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Management of Bradycardia Before Transcatheter Aortic Valve Implantation in a Patient with Mechanical Tricuspid and Mitral Valve Replacement

Mekanik Triküspit ve Mitral Kapak Replasmanı Olan Bir Hastada Transkateter Aort Kapak İmplantasyonu Öncesi Bradikardi Yönetimi

ABSTRACT

Transcatheter aortic valve implantation (TAVI) has proven to be a safe and effective treatment, particularly in patients with aortic stenosis and moderate to high surgical risk scores. One potential complication after TAVI is bradyarrhythmia due to high-grade atrioventricular block, which may necessitate permanent pacemaker (PM) implantation. We present a case of a patient with symptomatic intermittent pauses and severe aortic stenosis who underwent permanent PM implantation via the coronary sinus prior to TAVI, due to a history of mechanical tricuspid and mitral valve replacements. The subsequent TAVI procedure was successful, and the patient remained stable without periprocedural complications.

Keywords: Aortic stenosis, pacemaker, valve disease

ÖZET

Transkateter aort kapak implantasyonu (TAVI), özellikle cerrahi risk skoru orta ila yüksek olan aort darlığı hastalarında güvenli ve etkili bir yöntem olduğunu kanıtlamıştır. TAVI sonrası olası komplikasyonlardan biri, yüksek dereceli atriyoventriküler bloktan kaynaklanan bradiaritmidir. Bu durumdaki bazı hastalar kalıcı kalp pili (PM) implantasyonu gerektirebilir. Bu durumda, semptomatik aralıklı duraklamalar ve şiddetli aort darlığı olan, mekanik triküspit ve mitral kapak replasmanı öyküsü nedeniyle TAVI öncesinde koroner sinüs yoluyla kalıcı PM implantasyonu uygulanan ve ardından başarılı bir TAVI geçiren bir vaka sunduk. Hasta, işlem sırasında herhangi bir komplikasyon yaşamadan stabil kaldı.

Anahtar Kelimeler: Aort darlığı, kalp pili, kapak hastalığı

CASE REPORT
OLGU SUNUMU

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Transcatheter aortic valve implantation (TAVI) is a safe and effective procedure, especially for patients with aortic stenosis (AS) who have intermediate to high surgical risk scores.[1] A known complication following TAVI is bradyarrhythmia resulting from high-grade atrioventricular (AV) block.[2] We present a case of a patient with symptomatic intermittent pauses and severe AS who underwent permanent pacemaker (PM) implantation via the coronary sinus (CS) prior to TAVI, due to a history of mechanical tricuspid and mitral valve replacements (TVR and MVR), followed by an uneventful and successful TAVI procedure.

Case Report

A 68-year-old female with a history of myelodysplastic syndrome, mechanical TVR and MVR surgery, and atrial fibrillation was admitted to our center with complaints of shortness of breath, classified as New York Heart Association Class II. Physical examination revealed a mechanical prosthetic valve sound and a severe systolic murmur in the aortic focus on auscultation. Laboratory tests showed a hemoglobin level of 10.1 g/dL, a platelet count of 51 × 103u/L, and a brain natriuretic peptide (BNP) level of 109 pg/mL. A 12-lead electrocardiogram (ECG) on admission demonstrated atrial fibrillation with a ventricular rate of 50 bpm and a QRS duration of 90 ms (Figure 1). The patient's 24-hour Holter monitoring revealed a total of 37 pauses ranging from 2.5 to 3 seconds

in duration (Figure 2). These pauses were strongly associated with clinical symptoms including presyncope, dizziness, and severe fatigue, which occurred concurrently with the patient's complaints of shortness of breath and were temporally correlated with the documented pauses. Transthoracic echocardiography (TTE) showed a left ventricular ejection fraction of 60%, with a significantly enlarged left atrial anteroposterior diameter of 90 mm. The right ventricle was also dilated, with a mid-cavity diameter of 30 mm and a basal diameter of 43 mm. The mechanical tricuspid and mitral valves were functioning normally. However, the aortic valve was heavily calcified, with mild aortic valve insufficiency and severe aortic stenosis, (characterized by an aortic valve area of 0.7 cm2, a peak gradient of 72 mmHg, and a mean gradient of 39 mmHg). The European System for Cardiac Operative Risk Evaluation II (EURO-SCORE II) and the Society of Thoracic Surgeons (STS) score were calculated as 12.04% and 10.8%, respectively. Therefore, the patient was deemed high surgical risk by the heart team, and a decision was made to proceed with TAVI. Given the patient's documented symptomatic bradyarrhythmia with significant pauses, and the presence of a mechanical tricuspid valve prosthesis that precluded conventional transvenous right ventricular lead placement, the heart team decided to implant a single-chamber permanent PM via the CS approach, two weeks prior to the scheduled TAVI procedure. This pre-emptive strategy was deemed essential for both periprocedural temporary rapid ventricular pacing during valve deployment and potential post-procedural bradyarrhythmia management. A left axillary vein puncture was performed, and a 9F delivery sheath (Attain Command™ + SureValve™ integrated valve, Medtronic, Minneapolis, MN, USA) was introduced. Severe dilation of the right heart chambers (right ventricular [RV] mid: 30 mm, RV base: 43 mm) hindered CS cannulation using standard CS catheters, necessitating the use of a steerable radiofrequency ablation catheter for successful access. Despite these efforts, optimal CS venography could not be achieved due to distorted cardiac anatomy and the absence of an occlusion balloon. The guidewire was advanced to the most distal accessible location, identified as the anterior interventricular branch of the CS. Lead placement in this branch was successfully accomplished with acceptable electrical parameters (Medtronic, Minneapolis, MN, USA; threshold: 2.3 V, impedance: 805 Ω, sensing: 17.8 mV),

ABBREVIATIONS

AS	Aortic stenosis
AV	Atrioventricular
BNP	Brain natriuretic peptide
CS	Coronary sinus
ECG	Electrocardiogram
EURO-SCORE II	European System for Cardiac Operative Risk Evaluation II
LBBB	Left bundle branch block
LVEF	Left ventricular ejection fraction
MVR	Mitral valve replacement
PM	Pacemaker
RBBB	Right bundle branch block
RV	Right ventricular
SAVR	Surgical aortic valve replacement
STS	Society of Thoracic Surgeons
TAVI	Transcatheter aortic valve implantation
TTE	Transthoracic echocardiography
TVR	Tricuspid valve replacements

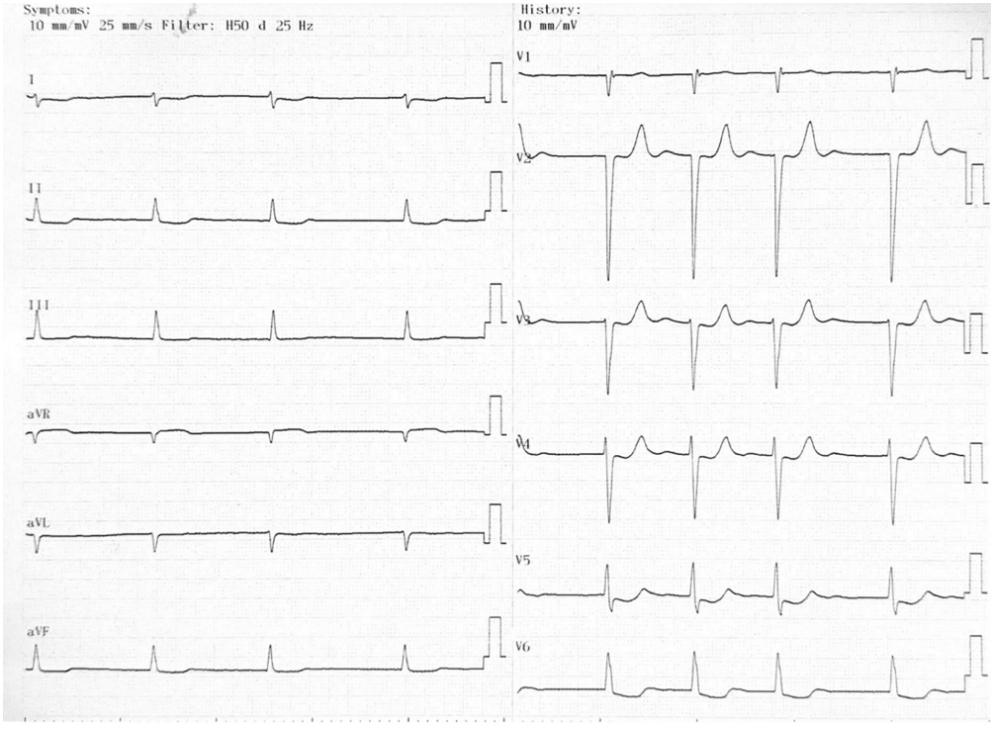

Figure 1. Twelve-lead electrocardiogram before the transcatheter aortic valve implantation (TAVI) procedure showing atrial fibrillation, a ventricular rate of 50 bpm, and a QRS duration of 90 ms.

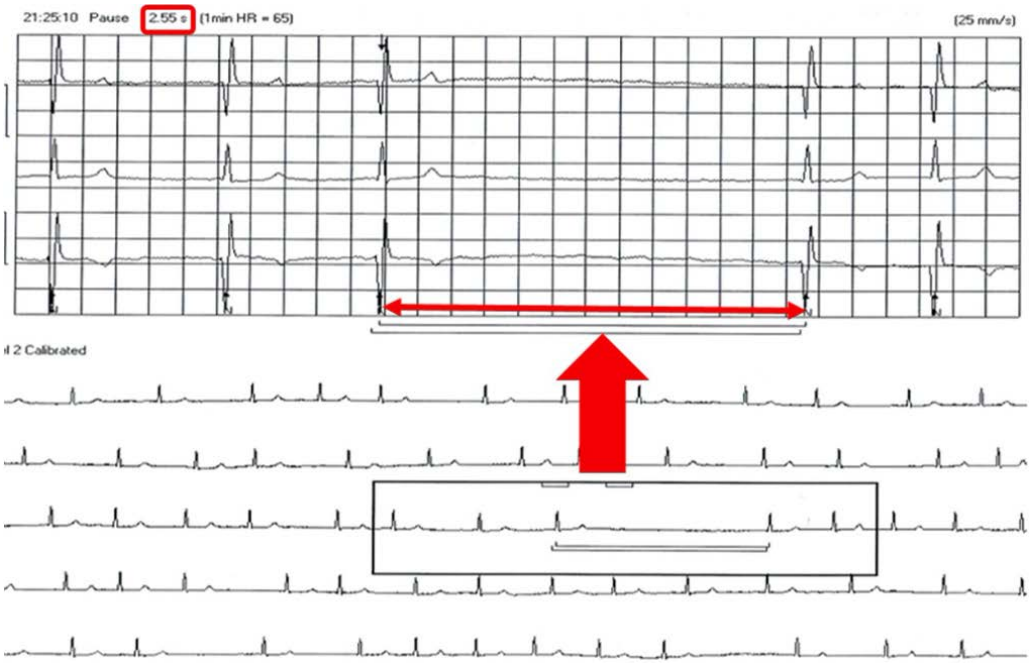

Figure 2. Twenty-four-hour Holter monitoring demonstrating a 2.6-second ventricular pause during atrial fibrillation.

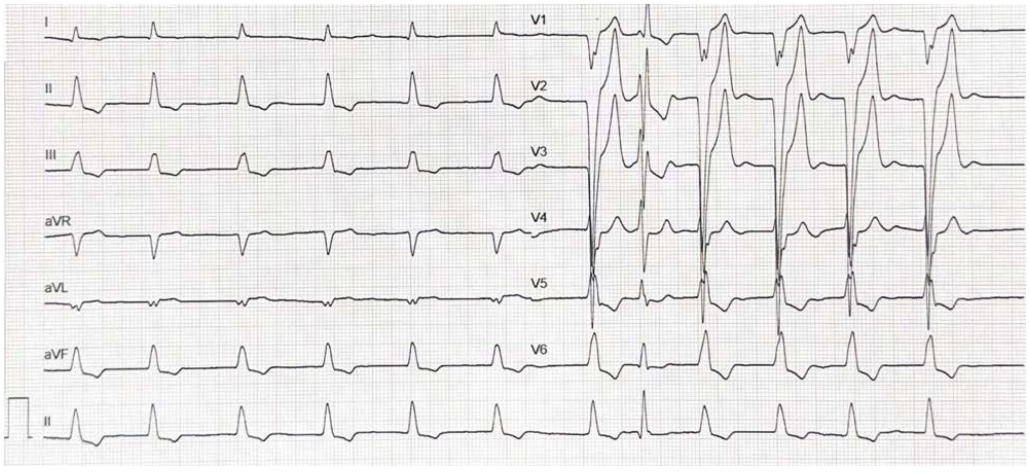

Figure 3. Twelve-lead electrocardiogram immediately after the transcatheter aortic valve implantation (TAVI) procedure showing atrial fibrillation, new-onset left bundle branch block, and a QRS duration of 150 ms.

providing adequate pacing support for both the TAVI procedure and the management of symptomatic pauses (Supplementary Video 1). After confirming acceptable sensing and pacing parameters, the lead was connected to the pulse generator, and the procedure was successfully completed using a standard approach. One week later, the patient underwent a successful TAVI procedure under anesthesia. A 29-mm self-expandable aortic prosthetic valve (Medtronic, CoreValve Evolut, USA) was successfully implanted (Supplementary Video 1). Ventricular overdrive pacing was performed via the previously implanted permanent PM during valve implantation. Postprocedural aortography revealed minimal aortic valve insufficiency. A post-procedural peak-to-peak transaortic gradient of 12 mmHg was measured. There were no periprocedural complications. Post-TAVI 12-lead ECG revealed a new-onset left bundle branch block (LBBB) with a QRS duration of 150 ms (Figure 3). However, on the second day, the 12-lead ECG showed intermittent ventricular pacing rhythm due to pauses, along with improvement of the LBBB (Figure 4). The patient was discharged uneventfully 48 hours later.

Discussion

The TAVI procedure was first performed and reported by Cribier et al. in 2002.[3] With increasing clinical experience and advancements in technology, TAVI has become widely adopted across the globe. During the TAVI procedure, various conduction system abnormalities, including bundle branch blocks and atrioventricular blocks, may occur due to the anatomical

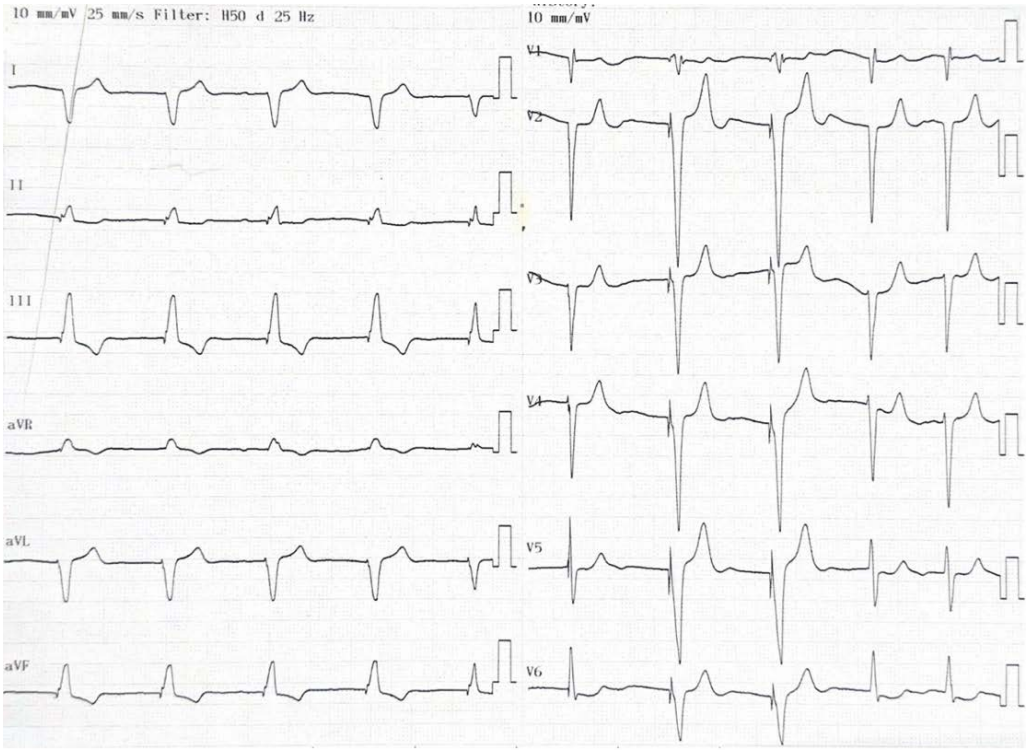

Figure 4. Twelve-lead electrocardiogram on the second day after transcatheter aortic valve implantation (TAVI) demonstrating an intermittent pacemaker rhythm and improvement of the left bundle branch block.

proximity. While surgical aortic valve replacement (SAVR) remains the preferred option for patients with low surgical scores (STS, EURO-SCORE), TAVI is a safe and effective alternative for appropriately selected elderly patients across all risk groups. Potential complications following TAVI include vascular injury, stroke, aortic valve insufficiency, bleeding, and valve malposition.[4] According to a meta-analysis, the rate of permanent PM implantation after TAVI is approximately 15%.[5] Predictive factors for the development of high-degree block after TAVI include right bundle branch block (RBBB), LBBB, intraventricular conduction delay, bifascicular block, atrial fibrillation with a low ventricular rate, male gender, and use of self-expandable valve prostheses.[6] Despite advancements in technology and procedural techniques, high-degree AV block and the subsequent need for permanent PM implantation remain relevant concerns following TAVI. Although permanent PM implantation is not required in most cases of newly developed LBBB after TAVR, studies and current guidelines indicate that the risk of permanent PM implantation is higher in patients with a QRS duration > 150 ms, PR duration > 240 ms, atrial fibrillation (AF), and a left ventricular ejection fraction (LVEF) < 40%.[7] Furthermore, ventricular overdrive pacing is routinely required during valve implantation, and periprocedural temporary transvenous pacing may be necessary in some patients. Therefore, a transvenous temporary PM electrode is generally placed in the right ventricle. However, the presence of a mechanical TVR before TAVI poses an obstacle to this approach for both overdrive ventricular pacing and temporary or permanent pacing after the procedure. Overdrive ventricular pacing during valve implantation can be achieved via a guidewire placed inside the left ventricle; however, this method cannot be used for temporary pacing after the procedure. Catheter ablation targeting atrial arrhythmias has been described in the literature as an effective treatment strategy for patients with refractory ventricular pauses, particularly in cases of bradycardia mediated by vagal reflexes.[8] Left atrial enlargement, especially with a diameter exceeding 50 mm, is a significant predictor of poor outcomes following catheter ablation for atrial fibrillation.[9] Our patient presented with severe left atrial dilatation (> 90 mm), which constituted a major limiting factor for ablation therapy. Additionally, the patient would have required a permanent PM in the event of developing high-grade atrioventricular block due to mechanical compression of the AV node following TAVI. Therefore, in our case, permanent PM implantation via the CS was performed two weeks prior to the TAVI procedure. Studies have shown that ventricular electrode implantation via the CS is a safe and effective method in patients where right ventricular pacing is not feasible due to tricuspid valve disease (e.g. atresia, severe stenosis) and/or TVR.[10] Alternative pacing modalities in patients with mechanical TVR present significant technical challenges. Epicardial lead placement is another option that can be prophylactically performed during tricuspid valve surgery; however, it requires a more invasive procedure and is generally associated with higher pacing thresholds.[11] More recently, leadless PM implantation through mechanical tricuspid valves has been reported in isolated cases, though this approach has not gained widespread acceptance due to limited data regarding potential effects on valve function.[12] To ensure safety, a permanent PM was implanted via the CS route prior to the TAVI procedure in our patient. The TAVI procedure was then successfully performed one week later, with no periprocedural complications observed.

Ethics Committee Approval: This is a single case report, and therefore ethics committee approval was not required in accordance with institutional policies.

Informed Consent: The patient was fully informed about the publication of this case in the literature and provided both written and verbal consent.

Conflict of Interest: Kudret Aytemir: Proctoring for Medtronic, Abbott, and Biosense Webster. Uğur Canpolat: Proctoring for Biotronik and Medtronic. Mehmet Levent Şahiner: Proctoring for Medtronic. Other authors have nothing to disclose.

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Video 1. (A) Difficult venography performed via the standard delivery sheath showing the coronary sinus (CS) venous branches. (B) Due to difficulty advancing the CS electrode into the lateral branches because of small diameters, the CS electrode was implanted into the anterior interventricular branch of the CS. (C) Successful transcatheter aortic valve implantation (TAVI) with minimal aortic insufficiency observed post-procedure.

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