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Occurrence of Torsade de Pointes prior to complete lead connection during pacemaker implantation

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ABSTRACT

Torsade de Pointes (TdP) can be triggered by a pacing spike on the T-wave, due to pacemaker undersensing. However, it is not widely known that this phenomenon can occur even during pacemaker implantation. An 84-year-old woman underwent pacemaker implantation for the treatment of a complete atrioventricular block with dyspnea. During the procedure, immediately following ventricular lead insertion and before torque wrench tightening, TdP was observed. Ventricular pacing was initiated by inserting the lead into the header of the generator; however, sensing remained unstable. T-waves associated with undersensed PVCs and ventricular pacing occurred simultaneously, resulting in a spike on the T-wave and TdP.

1. Introduction

In patients with permanent pacemakers, a pacing spike on the T-wave due to undersensing is a serious issue and could lead to ventricular arrhythmias [1,2]. However, it is unclear whether this could occur in a patient when connecting pacemaker leads during implantation. We report our experience of a rare but possible case of a spike on the T-wave during pacemaker implantation.

2. Case report

An 84-year-old woman was admitted with a 3-week history of dyspnea. On admission, a 12-lead electrocardiogram (ECG) revealed bradycardia at 36 bpm with complete atrioventricular block. The patient's QT and QTc intervals were 602 ms and 511 ms, respectively (Fig. 1). The patient's serum potassium level was 4.3 mEq/L, and magnesium level was 2.2 mg/dL, with no medical history suggestive of etiologies for prolonged QT intervals or bradycardia. The transthoracic echocardiogram showed an ejection fraction of 68% without synergy. Cardiac computed tomography showed no stenosis in the coronary arteries.

Accordingly, the patient underwent dual-chamber pacing (Assurity PM 2272, Abbott, St. Paul, MN, USA).

The pacemaker was initially set to the DDD mode, and the heart rate was set to 60 to 120 bpm. The atrial lead was screwed to the right atrial appendage, and the ventricular lead was attached to the inferior septum. The ventricular sensed R-wave amplitude was 13.3 mV, the pacing threshold was 0.75 V, and the impedance was 580 Ω. The atrial lead was connected to the generator followed by the ventricular lead. Immediately following ventricular lead insertion into the header of the generator and before torque wrench tightening, Torsade de Pointes (TdP) was observed (Fig. 2). Both the programmer records and magnified tracing revealed an undersensed premature ventricular contraction (PVC), precipitating a spike on the T-wave resulting in TdP (Fig. 3). External cardiac defibrillation was successful. TdP did not recur post-implantation; the patient was subsequently discharged.

3. Discussion

TdP can occur due to pacing spikes on T-waves. Undersensing commonly causes spikes on T-waves. When PVCs occur, QRS

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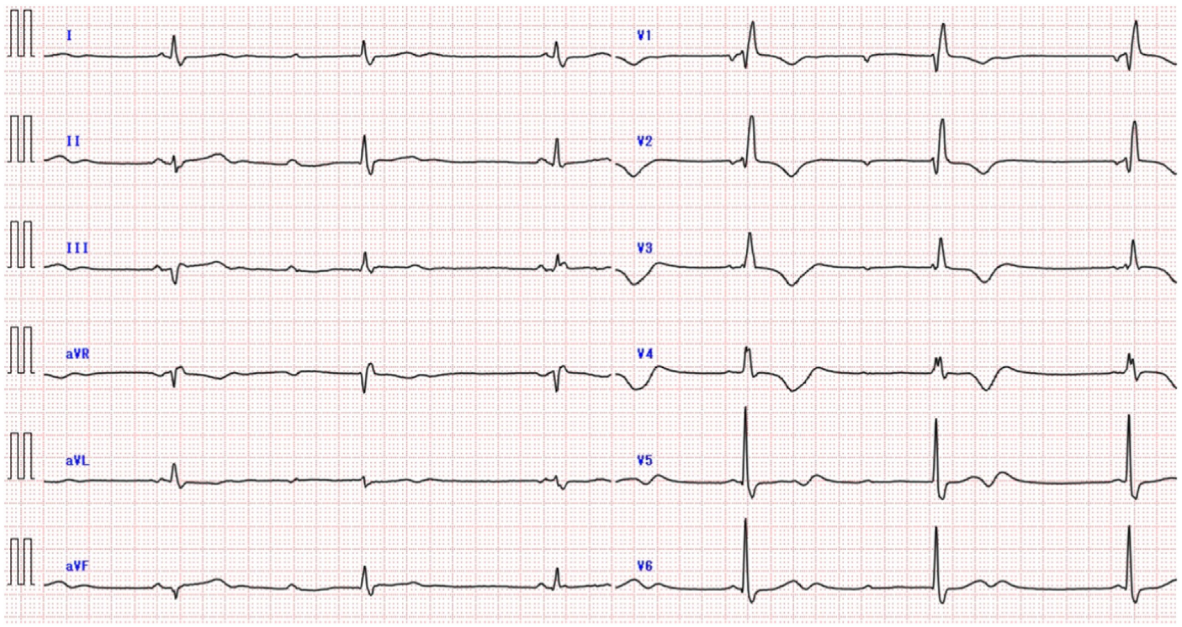

Fig. 1. The 12-lead electrocardiogram (ECG) on admission
|The ECG shows a heart rate of 36 bpm with complete atrioventricular block. The QT and QTc intervals were 602 ms and 511 ms, respectively.

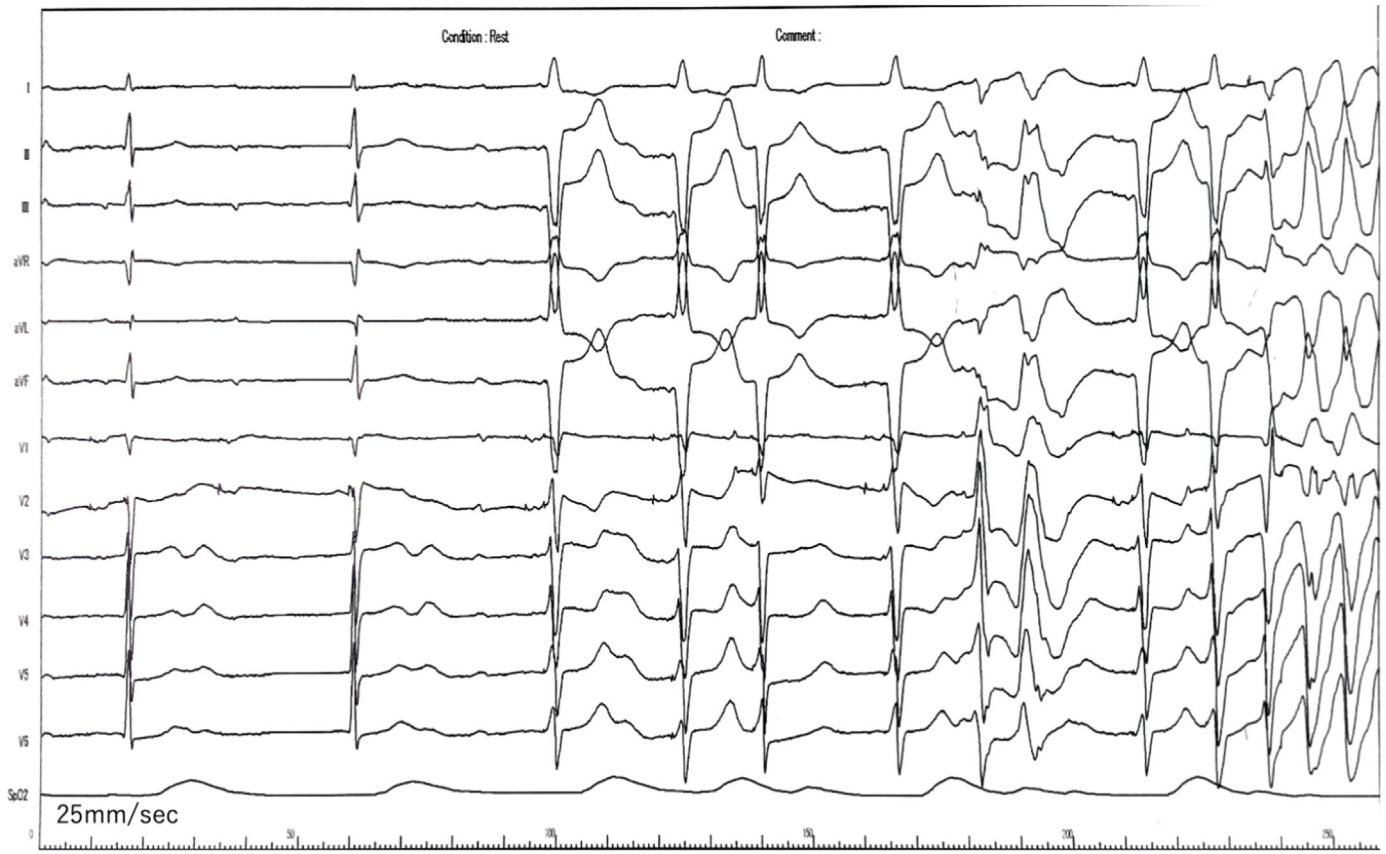

Fig. 2. Torsade de Pointes during pacemaker implantation
After inserting the ventricular lead into the header of the generator, and before tightening the torque wrench, Torsade de Pointes occurred after several pacing cycles.

complexes can be undersensed; these may then register as spikes on T-waves [3]. In this case, the undersensing and the T-wave spike occurred following lead insertion but before torque wrench tightening. Although there have been no prior reports on whether pacing can occur before the tightening, connection experiments in vitro demonstrated that irrespective of lead connection frequency, breakthrough pacing can occur before torque wrench tightening. Furthermore, TdP is more likely to occur in patients

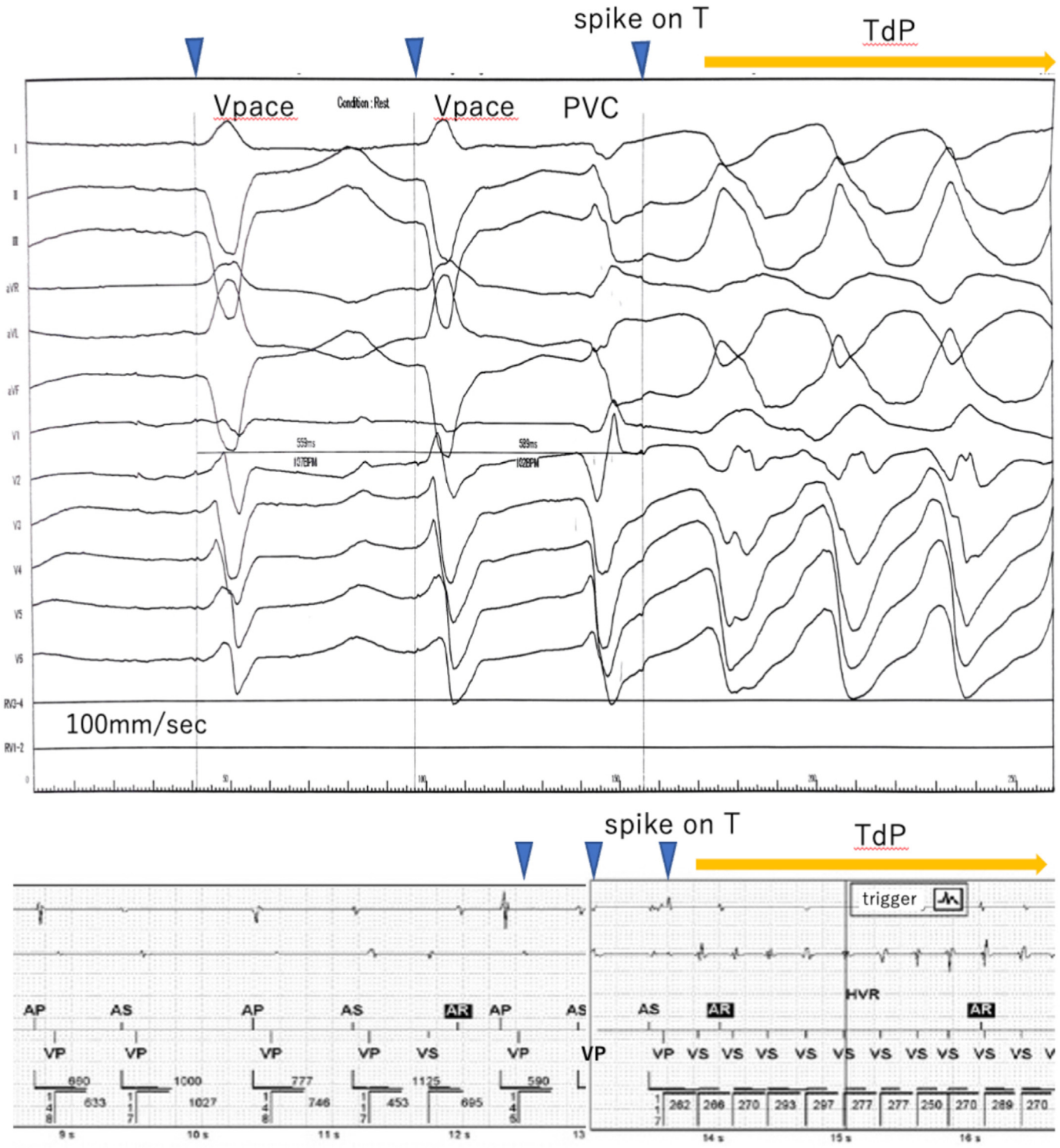

Fig. 3. Programmer records
Programmer records and enlarged ECG revealed that ventricular pacing (arrowhead) and undersensing of premature ventricular contraction (PVC) caused a spike on the T-wave, which resulted in Torsade de Pointes (TdP).

with QT prolongation. In this case with prolonged QT, T-waves associated with undersensed PVCs and ventricular pacing occurred simultaneously, resulting in a spike on the T-wave and TdP.

Several possible measures can prevent this. First, pre-operative insertion of a temporary pacing wire will help maintain a normal heart rate and reduce the occurrence of PVCs. Second, prior to connection, the device's pacing mode can be set to VVI or DDI, and the lower rate can be set at 30 bpm. In this case, the atrial lead was

first connected during DDD mode. Therefore, upon atrial wave detection, ventricular pacing occurred with a preset AV delay. If the VVI had been set even lower at 30 bpm, it would have minimized ventricular pacing while the patient was unstable before torque wrench tightening. However, an unexpected ventricular pace can occur when the device's pacing mode is set to VVI or ventricular lead is connected first, because of undersensed PVC under unstable conditions before the lead is completely connected. Third, the output of the ventricular lead should be set to a minimum value before device connection in order to inhibit effective pacing. The initial setting should be the lowest output at 0.2 V, thereby preventing unexpected pacing. Following torque wrench tightening and stabilization of sensing and pacing, the output may be increased upon reassessing the threshold. The last step is to lower the sensitivity threshold to avoid undersensing. However, excessively lowering the sensitivity is associated with oversensing due to abundant noise upon pacemaker implantation. In this case, a default setting of 2 mV was used, and this setting was reasonable.

In conclusion, this case describes TdP occurring upon pacemaker implantation caused by a spike on the T-wave. Ventricular pacing can be performed by simply inserting the lead into the header of the generator; however, sensing remains unstable. Changing the mode, lowering rate settings, inserting a temporary pacemaker, and tightening the lead quickly are key for ventricular arrhythmia prevention, especially in patients with prolonged QT and frequent PVCs.

Author contributions

Yusuke Morita and Junji Morita were substantial contributions to research design, or the acquisition, analysis or interpretation of data. Yusuke Kondo was drafting the paper or revising it critically. Kazuaki Tanabe was approval of the submitted and final versions.

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Dr. Kondo received lecture fees from Daiichi-Sankyo, Bayer, Abbott Medical Japan, Biotronik Japan, Boston Scientific, and Japan Lifeline, and research funds from Daiichi-Sankyo. Other authors have no conflicts of interest to declare.

Patient consent statement

Informed consent was obtained from the patient.

Declaration of competing interest

Dr. Kondo received lecture fees from Daiichi-Sankyo, Bayer, Abbott Medical Japan, Biotronik Japan, Boston Scientific, and Japan Lifeline, and research funds from Daiichi-Sankyo. The other authors declare no conflicts of interest.

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