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Journal of Clinical Cardiology and Cardiovascular Interventions
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Case Report

Micra Transcatheter Pacing System Implant under Direct Visualization During Minimally Invasive Tricuspid Valve Surgery

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Received: November 10, 2020; Accepted: November 16, 2020; Published: November 23, 2020
Citation: Mohamad C. Sinno., Mario C. Sang., (2020) Micra Transcatheter Pacing System Implant under Direct Visualization During Minimally Invasive Tricuspid Valve Surgery. *J. Clinical Cardiology and Cardiovascular Interventions*, 3(11); DOI:10.31579/2641-0419/105

Abstract:

Atrioventricular nodal conduction abnormalities are common after open heart surgery and more so during or after valve surgery. The incidence of atrioventricular (AV) block after tricuspid valve (TV) surgery is higher than what is observed following coronary artery bypass surgery or left sided valve interventions due to the proximity of the TV annulus to the AV node and hence requirements for cardiac pacing are high. However, the mechanical interference between pacing leads and TV leaflet mobility and coaptation can result in regurgitation rendering such an approach counterintuitive. We report a case of Micra Transcatheter pacing system (TPS) implant under direct visualization at the time of tricuspid valve surgery performed via a right mini-thoracotomy approach.

Key Words: atrioventricular; tricuspid regurgitation; tricuspid valve

Introduction

The prevalence of moderate to severe tricuspid regurgitation (TR) in the general US population is estimated at 1.6 million cases. Mortality rates associated with severe TR in the general population is estimated at 36% [1, 2] and almost 2-fold higher in patients with cardiac implantable electronic devices (CIED) [3,4]. Surgical tricuspid valve surgery can be performed in isolation [5] or in conjunction with left sided valve surgery with an acceptable operative mortality especially if performed before the onset of congestive heart failure or severe RV dysfunction[6-8] . The incidence of atrioventricular (AV) block after TV surgery is higher than what is observed following coronary artery bypass surgery of left sided valve interventions due to the proximity of the TV annulus to the AV node. The estimated prevalence of pacemaker implants after surgical tricuspid valve interventions is 5-8% [7, 9, 10] with some reports reporting an incidence of 21-28% [11]. We present a case of a patient in whom a Micra TPS was implanted under direct visualization at the time of tricuspid valve surgery performed via a right mini-thoracotomy approach.

Case report

A 60-year-old man with history of first-degree AV block, right bundle branch block, left anterior fascicular block and atrial septal defect closure 25 years prior performed via a median sternotomy approach presented for the management of symptomatic severe tricuspid valve regurgitation and moderate stenosis. The patient was evaluated and offered a right mini-thoracotomy tricuspid valve replacement with potential epicardial pacemaker lead placement in the event complete heart block occurred. The operation was carried out through a right mini-thoracotomy in the 4th intercostal space with femoral cannulation for cardiopulmonary bypass during a beating heart. Adhesion lysis of the heart to the lung to the pericardium and chest wall was carried out. The epicardial fat was densely adhered to the pericardium and placement of an epicardial pacing lead for pacing support was not feasible. The tricuspid valve was found to be thickened at the septal and anterior leaflets edges compatible with rheumatic changes. Annular sutures were applied in preparation to secure the valve in place. The patient had evidence of intermittent complete heart block with junctional escape rhythm. Due to the high risk of progression to complete heart block (CHB) and need for cardiac pacing in the setting of preexisting tri-fascicular block, a decision was made to proceed with insertion of a leadless pacemaker. Thereafter, while on a beating heart, a Micra AV TPS was implanted Via right trans-atrial approach. The leadless pacemaker delivery guide was advanced through the TV under direct visualization and positioned into a trabeculated area of the mid-septal right ventricle (**Figure 1**).

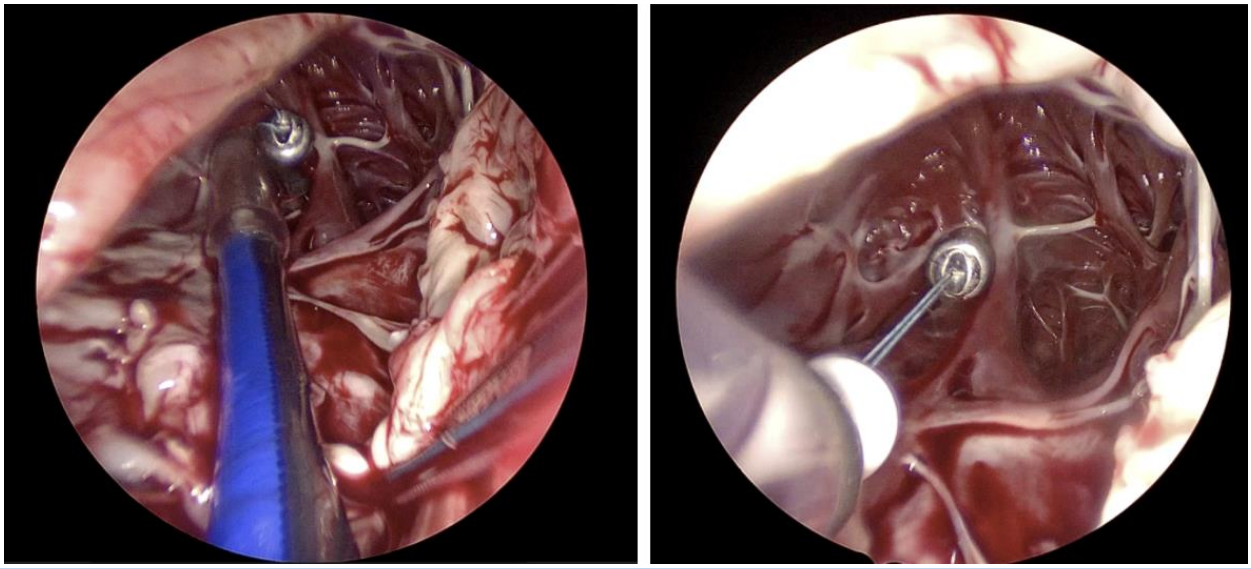

Figure 1: A. Micra Leadless pacemaker and tethered guide positioned in a trabeculated area on the Mid-septal RV across the TV. **B.** The guide pulled back into the right atrium with the tethered Micra Leadless pacemaker embedded in the septal RV.

The leadless pacemaker was deployed as recommended after confirming adequate forward pressure against the RV septum. Measurements were acceptable with pacing threshold of 0.5V at 0.24 ms pulse width, R-wave of 11.4 mV, and pacing impedance of 2500 Ohms. Stability was confirmed by visualization of all the tines anchored to the myocardium and by feel during a tug test. The tether was cut, and the delivery catheter was detached from the leadless pacemaker. After this stage, tricuspid ring annuloplasty was completed. Device interrogation the next morning revealed normal Micra Leadless pacemaker performance. Measurements were all stable and pacing impedance was down to 850 Ohms.

Discussion

The cumulative incidence of Atrioventricular (AV) conduction abnormalities following open heart surgery ranges between 10-15% [12-15]. Most of these electrical disturbances have been proven to be transient with 1-3% requiring permanent pacing [16-18]. However, several studies have shown that the incidence of AV conduction abnormalities requiring permanent pacing after tricuspid valve repair or replacement is higher than other valve interventions due to the proximity of the TV annulus to the AV node. The estimated prevalence of pacemaker implants after surgical tricuspid valve interventions is 5-8% [7, 9, 10] with some reporting an incidence of 21-28% [11]. However, the mechanical interference between transvalvular leads and TV leaflet mobility and coaptation can result in regurgitation rendering such an approach counterintuitive [19]. The prevalence and incidence of significant TR following CIED implantation ranges from 10% to 39% with a higher risk attributable to implantable cardiac defibrillator (ICD) leads or presence of more than 1 RV lead [20-27]. The impact of pacing or defibrillation leads on the development of significant TR after TV repair or replacement has also been reported in observational retrospective studies with findings ranging from severe TR to no significant effect on the repaired TV function[28-30]. To mitigate these effects, changes to lead design and coating have been implemented, and alternative pacing modalities that do not entail mechanical interaction with the tricuspid valve are sought for. Surgical epicardial pacing systems [31], placement of coronary sinus pacing leads [32, 33], direct His bundle pacing [34] and leadless pacing systems [35, 36] are all available alternatives to indwelling traditional pacemaker transvalvular leads.

We report a case of a Micra AV TPS implant under direct visualization during minimally invasive tricuspid valve repair. The lead impedance of 2500 Ohms at the time of surgery was elevated due to the open and bloodless chamber during surgery. The pacing impedance was within normal range the next morning. Leadless pacemaker implants during open heart surgery has been reported. Those previously reported cases were done through a standard sternotomy approach [37, 38]. Our case is the first reported transcatheter pacing system implant performed under direct visualization during minimally invasive right mini-thoracotomy approach on a beating heart. Given the high incidence of CHB requiring pacing after valve operations especially in patients with pre-existing AV conduction disease, insertion of a leadless pacemaker at the time of surgery should be considered especially in patients with prior open-heart surgery where epicardial adhesions would limit safe and easy access to the epicardial space. Insertion of a Micra TPS under direct visualization during minimally invasive surgery is safe and feasible.

Funding: None

Disclosures: None

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DOI: 10.31579/2641-0419/105