Ventricular Pacing via the Coronary Sinus in a Patient with a Mechanical Tricuspid Valve Prosthesis

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Implantation of a transvenous endocardial pacing lead in the right ventricle is contraindicated after mechanical tricuspid valve replacement; therefore a surgical approach to the epicardium is usually required. This case report describes ventricular pacing via a branch of the coronary sinus in a patient with mechanical mitral, aortic and tricuspid valve replacements. In conclusion, this approach is minimally invasive, provides effective ventricular stimulation with low pacing threshold and stable lead position, and is a feasible option when transvenous right ventricular pacing is not possible.

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Introduction

In certain situations such as the presence of a mechanical tricuspid prosthesis, endocardial pacing of the right ventricle is not possible. We present a case where we used a lead in the coronary sinus to pace the left ventricle in a patient with bradycardia, and 2 previous cardiac surgeries including tricuspid valve replacement.

Case Report

A 66-year-old woman with a history of childhood rheumatic fever underwent open mitral valvotomy in 1970. She re-presented in 1999 with moderate mixed aortic valve disease, moderately severe mitral stenosis and severe tricuspid regurgitation. Due to progression of her symptoms from valvular heart disease she underwent repeat surgery with triple valve replacement in 2002 (aortic St. Jude (St. Paul, MN, USA) 21 mm prosthesis, mitral St. Jude 27 mm prosthesis and tricuspid St. Jude 33 mm prosthesis). Co-morbidities included longstanding persistent atrial fibrillation, Type 2 diabetes mellitus, gout, gastritis and iron deficiency anaemia. She presented in 2010 with palpitations and pre-syncope. ECG monitoring showed atrial fibrillation with occasionally rapid ventricular rates and symptomatic 3.5 second pauses (Figure 1). To achieve satisfactory rate control of atrial fibrillation while preventing ventricular pauses, a permanent ventricular pacemaker was recommended.

After left subclavian vein access was achieved, a guiding catheter (Boston Scientific, Boston, MA, USA) was used to access the coronary sinus os, which was situated inferomedially to the tricuspid
valve prosthesis. A retrograde occlusion venogram was acquired to assess target vessels. A Boston Scientific Easytrak II ventricular lead was initially placed in the posterolateral cardiac vein, but pacing parameters were poor with high ventricular and low diaphragmatic pacing thresholds. The middle cardiac vein was cannulated by “double-wire” technique where access to the coronary sinus is maintained by one wire while the guide is withdrawn to the os of the coronary sinus and the middle cardiac vein orifice probed for by a second wire (Glidewire, Terumo Medical Corporation, Somerset, NJ, USA). The pacing wire was introduced into a proximal branch heading superiorly along the middle part of the middle cardiac vein with the aid of an angioplasty wire. In this position we obtained excellent pacing parameters (ventricular threshold 0.8 V at 0.5 ms and diaphragmatic threshold 6.9 V; R wave 20.1 mV; impedance 1578 ohms; slew rate >4.0 V/s). The lead delivery system was slit and removed without lead displacement, the lead secured to the pectoral muscle fascia and attached to a Boston Scientific Altrua 60 pulse generator. A chest x-ray on the following day (Figure 2) showed good lead position with no dislodgement, however the diaphragmatic pacing threshold had dropped to 2.5 V in some pacing configurations, so the output was reduced to 2 V while maintaining a 2.5-fold safety margin for ventricular capture. A 12 lead ECG showed left ventricular pacing on demand (Figure 3).

Discussion

In patients with tricuspid bioprostheses, endocardial right ventricular lead placement is possible but is associated with a significant risk of lead fracture at the valve site and valve damage may occur, especially during lead extraction. In patients with mechanical tricuspid valve prostheses, transvenous pacing of the right ventricle may also cause valve damage and failure and so is therefore contraindicated. One approach to pacing in this setting is the consideration of epicardial pacing leads, which requires a surgical technique involving a thoracotomy or sternotomy under general anaesthetic (a third surgical procedure in our patient) and a resultant longer hospital stay. This procedure is often technically challenging due to scar tissue and adhesions as a result of previous surgery, and presents the added risk of ventricular damage during dissection. Also long-term epicardial pacing thresholds are inferior to transvenous pacing thresholds and epicardial lead failure rate is high −26% for epicardial leads overall.1) In recent years, technological improvements and the development of leads specifically designed for left ventricular pacing have made left

Figure 1 Telemetry strips showing atrial fibrillation with rapid ventricular response, complete heart block and symptomatic pauses.
ventricular capture and sensing a feasible alternative where right ventricular pacing is not possible.

In 1970 Anagnostopoulos first described the use of the coronary sinus for intra-operative implantation of pacemaker leads in patients with tricuspid valve prostheses. Bai first reported permanent transvenous left ventricular pacing via the great cardiac vein in similar patients in 1994 and several other reports

Figure 2  PA and lateral chest X-ray 1 day after cardiac device implantation. AVR: Aortic Valve Replacement, MVR: Mitral Valve Replacement, TVR: Tricuspid Valve Replacement

Figure 3  12 lead ECG showing left ventricular pacing.
have since confirmed the medium to long-term success rate.\textsuperscript{4)} This method has also been used successfully in patients with complex congenital heart disease with no venous access to the right ventricle. Advantages of this approach are that it is minimally invasive and provides effective ventricular stimulation,\textsuperscript{5)} and in addition a stable position in a coronary vein with a reliably low threshold is generally achievable. Complications of ventricular pacing via the coronary sinus include diaphragmatic stimulation, coronary sinus dissection and lead displacement. The possibility of lead or delivery system entanglement in the mechanical prosthesis should be considered and avoided if at all possible. Another factor to consider is the risk associated with active fixation left ventricular lead removal after long-term implantation, should it become necessary.\textsuperscript{6)} The potential complications of left ventricular pacing via the coronary sinus must be considered in comparison to a further major surgical procedure and its associated risks. In the case we describe, a third surgical procedure would have involved substantial risks and increased morbidity, so ventricular pacing via a branch of the coronary sinus was the preferred approach.

In conclusion, pacemaker therapy after tricuspid valve surgery still poses a considerable challenge. Left ventricular pacing via the coronary sinus may provide effective ventricular stimulation with a low threshold and stable lead position, and is a feasible option when transvenous right ventricular pacing is not possible.

References