

Permanent His-bundle pacing from the right atrium in patients with prosthetic tricuspid valve



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Introduction

Permanent His-bundle pacing (PHBP) has become increasingly popular, as it provides the most physiological form of ventricular activation when compared to other pacing modalities.¹ PHBP has been reported in patients with mitral and aortic prosthetic cardiac valves.² To date, there have been no published reports regarding the feasibility of PHBP in the setting of prosthetic tricuspid valve (TV). We report 2 cases of patients with prosthetic TV who underwent PHBP.

Case report

Case 1

A 46-year-old woman with history of non-Hodgkin lymphoma treated with chemoradiation 19 years prior to admission developed constrictive pericarditis and cardiomyopathy with left ventricular ejection fraction (LVEF) of 30%–34% and left bundle branch block. An attempt to implant a left ventricular (LV) pacing lead failed owing to small LV vein size. Therefore, she underwent pericardiectomy and cardiac defibrillator with resynchronization implantation with surgical LV pacing lead placement. Her heart failure symptoms initially improved and her LVEF normalized. However, over the span of 7 years, she developed worsening lower-extremity edema, progressing to anasarca.

She was found to have severe tricuspid regurgitation (TR) attributed to lead impingement preventing proper leaflet coaptation. Therefore, she underwent laser lead extraction.

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KEY TEACHING POINTS

- Tricuspid valve prosthesis is an anatomical barrier to right ventricular pacing.
- The anatomical location of optimal His-bundle pacing site has been reported to be in the right atrium (RA) side of the tricuspid valve.
- The RA portion of the His bundle remains anatomically unaltered by tricuspid valve prosthesis; hence, permanent His-bundle pacing from the RA is a feasible option for patients with inaccessible right ventricle.

On intraoperative transesophageal echocardiogram, the TV septal leaflet was noted to be flail and severe TR did not improve after lead extraction. The patient underwent TV replacement (TVR) with 25 mm mitral mechanical valve prosthesis expanded cuff (St. Jude Medical, St Paul, MN). On postoperative day 2, she developed complete heart block and required pacing from surgically implanted temporary pacing wires. The presence of a mechanical TV, however, made it impossible to place a pacing lead in the right ventricle (RV), as the latter would entrap the tilting discs of the valve. Hence, we had to approach ventricular pacing (VP) without accessing the RV. A deflectable sheath (C304S59 model, Medtronic, Minneapolis, MN) was inserted in the right atrium (RA) and directed septally. A SelectSecure His lead (3830-59 model, Medtronic) was programmed to unipolar pacing until ventricular capture was detected, torquing the sheath toward the annular high septum of the RA. His-bundle capture was obtained and the screw-in lead was fixated in the His bundle and the anatomical RA proximal to the TV (Figure 1A–D). The His-bundle pacing threshold was 4.7 V at 0.5 ms. This was the threshold for the narrowest QRS (His capture). At lower outputs, a wider paced QRS resulted in a myocardial capture threshold of 1.9 V at 0.5 ms (not shown). Given the lack of reference data to support

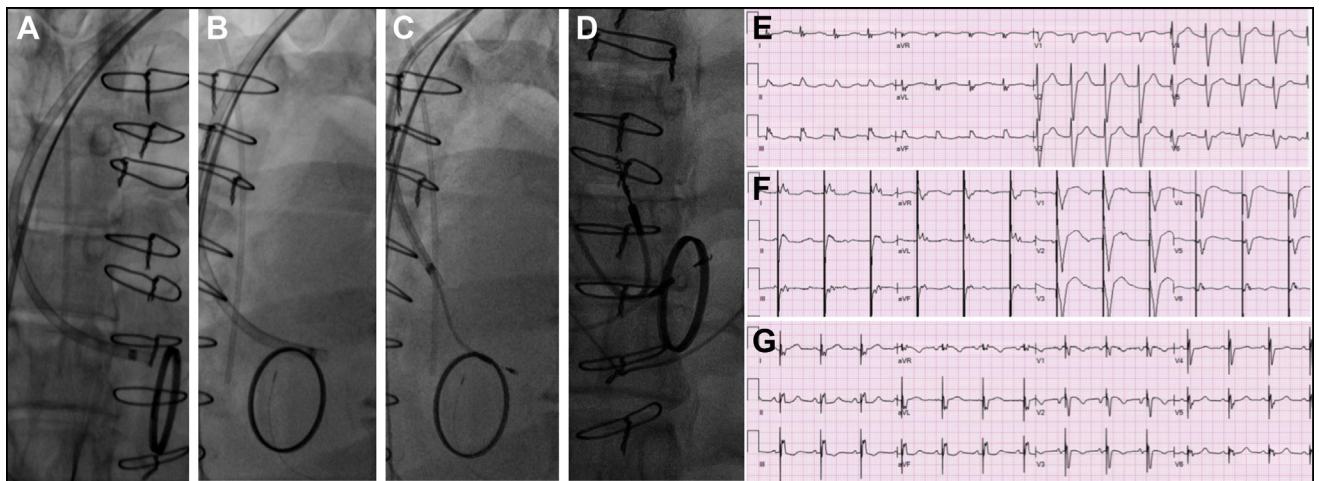


Figure 1 Patient 1. **A, B:** Fluoroscopy depiction of deflectable sheath tip (Medtronic, Minneapolis, MN) in the area just proximal to the tricuspid valve ring. **C:** Delivery of SelectSecure His lead (Medtronic). **D:** Left anterior oblique view of SelectSecure His lead. **E:** Baseline electrocardiogram (ECG) prior to tricuspid valve replacement; QRSd 155 ms. **F:** ECG on postoperative day 2 depicting epicardial wire pacing (VVI) with underlying complete atrioventricular block; QRSd 209 ms. **G:** ECG postimplant depicting para-Hisian pacing (DDD with pacing output of 4.7 V at 0.5 ms); QRSd 94 ms.

long-term stability of His-bundle capture from the anatomical RA, we chose to implant an LV back-up pacing lead via the coronary sinus in an anterior interventricular vein. Of note, the QRS complex narrowed significantly during para-Hisian pacing, even narrower than her preexisting left bundle branch block (Figure 1E–G). During follow-up, the patient had improvement of LVEF to 40%–44% with 100% VP and His-bundle pacing threshold of 3.5 V at 1.00 ms.

Case 2

A 65-year-old man with history of carcinoid small bowel carcinoma with liver metastasis treated with surgical resection, chemotherapy, and hepatic embolization presented with progressively worsening dyspnea on exertion, abdominal distention, and peripheral edema. On transthoracic echocardiogram, he was found to have severe TR with no coaptation of TV leaflets, which was suggestive of carcinoid TV disease. He was also found to have severe aortic root enlargement with moderate eccentric aortic regurgitation. He therefore underwent TVR with a 31 mm Carpentier-Edwards Magna pericardial valve (Edwards Lifesciences, Irvine, CA) and aortic valve replacement with 25 mm Carpentier-Edwards Magna pericardial valve (Edwards Lifesciences). The postoperative course was complicated by complete AV block and asystole requiring pacemaker implantation. Because of his existing TVR, we opted for pacing the His bundle from the RA without crossing the existing TVR. To pace the His bundle, a CapSureFix Novus lead (5076, Medtronic) was delivered through a deflectable sheath (6227DEF model, Medtronic) into the His bundle (Figure 2A–D). Selective His-bundle capture was obtained and the screw-in lead was fixated in the His bundle. His-bundle threshold was 3 V at 0.5 ms. We again chose to implant an LV back-up pacing lead via the coronary sinus in the middle cardiac vein. As noted on Figure 2E and F, with selective His-bundle pacing, QRS complex narrowed. During follow-up, His-bundle pacing threshold was 3.25 V at 1.00 ms.

Discussion

The presence of a mechanical TV hinders transvenous endocardial lead implantation into the RV. Alternative methods for VP in this setting include epicardial lead implantation, which is limited by dyssynchronous VP and poor lead durability.³ Coronary sinus pacing has also been successfully used in patients in whom RV pacing is prohibited.^{4–6} However, it results in dyssynchronous left-to-right ventricular activation, which is less physiological than His-bundle activation. Further complicating the first case, the patient had a history of postradiation cardiomyopathy and constriction, making a surgical approach very high risk. PHBP has been reported in patients with valve prostheses,² but none of the reported cases included a mechanical tricuspid valve (1 case had a tricuspid valve ring).

The cases presented here illustrate the feasibility of PHBP in this setting, with the added benefit of normalization of conduction resulting in resynchronization, which is consistent with the model of bundle branch block correction owing to longitudinal dissociation.⁷ This was achieved exclusively from a right atrial approach. The anatomical location of an optimal His-bundle pacing site has been reported to be in the RA side of the septal leaflet of the tricuspid valve.⁸ Here, we capitalize on the fact that the RA portion of the His bundle remains anatomically unaltered by the valve prosthesis—both mechanical and biological—and is therefore amenable to pacing lead implantation without the need to cross the valve into the RV.

In both cases, at time of implant, the PHBP thresholds were higher than conventionally acceptable. As such, several attempts were made to try different positions that would yield lower thresholds. Considering that in both cases there was only 1 location where selective His-bundle capture was obtained, the threshold—albeit higher than ideal—that yielded the narrowest QRS was considered acceptable. In the first

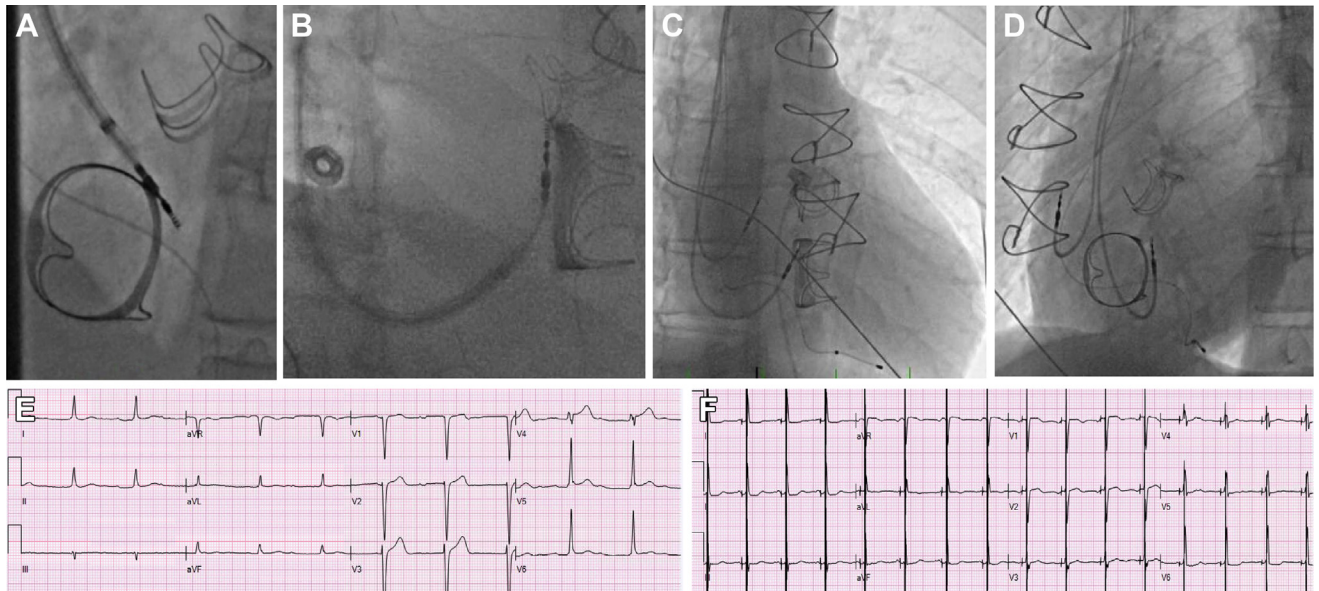


Figure 2 Patient 2. **A:** Fluoroscopy left anterior oblique (LAO) view of deflectable sheath tip (Medtronic, Minneapolis, MN) in the area just proximal to the tricuspid valve ring. **B, C:** Fluoroscopy right anterior oblique view of delivery of CapSureFix Novus lead (Medtronic). **D:** Fluoroscopy LAO view of CapSureFix Novus lead delivered. **E:** Electrocardiogram (ECG) depicting atrioventricular block after tricuspid valve replacement. **F:** ECG postimplant depicting selective His-bundle pacing (DDD with pacing output of 3 V at 0.5 ms and no left ventricular pacing).

case, PHBP led to an increase in ejection fraction, confirming the appropriateness of our choice.

Conclusion

PHBP in patients with prosthetic valves is not yet commonly used. We report 2 cases whereby PHBP was used in patients with prosthetic tricuspid valves and complete atrioventricular block, albeit with relatively high thresholds.

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References

1. Dandamudi G, Vijayaraman P. History of His bundle pacing. *J Electrocardiol* 2017;50:156–160.

- Sharma PS, Subzposh FAS, Ellenbogen KA, Vijayaraman P. Permanent His bundle pacing in patients with prosthetic cardiac valves. *Heart Rhythm* 2016; 16:59–64.
- Zabek A, Malecka B, Tomala I, Matusik P, Boczar K, Lelakowski J. Cardiac pacing in a patient with mechanical tricuspid valve. *Pol Arch Med Wewn* 2015; 125:89–91.
- Hsieh MJ, Yeh KH, Satish OS, Wang CC. Permanent pacing using a coronary sinus lead in a patient with univentricular physiology: an extended application of biventricular pacing technology. *Europace* 2006;8:147–150.
- Herre JM, Bullaboy CA, Derkac WM, Dow MT. Permanent transvenous dual-chamber pacing using the coronary sinus in a patient with a mechanical prosthetic tricuspid valve. *Pediatr Cardiol* 2004;25:65–66.
- Vijayakumar M, Kamath P, Pai PG. Permanent pacing in a patient with tricuspid prosthesis—widening therapeutic use of coronary sinus. *Indian Heart J* 2013; 65:611–613.
- Naruloa OS. Longitudinal dissociation in the His bundle. Bundle branch block due to asynchronous conduction within the His bundle in man. *Circulation* 1977; 56:996–1006.
- Correa de Sa DD, Hardin NJ, Crespo EM, Nicholas KB, Lustgarten DL. Autopsy analysis of the implantation site of a permanent selective direct His bundle pacing lead. *Circ Arrhythm Electrophysiol* 2012;5:244–246.