

**CASE REPORT****Cardiac Rehabilitation in Patients with Pacemakers Implantation:  
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**ABSTRACT**

Total atrioventricular (AV) block is a cardiac condition in which the impulses originating from the atrium fail to reach the ventricles. Implantation of a permanent pacemaker (PPM) is recommended in the presence of symptomatic bradycardia and high-risk conditions such as total AV block. In this case, a 72-year-old male patient was subjected to PPM implantation for total AV block, and the cardiac rehabilitation program commenced after the patient was hemodynamically stable. During the initial phase of cardiac rehabilitation, in-bed exercises were carried out to prevent complications associated with rest, such as joint range of motion and breathing exercises. Furthermore, the program started 24 hours after the PPM implantation and involved more intensive mobilization to promote quicker recovery. The second phase of cardiac rehabilitation (outpatient) was carried out for 4-8 weeks considering the required healing time of 1 week after implantation. The patient's mobility improved significantly and was able to walk longer distances without the need for walking aids. A six-minute walking test was conducted, where the patient covered a distance of 315 meters, with a  $\text{VO}_2$  max of 13.43 and 3.83 METs.

**Keywords:** Atrioventricular Block; Pacemaker; Cardiovascular disease; Cardiac Rehabilitation

## ABSTRAK

AV blok total merupakan suatu kondisi saat impuls dari atrium tidak bisa sampai di ventrikel. Indikasi pemasangan alat pacu jantung yaitu bradikardia yang menimbulkan gejala serta kondisi berisiko tinggi termasuk AV blok total. Pembahasan kasus berikut merupakan pasien laki-laki berusia 72 tahun dengan AV blok total pasca pemasangan *permanent pacemaker* (PPM). Program rehabilitasi jantung, dimulai ketika pasien stabil secara hemodinamik setelah pemasangan PPM. Latihan di tempat tidur dilakukan untuk mencegah komplikasi tirah baring seperti latihan lingkup gerak sendi serta latihan pernapasan rutin (*breathing exercise*). Setelah pasien menjalani pemasangan PPM, fase pertama (*inpatient*) rehabilitasi jantung dengan program mobilisasi dimulai saat 24 jam setelah implantasi. Selanjutnya setelah implantasi dilakukan mobilisasi lebih intensif. Pada fase selanjutnya, dilakukan rehabilitasi jantung fase kedua (*outpatient*) selama 4-8 minggu dengan memperhitungkan waktu penyembuhan setelah 1 minggu pasca implantasi. Pasien sudah mampu berjalan lebih jauh tanpa alat bantu jalan. Hasil uji jalan enam menit didapatkan jarak tempuh 315 meter dengan  $VO_2$  max 13,43 dan 3,83 METs.

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## INTRODUCTION

Atrioventricular (AV) conduction block refers to an abnormality in which the atrial impulses to the ventricle are delayed or even absent. This condition is classified as first, second, and third-degree AV block based on the abnormality severity. Third-degree AV block is also known as total AV block (TAVB) when the atrial impulses cannot reach the ventricles.<sup>1</sup> Clinically, a patient with TAVB feels fatigued

or syncope, depending on the speed of ventricular escape. TAVB is characterized by an abnormality of AV conduction, in which the P wave is not interconnected with the QRS complex, and slower ventricular pulses are observed.<sup>2</sup>

AV block commonly occurs in the absence of significant heart disease, and it is often linked to idiopathic fibrosis, inflammation, infarction, or other conditions that disrupt the conduction system.<sup>3,4</sup> In the context of an acute coronary syndrome (ACS), the incidence of TAVB reaches 3-14%<sup>5</sup> in association with a higher prevalence of permanent pacemaker (PPM) implantation ranging from 13%-17%.<sup>6</sup>

AV block is a frequent cause of pacemaker implantation<sup>3</sup> and the temporary type is preferred when the bradyarrhythmia is reversible. PPM implantation is indicated

when bradycardia produces symptoms such as syncope and falls.<sup>4</sup>

Cardiac rehabilitation has proven effective as a secondary prevention strategy, encompassing both psychosocial and physiological health conditions in patients with heart disease. However, there are only limited specific recommendations available for patients with conventional pacemakers.<sup>7</sup> Previous study consistently showed that therapeutic exercise was safe and effective in maintaining post-pacemaker implantation condition.<sup>8</sup> The following case report discussed a rehabilitation program in 72 years old male patient with TAVB on TPM which was planned for PPM implantation. There were complications such as infection and displacement of TPM which caused pericardium perforation in the patient.

## CASE PRESENTATION

A 72-year-old male presented with severe dyspnea and was admitted to the Intensive Cardiac Care Unit (ICCU) at RSCM. The patient reported worsening symptoms when lying down, which were relieved by sleeping with two pillows. There was no report of chest pain and was previously subjected to an ECG examination at the first hospital, which showed TAVB, as seen in Figure 1. Additionally, Coronary Angiography (CAG) was performed, and the results reported non-significant coronary artery disease. To manage TAVB, TPM implantation was conducted through the right femoral vein, with a frequency of 80 beats per minute, a sensitivity of 2 mA, and an output of 3 mA. Furthermore, the patient was then referred to RSCM for PPM implantation.

On the second to the third day of treatment at ICCU, RSCM, shortness of breath was still present. The patient also had a fever with a temperature of 40 degrees, pulse frequency of 45-60 x/minute, breathing frequency of 24 x/minute, blood pressure of 135/89 mmHg, and saturation of 98% with oxygen supplementation of 1 lpm. On physical examination, the insertion site of TPM looked swollen, and red with a hematoma. On the supporting examination, there was an increase in infection markers (leukocytes 12,710 mg/dL, CRP 21.9 mg/L, procalcitonin 0.09 ng/dL), and urine examination (turbid urine, leukocytes >30, erythrocytes>30, HB +3, positive nitrites, leucocyte esterase +2). Furthermore, the ECG showed a picture of TAVB, 41 bpm, QRS duration 0.16 s, and no change in ST-T. The patient was scheduled for PPM implantation and provided with rehabilitation programs that included bed activities and sitting mobilization at 30-45° to prevent movement of TPM. However, the exercise was postponed due to the presence of a fever.

On the fourth day, the patient experienced unconsciousness, and on the supporting examination, there was an increase in infection markers compared to before (CRP 102.9 mg/L, procalcitonin 2.93 ng/dL). Echocardiography reported TPM dislodgement accompanied by massive pericardium effusion due to cardiac perforation and the insertion was then changed through the left femoral and pericardiocentesis. After the patient's condition stabilized, mobilization was initiated with a program that included sitting at a 30-45° angle to prevent the movement of TPM. Additionally, breathing exercises were performed with ankle pumping, and active joint motion in both the upper and lower right extremities.

On the thirteenth day of treatment, the patient was subjected to PPM implantation. Mobilization was gradually increased 24 hours after the procedure, with a target of 1-2 METS physical activity levels for out-of-bed mobilization. However, activities were only performed around the bed for less than 5 minutes due to dizziness and nausea. On the seventeenth day, the patient was discharged using a wheelchair due to the inability to walk for long distances.

The patient had a follow-up visit at the medical rehabilitation outpatient clinic two weeks after being discharged. There were no complaints of chest pain or dyspnea and was able to walk long distances without any walking aid. A six-minute walking test was conducted, where the patient covered a distance of 315 meters with a VO<sub>2</sub> max of 13.43 and 3.83 METs. Due to the ongoing pandemic situation, phase II home-based cardiac rehabilitation was conducted. The prescribed aerobic exercise regimen included 3-5 days/week with an intensity on the BORG scale of 11-13.

## DISCUSSION

AV block is a common indication for pacemaker implantation.<sup>9</sup> It is important to note that when the bradycardia is reversible, TPM is preferred over PPM implantation. However, a PPM is considered necessary when bradycardia causes symptoms such as syncope, falls, or sudden death. Mobitz type I (Wenckebach) or type II second-degree AV block, advanced AV block (block 2 or more consecutive P waves), or total AV block (third degree) are high-risk conditions that may require PPM implantation.<sup>10</sup>

Initially, the patient was subjected to external TPM implantation on the femoral site. This approach is often used in emergencies or for older patients with poor general health who are hemodynamically unstable and uncooperative before permanent pacemaker placement.<sup>11</sup> As documented in the literature, the duration of implantation was prolonged due to infection at the insertion site, which subsequently resulted in dislodgement of TPM, leading to pericardial effusion. The incidence of infections at the site of insertion and sepsis is typically low, estimated to be around 1%, which may be attributed to adherence to rigorous aseptic techniques during implantation. It is important to note that electrode migration occurs in a significant proportion of patients, ranging from 18% to 43%, and may be further compounded by disorientation in elderly patients. According to the study by Lopez Ayerbe et al, disorientation in elderly patients may increase the risk of pacemaker malfunction by 10.7-fold. It is a frequently observed condition among older patients, which may lead to inadvertent movement of limbs and electrode catheters, ultimately contributing to device malfunction.<sup>12</sup> Presently, the patient's mobility is restricted to bed rest, with ambulation being contraindicated.<sup>11</sup> Direct implementation of rehabilitation programs in patients with sepsis may not be feasible, resulting in prolonged immobilization. This may further exacerbate functional impairments and lead to decreased muscle mass.<sup>13</sup>

Cardiac rehabilitation has effectiveness as a secondary prevention, as well as improving psychosocial and physiological health conditions in cardiac patients.<sup>7</sup> Exercise may improve heart function through the effects

of restoring peripheral circulation and has consistently been shown to be safe as well as effective in sustaining the changes affected by pacemakers.<sup>8</sup> Despite the importance of rehabilitation after pacemaker device implantation, there are limited specific guidelines available for this purpose. To determine an appropriate exercise program, it is crucial to conduct an exercise test. The exercise prescribed should be designed to the patient's level of responsiveness, with a goal of achieving heart rate adaptation to the physical activity that closely mimics the physiological range achievable with the function of the pacemaker. An important feature, known as rate response or rate-adaptive pacing, is the ability to increase the pulse rate in response to physical activity, as well as mental or emotional stress. This feature can aid in achieving appropriate heart rate adaptation during exercise.<sup>7</sup>

Therapeutic exercise has consistently been shown to be safe and also effective in maintaining a better condition after pacemakers implantation.<sup>8</sup> In this patient, cardiac rehabilitation started after PPM insertion when the hemodynamic condition was stabilized. The initial phase of rehabilitation following pacemaker implantation typically begins 24 hours after the procedure. During this phase, light-intensity exercises are often prescribed to prevent complications associated with immobilization.<sup>14</sup> The second phase of rehabilitation can typically begin as early as one week after implantation and may involve aerobic exercises. However, strenuous activities involving the upper extremities, such as swimming, bowling, weightlifting, or golf, should be avoided for up to six weeks

following implantation.<sup>8,15</sup> The recommended frequency of aerobic exercise was 3-5 days/week, and Haennel et al. did not recommend exercise for 2 hours per session due to a lack of safety evidence. The European Society of Cardiology (ESC) stated that exercise intensity reached 40%-70% of the heart rate reserve (HRR) or 10-14 on the RPE Borg scale. Furthermore, Haennel et al. recommended that exercise targets in post-pacemaker insertion patients were to reach the frequency of resting pulses added with 40%-60% of HRR. Another guide to aerobic exercise in post-implantation patients was movement in a standing position, such as walking.<sup>8</sup>

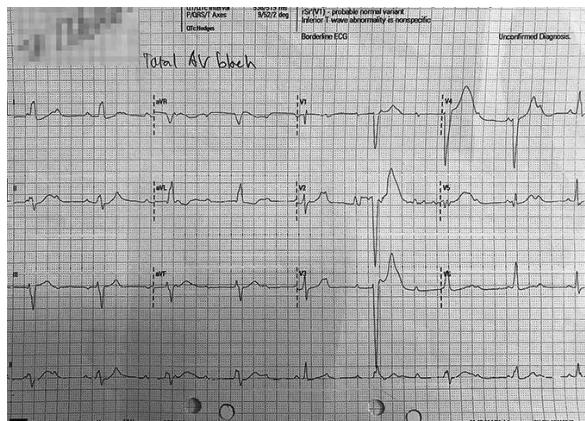
In the patient, phase two rehabilitation was set to a home-based program. Several studies investigated the effectiveness of home-based exercise programs for patients with some promising results. For instance, Smolis Bak et al. showed improvements in endurance and quality of life among patients subjected to a telemonitoring-based exercise program. The exercise regimen involved five sessions per week, for a total of eight weeks, and no adverse effects were reported during the program.<sup>8</sup>

## CONCLUSION

In conclusion, cardiac rehabilitation in patients with TAVB after PPM implantation is carried out by paying attention to stable criteria before starting exercise. In addition, exercise is adjusted to the hemodynamic response that occurs as signs or symptoms of exercise intolerance. Cardiac rehabilitation is safe and effective to provide improvement of functional capacity in patients after PPM implantation.

## ACKNOWLEDGMENTS

The author is grateful to the patient for willing to participate in this study.



**Figure 1. ECG Results**



**Figure 2. Anteroposterior Chest X-Ray after PPM implantation**

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