Permanent left posterior fascicular area pacing through the interventricular septum in a patient with infra-Hisian block

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Introduction

Right ventricular apical (RVA) pacing is associated with a high incidence of heart failure and atrial fibrillation related to ventricular dyssynchrony.[1,2] Permanent His bundle pacing (HBP) has emerged as an alternative approach that has proven safe and has yielded better clinical outcomes compared with RVA pacing in patients requiring permanent pacing.[3] However, Vijayaraman and colleagues[4] reported that HBP was not successful in 24% of patients presenting with infranodal atrioventricular (AV) block. The optimal pacing site in these patients has yet to be determined. We describe a case of a patient with infranodal AV block, which was successfully corrected by permanent left posterior fascicular (LPF) area pacing via the interventricular septum (IVS).

KEY TEACHING POINTS

- In patients with infranodal atrioventricular block and failed His bundle pacing, the optimal pacing site has yet to be determined, and pacing distal to the site of block is a clinically achievable option.
- The left posterior fascicular area is composed of multiple fibers dispersed over a relatively broad area, providing extensive opportunity for successful capture via the interventricular septum.
- The 3 most useful indicators that guide lead insertion are the V_1 morphology during the intermittent pacing test, the appearance of a Purkinje potential before the local V wave, and the depth of the lead in the septum.

Case report

A previously healthy 37-year-old man presented with a 2-week history of syncope and bradycardia (36 beats/min) and was referred to our institution for pacemaker implantation. The baseline electrocardiography (ECG) showed 2:1 AV block with right bundle branch block (RBBB) (Figure 1A). The results of the physical examination and echocardiography were unremarkable. Given the young age and the deleterious effects of long-term RVA pacing, we attempted HBP. A SelectSecure 3830 lead (Medtronic, Minneapolis, MN) was placed through a C315 sheath (Medtronic) and guided to the AV septum for mapping and pacing. His bundle recordings revealed a prolonged HV interval of 242 ms of conducted sinus beats and atrio-His block of nonconducted sinus beats, suggesting both AV nodal block and infra-Hisian conduction delay (Figure 1B). Even at a high output of 5 V/1 ms, HBP resulted in antegrade block (Figure 1C). Therefore, we attempted to pace the proximal left fascicle by screwing the lead deeply into the IVS, starting approximately 15 mm anterior and 5 mm inferior to the His region (Figure 2B). Mapping and pacing was performed alternately while screwing the 3830 lead, to obtain a qR pattern in lead V_1 and a Purkinje potential before the local V wave. The depth of the 3830 lead in the septum was confirmed by the angiography performed using the C315 sheath (Figure 2A). The lead was screwed in by means of 15–20 clockwise rotations before a sharp Purkinje potential followed by a ventricular electrogram were recorded (Figure 1D). We decided to fix the lead in this particular position. Unipolar pacing during the procedure yielded a narrow QRS (94 ms) with a threshold of 0.75 V/0.42 ms. The atrial lead was placed in the right atrial appendage. Postprocedural echocardiography suggested that the tip of the 3830 lead was positioned just beneath the left ventricular endocardium (Figure 2C). The 12-lead pacing ECG obtained after the procedure showed left axis deviation and right ventricular activation

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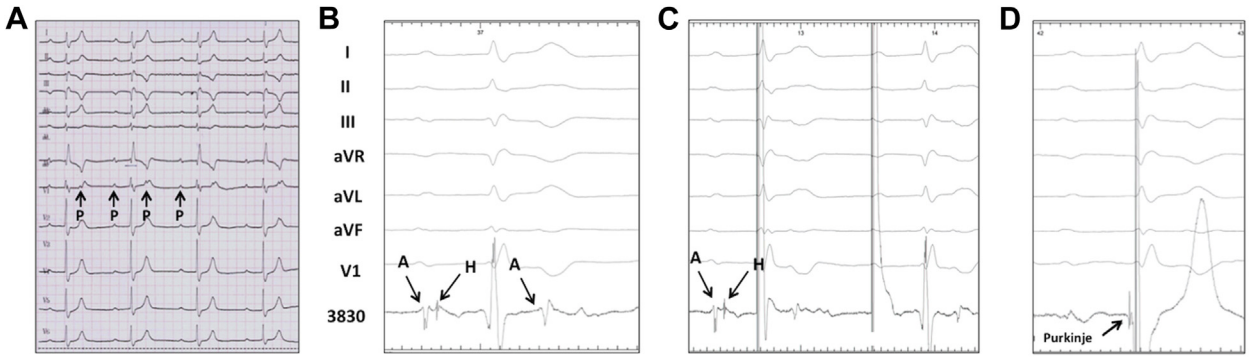

Figure 1 Twelve-lead electrocardiography (ECG) and intracardiac electrograms of the patient. **A:** Baseline ECG showed sinus rhythm, 2:1 atrioventricular block, and right bundle branch block. The *arrow* indicates the P wave. **B–D:** From top to bottom, the image shows leads I, II, III, aVR, aVL, aVF, and V_1 and the intracardiac electrograms recorded by the 3830 lead. **B:** The prolonged HV interval was 242 ms in conducted sinus beats, and the following nonconducted sinus beats showed atrio-His (AH) block. **C:** The impulses were not conducted to the ventricle during pacing from the His bundle region. **D:** A sharp Purkinje (P) potential with normal P to ventricular interval was recorded deep in the interventricular septum. The sweep speed of the tracing in A and in B–D was 25 mm/s and 100 mm/s, respectively. A = atrial electrogram; V = ventricular electrogram.

delays during unipolar pacing, which indicated left anterior fascicular block (LAFB) and RBBB (Figure 3A). Bipolar pacing corrected the RBBB, leaving only the LAFB (Figure 3B). There was no change in QRS morphology during threshold testing. After 9 months of follow-up, this patient was free of any symptoms. The 12-lead ECG and the ventricular pacing threshold were unchanged during the follow-up period.

Discussion

Left bundle branch area pacing through the IVS was first reported in treating a patient with heart failure and left bundle branch block in whom this novel pacing strategy corrected the left bundle branch block with accompanying RBBB on the electrocardiogram.[5] In our case, the intermittent atrio-His conduction suggested AV nodal block, and the prolonged HV interval and failure of His bundle capture suggested the existence of infra-Hisian block. Based on a combination of intracardiac electrograms, fluoroscopy, and postprocedural 12-lead ECG features, we inferred that the 3830 lead has been capturing the LPF area and possibly the adjacent myocardium in this patient. The infra-Hisian conduction delay site occurred between the His bundle and the LPF area. This observation also explains why pacing distal to the site of the block would correct AV block in this patient. Notably, the LPF area is composed of multiple fibers dispersed over a relatively broad area,[6] providing extensive opportunity for successful capture. In this case, however, we inferred that the pacing site was the LPF trunk in this patient based on the following 2 findings: (1) a large Purkinje potential was recorded at this site; and (2) the intraprocedural ECG suggested selective pacing during low output (not shown). As the LPF area was captured first, the left anterior fascicular area was activated slightly later, resulting in LAFB manifestation on the surface ECG. In conclusion, proximal LPF area pacing through the IVS provides a more stable, low-threshold, physiological approach to pacing in patients with infra-Hisian block.

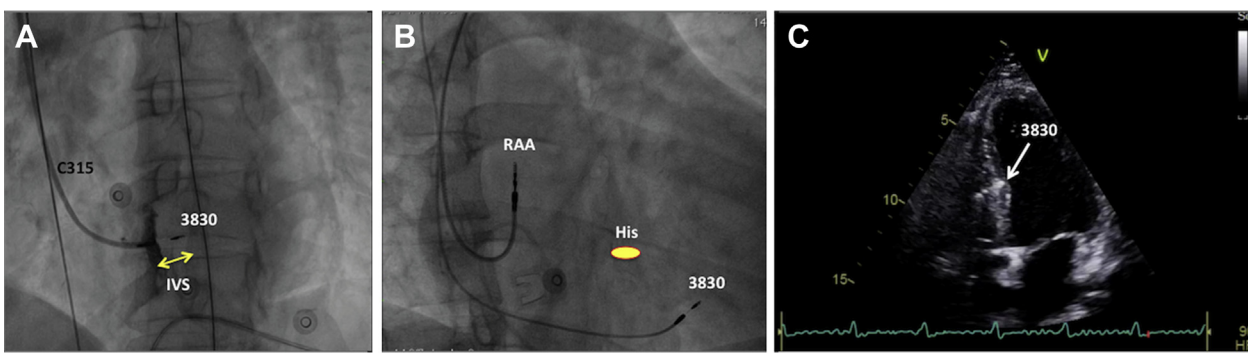

Figure 2 Lead position determined by fluoroscopy and echocardiography. **A:** The angiography performed using the C315 sheath in the anteroposterior view. **B:** Fluoroscopic image in the right anterior oblique view. **C:** Four-chamber view in echocardiography. The *yellow double arrow* shows interventricular septum. The *white arrow* shows the 3830 ventricular lead. IVS = interventricular septum; RAA = right atrial appendage.

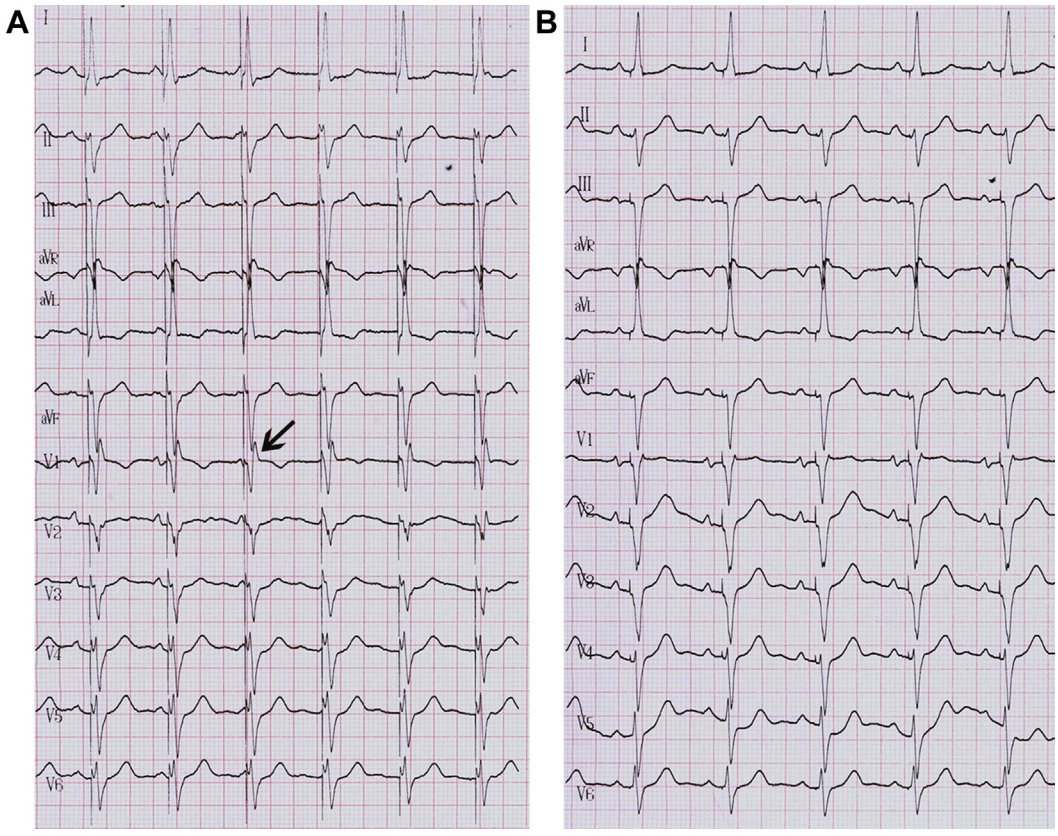

Figure 3 Twelve-lead electrocardiography during unipolar and bipolar pacing, respectively. **A:** Unipolar pacing resulted in delayed right ventricular activation. The *arrow* shows a QR pattern in V_1. **B:** Bipolar pacing showed attenuated R wave in V_1. The left axis deviation in both electrocardiograms indicated left anterior fascicular block.

References

1. Tops LF, Schalij MJ, Bax JJ. The effects of right ventricular apical pacing on ventricular function and dyssynchrony implications for therapy. J Am Coll Cardiol 2009;54:764–776.
2. Abdelrahman M, Subzposh FA, Beer D, et al. Clinical outcomes of His bundle pacing compared to right ventricular pacing. J Am Coll Cardiol 2018;71:2319–2330.
3. Sharma PS, Dandamudi G, Naperkowski A, et al. Permanent His-bundle pacing is feasible, safe, and superior to right ventricular pacing in routine clinical practice. Heart Rhythm 2015;2:305–312.
4. Vijayaraman P, Naperkowski A, Ellenbogen KA, Dandamudi G. Electrophysiologic insights into site of atrioventricular block: lessons from permanent His bundle pacing. JACC Clin Electrophysiol 2015;1:571–581.
5. Huang W, Su L, Wu S, 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;33:1736.e1–1736.e3.
6. Rosenbaum MB, Elizari MV, Lazzari JO. The Hemiblocks: New Concepts of Intraventricular Conduction Based on Human Anatomical, Physiological, and Clinical Studies. Oldsmar, FL: Tampa Tracings; 1970.