Case Report

Successful Implantation of a Leadless Pacemaker in a Patient With a Tricuspid Clip

Maria Terricabras, MD, Enes Elvin Gul, MD, and Yaariv Khaykin, MD, FHRS

*Southlake Regional Health Centre, University of Toronto, Newmarket, Ontario, Canada***ABSTRACT**

Leadless pacemakers have become an effective alternative to conventional transvenous pacemakers to prevent the risk of lead failure, pocket complications, and iatrogenic tricuspid regurgitation. The current transcatheter approach for tricuspid valve repair can limit the implantation of these devices, unless the procedure is performed with appropriate image guidance. We present the case of a patient with severe tricuspid regurgitation secondary to pacemaker lead impingement who, despite the implantation of a tricuspid clip, received a leadless pacemaker. The procedure was successfully guided by transthoracic echocardiography, an alternative to transeptal or intracardiac echocardiography.

RÉSUMÉ

Les stimulateurs cardiaques sans électrodes sont devenus une solution de rechange efficace aux stimulateurs transveineux classiques pour prévenir le risque de défaillance des électrodes, les complications liées à la loge et la régurgitation tricuspidiennne iatrogène. L'approche actuelle de réparation de la valve tricuspide par cathétérisme peut empêcher l'implantation de ces dispositifs, à moins que l'intervention ne soit réalisée avec un guidage par image approprié. Nous présentons le cas d'un patient ayant une régurgitation tricuspidiennne grave consécutive à la compression des électrodes d'un stimulateur cardiaque qui, malgré l'implantation d'un clip tricuspide, a reçu un stimulateur cardiaque sans électrodes. L'intervention a été guidée avec succès au moyen d'une échocardiographie par voie transthoracique, une solution de rechange à l'échocardiographie transseptale ou intracardiaque.

Leadless pacemakers offer several advantages over conventional single-chamber devices, including lower long-term risk of complications related to lead fracture, dislodgment, infection, or tricuspid regurgitation (TR).¹

Chronic TR can lead to right atrial remodeling, atrial arrhythmias, and right heart failure symptoms. Cardiovascular implantable electronic device leads implanted in the right ventricle via the tricuspid valve are a known iatrogenic cause of TR. Current transcatheter approaches for mitral regurgitation and tricuspid regurgitation allow a partial or complete correction of these valvulopathies, with a minimally invasive technique, which is especially useful in high-risk patients or patients with previous sternotomies.²

Herein, we report the case of a successful implantation of a leadless pacemaker in a patient with a failed tricuspid clip, due to the presence of a transvenous ventricular lead.

Case

An 84-year-old gentleman with a history of coronary artery disease, bypass surgery in October 2012, and permanent atrial fibrillation was referred for a single-chamber pacemaker generator replacement. He had undergone a pacemaker implantation for complete heart block after cardiac surgery. He was right ventricular (RV) pacing 99% of the time with an underlying escape rhythm at 30 beats per minute. Over the years, he developed severe mitral and tricuspid regurgitation (TR) and had undergone interventional mitral and tricuspid valve repair with mitral clips (MitraClip, Abbott, IL) at another institution. Thus, we did not have access to the periprocedural or intraprocedural imaging at the time of the tricuspid valve repair.

Although the mitral valve repair achieved was optimal, with mild to moderate residual regurgitation, the patient still had severe TR following tricuspid clip placement, owing to incomplete coaptation of the valve, secondary to the mechanical interaction with the RV lead.

Pre-procedure transthoracic echocardiography (TTE) revealed preserved left ventricular ejection fraction, severe TR with leaflet impingement by the RV lead, RV dilation measuring 55 mm in the apical 4-chamber view, mild RV hypokinesis, and severe right atrial dilation. Considering the persistent right-sided heart failure symptoms, the decision was made to implant a Micra transcatheter pacing system (TPS; Medtronic Inc., Minneapolis, MN) and remove the old transvenous lead.

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Ethics Statement: The research reported has adhered to the relevant ethical guidelines.

Corresponding author: Dr Yaariv Khaykin, 602-581 Davis Dr, Newmarket, Ontario L3Y 2P6, Canada. Tel.: +1-905-953-7917; fax: +1-905-953-0046.

E-mail: YKhaykin@southlakeregional.org

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Due to the preexistent tricuspid clip, the procedure was guided by TTE in addition to fluoroscopy. Surface echocardiography was very helpful in guiding the Micra introducer workstation across the valve into the right ventricle, and around the clip. The Micra TPS was successfully implanted in the mid-RV septum with optimal parameters (threshold 0.74 V at 0.24 ms; impedance 560 Ω ; and R-wave sensing 10.5 mV). Engagement was confirmed with the pull-and-hold test. The device position was confirmed in both left and right anterior oblique views (Fig. 1).

The transvenous lead was then successfully extracted with manual traction. This was a 7 French active fixation pacing lead that had been implanted 8 years earlier. Laser and mechanical tools were not required for the extraction. Post-procedure TTE revealed only mild TR (Fig. 2).

Discussion

RV lead implantation may cause tricuspid valve dysfunction and an increase in TR.^{3,4} Leadless pacemaker implantation can help prevent lead-mediated TR by eliminating the need for a lead passing through the tricuspid valve.

In this case, the mechanism of the TR was probably mixed annular dilation and leaflet impingement; therefore, the tricuspid clip could not completely correct the valvular regurgitation. However, the lead impingement and loss of coaptation of the valve could have been the initial cause of the TR, leading to chronic RV overload, progressive annular dilation, and worsening of the existing TR.

Using TTE, we were able to successfully cross the tricuspid valve and deliver the leadless pacemaker to the RV septum. We used TTE to guide the delivery system safely across the valve in a patient with a tricuspid clip and to choose the appropriate anatomic position for deployment. Image guidance during these procedures can be critical to avoid complications and proceed with a successful implantation in patients with an enlarged right ventricle, unusual anatomy, tricuspid stenosis, or as in the present report, a tricuspid clip.

Afzal et al.⁴ reported a series of 19 patients who received a Micra TPS after surgical tricuspid valve repair or replacement with a bioprosthetic valve. The operators used image guidance with intracardiac echocardiography (ICE), or as an alternative, a 5F deflectable catheter to cross the valve and use as a rail to advance the Micra TPS. All devices were successfully

Figure 1. Chest X ray showing the mid-septal location of the Micra TPS (Medtronic Inc, Minneapolis, MN). The red arrows indicate the tricuspid clip; the blue arrows indicate the 3 mitral clips; and the black arrows indicate the leadless pacemaker.

Figure 2. Echocardiography showing the septal location of the leadless pacemaker. (A) Apical 4-chamber echocardiographic view. Severe biatrial enlargement. (B) Modified apical 4-chamber view showing mild residual tricuspid regurgitation post procedure. The white arrow indicates the septal location of the Micra TPS (Medtronic Inc., Minneapolis, MN).

implanted, and none of them resulted in worsening of TR.⁵ Recently, a case report of a Micra TPS implanted after a tricuspid valve repair using 3 MitraClips was published. The procedure was successfully guided by transesophageal echocardiography.⁵

Although ICE and transesophageal echocardiography provide outstanding imaging, ICE is not widely available, is expensive, and requires a trained specialist familiar with both the use of ICE and implantation of the leadless pacemaker devices. Transesophageal echocardiography is more readily available, but its intraprocedural use requires use of general anesthetic and performance by a trained echocardiographer. Right heart can be adequately imaged by a trained sonographer using TTE, providing for a cheaper and more readily available alternative, without the need for general anesthetic. This case also highlights the importance of the cardiovascular implantable electronic device leads in causing TR and right heart failure, the incidence of which varies from 10% to 39% depending on the number of leads in the right ventricle and the type of lead (pacing vs implantable cardioverter defibrillator lead).⁵ As leadless devices become more readily available, in cases in which only pacing is required, consideration should be given to removal of the transvenous lead and implantation of a leadless pacemaker as the primary therapeutic modality, which in this case might have allowed the patient to avoid having the tricuspid clip implanted in the first place.

Conclusion

Leadless pacemaker implantation should not be discouraged by the presence of a tricuspid clip, as long as the valve neo-orifices are large enough to accommodate the 23F Micra TPS introducer sheath (Medtronic Inc, Minneapolis, MN). The procedure requires image guidance to safely deploy the pacemaker in the RV septum without worsening the preexisting TR. In patients with clinically important TR and a cardiovascular implantable electronic device lead spanning the tricuspid valve, consideration should be given to implantation of a leadless pacemaker and removal of the transvenous lead as a primary therapeutic modality before considering placement of a tricuspid clip to repair the valve.

Novel Teaching Points

- The presence of a tricuspid clip should not limit implantation of a leadless pacemaker.
- Implantation of a leadless pacemaker through a repaired tricuspid valve requires image guidance to safely deploy the device without worsening the TR.
- Transthoracic echocardiography is a readily available and inexpensive technique to guide this procedure when ICE and transesophageal echocardiography are not available.

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Disclosures

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