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RHYTHM DISORDERS AND ELECTROPHYSIOLOGY

CASE REPORT: CLINICAL CASE

Leadless Pacemaker Implantation Across Percutaneous Tricuspid Valve Prothesis Implanted Via Valve-in-Valve Technique

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ABSTRACT

We present the case of an 82-year-old woman with history of bivalvular replacement (mitral mechanical prothesis and tricuspid bioprothesis) and subsequent tricuspid percutaneous valve-in-valve bioprothesis implantation. The patient developed an indication for pacemaker implantation. We describe the feasibility of leadless pacemaker implantation across the tricuspid prothesis when all other techniques fail. (J Am Coll Cardiol Case Rep 2024;29:102300) © 2024 The Authors. Published by Elsevier on behalf of the American College of Cardiology Foundation. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).

HISTORY OF PRESENTATION

An 82-year-old woman presented to our emergency department in October 2023 experiencing dyspnea. She presented with signs and symptoms of acute heart failure (peripheral and pulmonary congestion with low arterial blood saturation). Her electrocardiogram showed blocked atrial fibrillation with junctional rhythm at 25 to 30 beats/min and right bundle branch block morphology.

LEARNING OBJECTIVES

- To decide the best pacing option in patients who deserve PM implantation and previously underwent tricuspid valve replacement.
- To state feasibility and safety of leadless PM implantation in patients carrying tricuspid valve prothesis.

PAST MEDICAL HISTORY

The patient had a history of long-standing valvular cardiomyopathy with preserved left ventricular (LV) systolic function: she first underwent mitral valve replacement with mechanical prothesis in 1985 because of mitral valve prolapse and severe regurgitation. She developed severe symptomatic tricuspid regurgitation and, in 2015, underwent surgical tricuspid valve replacement with bioprothesis. In 2018, she needed a percutaneous tricuspid valve-in-valve prothesis implantation because of accelerated degeneration and dysfunction of the previously positioned tricuspid bioprothesis.

Good functioning and stable gradients across the mitral mechanical prothesis were reported during clinical and echocardiographic follow-up. Since the first surgical valve replacement, permanent atrial fibrillation was reported, with an indication for rate control strategy.

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The authors attest they are in compliance with human studies committees and animal welfare regulations of the authors' institutions and Food and Drug Administration guidelines, including patient consent where appropriate. For more information, visit the Author Center.

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ABBREVIATIONS AND ACRONYMS

LV = left ventricular

PM = pacemaker

DIFFERENTIAL DIAGNOSIS

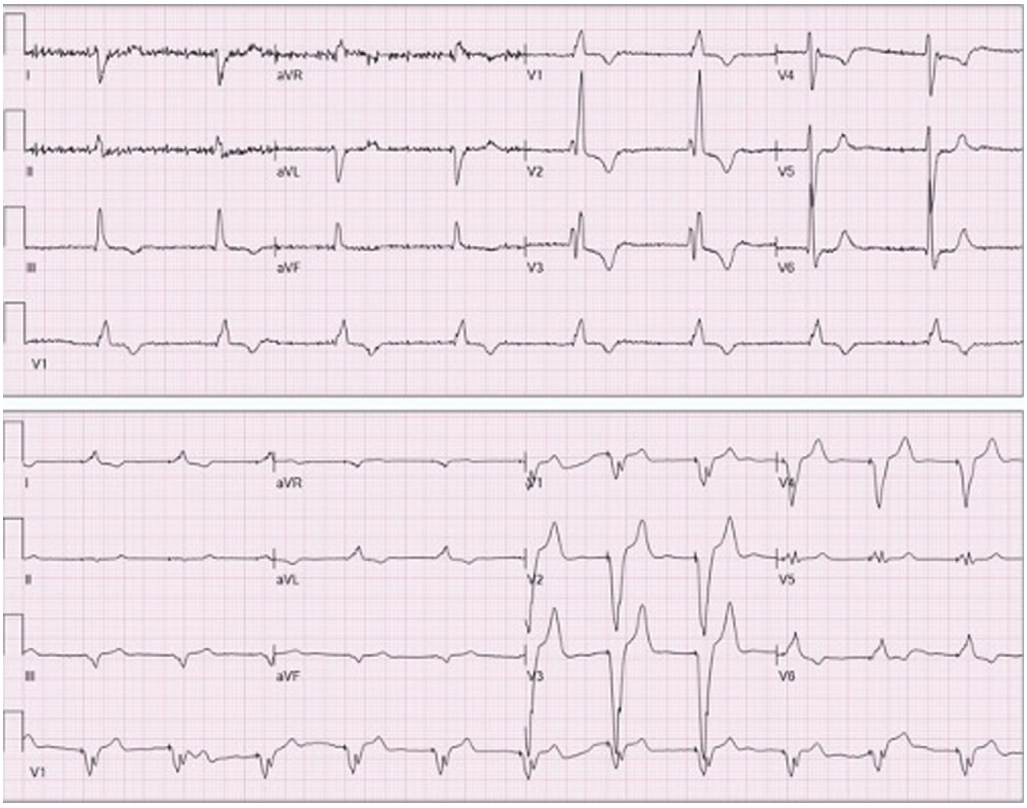
At the time of admission, the patient's medical treatment did not include drugs with negative chronotropic effect nor with slowing effects on atrioventricular node conduction, so a iatrogenic block was promptly excluded. Blood examinations showed a normal electrolyte panel; therefore, ionic imbalance was also ruled out as a possible cause of atrioventricular conduction block.

INVESTIGATIONS

Transthoracic echocardiography showed normal LV dimensions and systolic function, stable gradients across mechanical mitral valve, and normal functioning of the tricuspid bioprothesis with estimated pulmonary artery pressure of 45 mm Hg; of note, an extreme biatrial dilatation (left and right atrial volumes 550 and 270 mL, respectively, estimated by 2-dimensional echocardiography and Simpson's single plane method) was also documented.

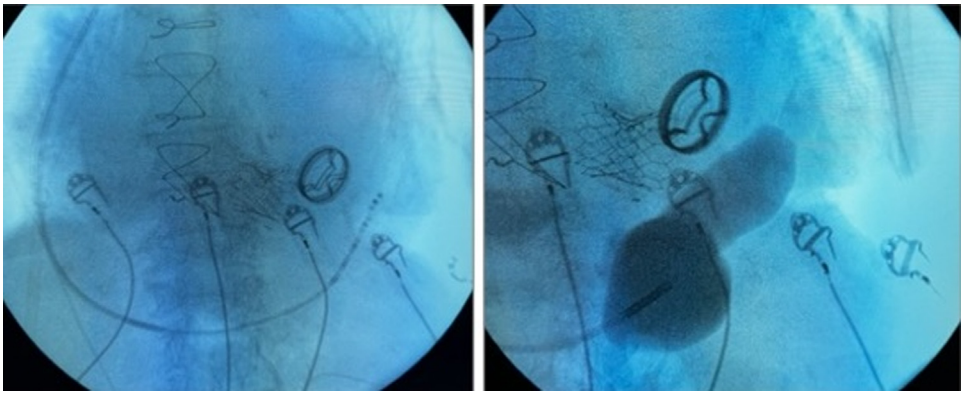
Although anatomical and surgical difficulties were foreseeable and a satisfying rhythm stability was reached, considering the emergency setting and operator experience, we decided not to perform any preliminary investigations except for intraprocedural coronary sinus angiography for determining coronary sinus anatomy.

FIGURE 1 Electrocardiogram at Presentation and After Leadless Pacemaker Implantation



Electrocardiogram at presentation (top) and after leadless pacemaker implantation (bottom).

FIGURE 2 Fluoroscopy Left Anterior Oblique Projection: Coronary Sinus Selectivation and Opacization



(Left) Coronary sinus selectivation, and (right) opacization.

MANAGEMENT

The patient was treated with intravenous diuretic agents and isoproterenol, reaching clinical stability and euvolemia (see electrocardiogram in **Figure 1**, top). Given the good response to low-dose isoproterenol, we considered temporary pacemaker (PM) implantation to be unnecessary, with risks and technical challenges outweighing possible benefits in the presence of the tricuspid valve bioprothesis.

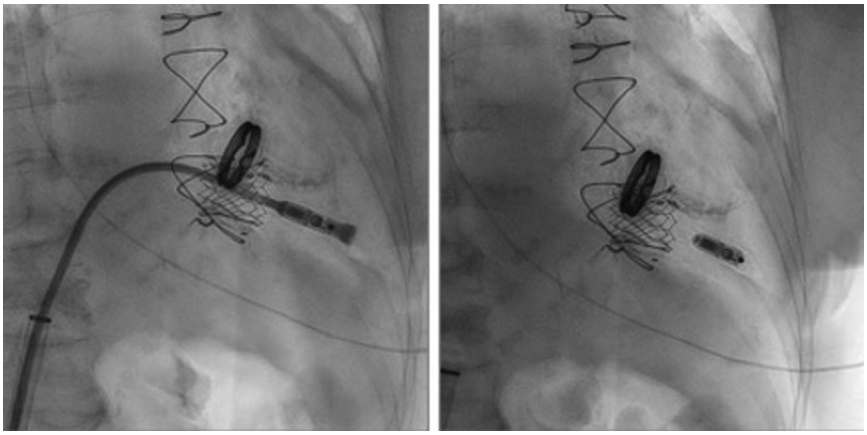
The patient had a Class I indication for PM implantation, with 2 main technical options according to current guidelines: surgical placement of an epicardial lead (which was excluded because of frailty and surgical history of the patient) and coronary sinus lead positioning.[1]

The first attempt was to place a lead in the coronary sinus; we found a huge dilatation of the vessel, with total lack of collateral branches even on the anterior LV wall, despite several attempts with long contrast injections (**Figure 2**).

We excluded standard endocardial leads for the right ventricle because of the risk of tricuspid regurgitation caused by interaction of the prothesis with the lead.

Because the standard endocardial road and surgical option were not feasible, a leadless PM option was left. The huge right atrium was reached through right

FIGURE 3 Fluoroscopy Right Anterior Oblique Projection: Leadless Pacemaker Positioning and Final Device Position



(Left) leadless pacemaker positioning, and (right) final device position.

femoral vein access. After that, carefully moving across the tricuspid prothesis and monitoring each movement both in left and right anterior oblique projections, the right ventricle was reached. An effort was made to constantly hold the delivery system at the center of the tricuspid prothesis during delivering attempts: 3 attempts were necessary because of suboptimal electrical parameters. In the end, the best parameters were found on the middle interventricular septum (**Figure 3**) (R-wave amplitude 5 mV, impedance 650 Ω, threshold 0.63 V at 0.24 ms), theoretically the best position for avoiding interactions with the tricuspid valve and for minimizing cardiac perforation risks. At traction test, the device was determined to be adequately engaged.

The day after, a routine device check confirmed the good electrical parameters. The transthoracic echocardiography confirmed the absence of tricuspid prothesis damages. To guarantee a chronotropic support in the setting of acute heart failure caused by previous extreme bradycardia, we set the lower rate to 70 pace per minute (**Figure 1**, bottom).

DISCUSSION

In recent years, tricuspid valve disease has been gaining attention because of its increased prevalence in an ageing population, and there has been a push to develop percutaneous options for replacement and repair in high surgical risk cases.[2,3] Technologies advances made treatment of severe tricuspid valve disease possible also in older patients with history of valvular heart disease already treated with surgery.[2]

These are patients that often, during follow-up, present with both atrial arrhythmias and atrioventricular node conduction pathologies that may lead to PM implantation.

Traditionally, endocardial lead positioning through a repaired or a bioprosthetic tricuspid valve, although not contraindicated, has been regarded as a suboptimal solution, because of the possible interference with the repaired valve or prothesis.[1] According to the most recent European guidelines, our patient had 2 main technical options to be preferred over endocardial right ventricular pacing lead positioning: surgical placement of an epicardial lead and coronary sinus lead positioning.[1]

A single lead in the coronary sinus may not be the best option in PM-dependent patients, because of limited lead stability after implantation; active fixation leads currently available are only quadripolar, so in this case, we would have been forced to use a passive fixation bipolar catheter. On the other hand, a surgical epicardial lead implantation was not considered a feasible option in our fragile and already surgically treated patient: this option presents higher operatory risks, requires a longer recovery period, and may not be anatomically feasible in patients who already underwent cardiac surgery.

In the last few years, leadless PM has become a very important alternative in patients who need cardiac pacing and who present contraindications to standard endocardial implants. Moreover, it has already been proven that leadless PM implantation has not a significant impact on tricuspid valve regurgitation, above all if the basal septum position is avoided.[4]

To our knowledge, there are only few examples in the published data of patients with transcatheter tricuspid valve prothesis who underwent a leadless PM implantation.[5-7] In our patient's case, percutaneous and surgical options were excluded or not feasible, leaving us with no possible alternative but a leadless PM implantation. The procedure was well tolerated in the absence of complications in the acute phase and without damaging the tricuspid prothesis.

FOLLOW-UP

The patient was discharged to cardiac rehabilitation. A device control was planned early to lower the rate to 60 pace per minute. Heart failure therapy was further optimized. Regular clinical and instrumental follow-up was scheduled.

CONCLUSIONS

Leadless PM should be considered a technically feasible alternative to coronary sinus or epicardial lead positioning in patients with percutaneous tricuspid valve bioprothesis and need for permanent pacing. As the number of tricuspid prothesis is increasing, additional information about feasibility and safety of these kind of implantations will have growing importance in clinical practice.

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KEY WORDS **leadless pacemaker, percutaneous tricuspid valve prothesis**