DEVICE THERAPY

COMPLEX CASE STUDY

Transvenous Extraction of Right Ventricular Leads Jailed by a Bioprosthetic Tricuspid Valve

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ABSTRACT. We present a case of extraction of a right ventricular pacing lead jailed by a mechanical tricuspid valve. A 68-year-old man presented with pocket-site infection following pulse generator replacement. He had two right ventricular leads including a capped passive-fixation Boston Scientific 4285 pacing lead (implanted 15 years previously) and a Medtronic 6947 Sprint Quattro active-fixation implantable cardioverter-defibrillator lead (implanted 7 years previously) that were externalized between the sewing ring and tricuspid annulus during bioprosthetic tricuspid valve replacement (St. Jude mitral epic stented 31 mm) 16 months previously. Both leads were successfully extracted using a locking stylet and laser sheath under transesophageal echocardiographic monitoring. The post-procedural transesophageal echocardiogram showed no evidence of perivalvular leak. A pacemaker/implantable cardioverter-defibrillator with coronary sinus lead and inferior vena cava defibrillator coil were implanted a month later.

KEYWORDS. artificial, cardiac pacemaker, jailed pacemaker lead, lasers, laser extraction, Lead extraction, tricuspid valve, tricuspid valve replacement.

Introduction

Transvenous pacemaker leads may be externalized at the time of tricuspid valve replacement so that the lead is positioned between the valve ring and myocardium.1 The feasibility and safety of transvenous extraction of these “jailed” leads is unknown. We present a 68-year-old man with extraction of a right ventricular pacing lead jailed by a mechanical tricuspid valve.

Case report

A 68-year-old man with a cardiac resynchronization therapy-defibrillator device presented with a pocket-site infection 3 weeks after pulse generator replacement. Blood cultures were negative for bacteremia. He had a history of atrial fibrillation status post atrioventricular node ablation, non-ischemic dilated cardiomyopathy, and recurrent ventricular tachycardia status post left ventricular assist device implantation as destination therapy. His preoperative chest X-ray (Figure 1) shows two right ventricular leads including a capped passive-fixation 4285 pacing lead (Boston Scientific Corp., Natick, MA) (implanted 15 years previously) and a 6947 Sprint Quattro active-fixation implantable cardioverter-defibrillator lead (Medtronic Inc., St. Paul, MN) (implanted 7 years previously) that were externalized between the sewing ring and tricuspid annulus during bioprosthetic tricuspid valve replacement (mitral epic stented 31 mm, St. Jude Medical, St Paul, MN) 16 months previously. A preprocedural transesophageal echocardiogram (TEE) confirmed that the leads were jailed at the inferior aspect of the tricuspid annulus without evidence of lead vegetation. Lead extraction was performed in an operating room with cardiac surgery back-up available. The coronary sinus (CS) and right atrial leads were extracted using a locking stylet and laser sheath without difficulty. A locking stylet was placed in the implantable cardioverter-defibrillator (ICD) lead and a laser sheath advanced to the level of the right atrium. With traction,
the lead traversed the tricuspid annulus and was extracted. A locking stylet was then advanced in the passive-fixation right ventricular lead. A 14-French and a 16-French laser sheaths were alternately advanced to the level of the tricuspid annulus over the lead with difficulty, presumably due to “snowplowing” related to scar accumulation. Under TEE monitoring and with firm, continuous traction, the lead traversed the tricuspid annulus and was extracted. Post-procedural TEE demonstrated trivial central prosthetic regurgitation, a tiny anterior pericardial effusion, and no evidence of peri-valvular leak. The total fluoroscopy time was 41.8 min. A temporary pacemaker was not implanted, as the patient was no longer pacemaker dependent despite the remote history of atrioventricular node ablation. Pocket and lead cultures obtained during extraction were negative. As the patient was no longer pacemaker dependent and out of concerns that a permanent transvalvular right ventricular ICD lead could cause structural or functional damage to the bioprosthetic tricuspid valve, a pacemaker/ICD system with a CS lead and inferior vena cava defibrillator coil were implanted a month later. There was no evidence to suggest co-infection of the left ventricular assist device or bioprosthetic tricuspid valve.

Figure 1: Chest X-ray showing the capped passive-fixation Boston Scientific 4285 pacing lead and a Medtronic 6947 Sprint Quattro active-fixation implantable cardioverter-defibrillator lead jailed by the bioprosthetic St. Jude mitral epic stented 31-mm tricuspid valve.
Suppression antibiotics were not prescribed and the patient remained free of infection greater than 1 year post extraction.

Discussion

Transvenous extraction of pacemaker leads jailed by stents has been reported. To our knowledge, this is the first report of extraction of a transvenous pacemaker lead jailed by an artificial tricuspid valve replacement. This case highlights the feasibility of transvenous extraction of two right ventricular leads externalized at the time of tricuspid valve replacement.

The 2009 Heart Rhythm Society Expert Consensus document indicates that it is inappropriate to stent open a vein, trapping the pacing leads against the vein wall. This is due to concerns regarding the feasibility of extraction of such leads and potential for transmitting any future infection to the stent. Externalizing a pacemaker lead at the time of tricuspid valve replacement creates the same potential challenges. One must consider the patient characteristics and feasibility of other pacing options before deciding on this approach.

Ventricular pacing with a tricuspid valve replacement can be achieved through multiple techniques. If the existing transvenous lead is removed at the time of surgery, there are at least four potential pacing strategies. Epicardial pacing leads placed at the time of surgery eliminate the need to cross the tricuspid valve but have higher pacing thresholds than transvenous leads and are prone to lead failure due to elevated pacing thresholds with time.

Figure 2: Illustration showing the relationship of the transvenous leads between the tricuspid annulus and bioprosthetic tricuspid valve. Note that the leads were positioned between the sutures and not within the horizontal mattress stitches.
Alternatively, a lead can be placed in a CS tributary if access is not surgically obstructed, which avoids crossing the valve. A higher rate of acute lead dislodgement makes this a suboptimal strategy in pacemaker-dependent patients. Although it is preferable to avoid implantation of a right ventricular lead through a bioprosthetic tricuspid valve, a transvalvular lead may be implanted selectively at an optimal position across the valve orifice under echocardiographic guidance. After a mean follow-up of 25 months, bioprothetic tricuspid regurgitation does not differ between patients with and without transvalvular right ventricular leads. In the future, it may be possible to place a novel intramyocardial ventricular lead in the atrioventricular septum superior to the tricuspid annulus. Anecdotally, transmyocardial implantation has been performed in which a standard endocardial lead is placed through the right ventricular wall directly into the right ventricle in order to bypass the tricuspid valve. Long-term data with this approach are lacking.

If the existing right ventricular lead is functioning well and there is sufficient redundancy in the lead, it can be externalized at the time of tricuspid valve replacement. The native tricuspid valve is removed and the leads left to pass between the sewing ring and tricuspid annulus (Figure 2). Mattress stitches are often placed on either sides of the lead. It is critical that the leads are positioned between the sutures and not within the horizontal mattress stitches to allow for potential future transvenous lead extraction.

In our patient, it was elected to externalize the right ventricular leads at the time of tricuspid valve replacement. There are several potential pitfalls with extraction of a jailed device lead. If a lead vegetation is present distal to the tricuspid annulus, there would be a high risk for embolization of the vegetation. A preoperative TEE is necessary to evaluate for this prior to lead extraction. As it is likely risky to advance a laser sheath beyond the tricuspid annulus, lead adhesions distal to the tricuspid annulus can only be overcome with traction. Thus, the distal portion of the lead can only be extracted with a locking stylet. The degree of linearity of the lead as it crosses the annulus and reaches its tip electrode may determine the feasibility of jailed lead extraction, as the distal-most sheath position serves as the anchor point for extraction counter-tension. Damage to the structure and function of the tricuspid valve replacement is possible, especially if the laser sheath is utilized near the bioprosthetic tricuspid valve. We performed lead extraction under TEE guidance to monitor for valve deformation, perivalvular regurgitation, and pericardial effusion. Myocardial perforation and vascular damage at the tricuspid annulus is also possible. Owing to these potential complications, extraction of jailed leads should be performed in an operating room with cardiac surgery back-up. If transvenous extraction is unsuccessful and device infection necessitates removal of the leads in entirety, open surgical extraction must be considered. If our patient were pacemaker dependent, we would have placed a transvalvular right ventricular temporary pacemaker.

**Conclusion**

Percutaneous extraction of transvenous right ventricular leads jailed at the time of tricuspid valve replacement is feasible. It may be reasonable to attempt transvenous extraction rather than an open surgical approach for extraction of jailed tricuspid valve leads. More extractions will need to be performed before the safety and risks of the procedure can be fully understood.

**References**