent a previous Morrow surgery, SDL demonstrated a major implantation success rate, attributed by the authors to greater lead stiffness. Therefore, we considered SDL to be more reliable to guarantee screwing support while advancing in IVS.

No hindrance ascribable to SM was reported with a total procedural and X-ray time (40 and 7 minutes, respectively) consistent with that required for ordinary PM implantation. Only one screwing attempt was necessary to obtain stimulated ECG matching criteria for selective LBB capture with a lead tip penetrating up to 16 mm perpendicularly inside the IVS of overall 17-mm thickness. The opportunity given by SDL of continuous stimulated QRS monitoring while advancing lead in IVS⁸ was helpful and allowed us not to exceed toward the left ventricle.

LBBAP lead distance from tricuspid valve (TV) was 31 mm. Avoiding proximity to TV annulus area is always recommended because there is a proven long-term benefit in terms of the risk of leaflet entrapment or valve regurgitation.⁹ Furthermore, after Morrow surgery, basal IVS has been subjected to surgical resection, and moving away from basal RV is preferred because it is not advisable as a target area. In our opinion, this caution guarantees greater delivery of sheath handling, deeper penetration, and a more stable position in IVS.

QRS duration post LBBAP implantation was significant shorter (135 vs 185 ms), restoring a more physiologic synchronous ventricular contraction (Figure 4). Asynchronous ventricular stimulation is a known possible treatment for symptomatic obstructive HCM, and it could be argued that ventricular dyssynchrony could be used as a strategy to reduce outflow gradient.¹⁰ In addition, appropriate AV delay in a patient with LBBAP is not well known and is currently a matter of debate.^{11,12} After Morrow surgery in the presenting case, the patient had hemodynamic improvement with resection of basal IVS (13 mm starting for 17 mm) and remarkable reduction of outflow or midventricular obstruction (transaortic mean gradient 14 mm Hg). She had a postsurgery complete AVB with an expected need for a long-term PM ventricular stimulation. Considering her young age, we presumed that she could benefit more from physiologic ventricular contraction to avoid pacing-induced cardiomyopathy. Sensed AV delay was therefore programmed to optimize RV filling (180 ms) with a physiologic PR on the ECG surface. Six-month follow-up confirmed the absence of PM-aggravated LVOTO or reduction in EF.

Conclusion

LBBAP with SDL is safe and feasible in postmyectomy HCM patients, allowing fast and reliable CSP. LV synchrony delivered by LBBAP pacing does not appear to negatively affect outflow obstruction after myectomy.

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Appendix Supplementary data

Supplementary data associated with this article can be found in the online version at <https://doi.org/10.1016/j.hrncr.2025.02.017>.

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