



Rapid firing

Two cases of inappropriate implantable cardioverter-defibrillator therapies due to T wave oversensing induced by body twisting

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ABSTRACT

T wave oversensing (TWOS) is a common cause of inappropriate implantable cardioverter-defibrillator (ICD) therapies. Various algorithms to avoid inappropriate ICD therapy are available; however, they are not helpful to avoid TWOS. Although the reproduction of TWOS is useful to resolve the problem of TWOS, it is sometimes difficult to reproduce TWOS. We report two cases of inappropriate ICD therapy due to TWOS, which were induced only by body twisting. We can successfully manage the device based on the evidence of reproduced TWOS.

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1. Introduction

T wave oversensing (TWOS) is a common cause of inappropriate implantable cardioverter-defibrillator (ICD) therapies. Diminution of the R wave amplitude or dynamic gain of the T wave amplitude is a major cause of TWOS [1]. However, it is sometimes difficult to reproduce TWOS [1–3], which makes the management of TWOS by a noninvasive method difficult. A sensitivity change without any evidence often fails to prevent TWOS [1–3]. We experienced two cases of inappropriate ICD therapies due to TWOS, and we were able to reproduce TWOS by body twisting.

2. Case 1

A 32-year-old man was referred to our hospital for resuscitation from ventricular fibrillation (VF). After several examinations, he was diagnosed as having idiopathic VF. A single chamber ICD was implanted (Gem Model 7227, Medtronic Inc., Minneapolis, MN, USA). An integrated bipolar dual-coil ICD lead

(6944, Medtronic Inc.) was used. At implantation, the pacing threshold was 0.3 V at 0.5 ms; R wave amplitude, 13.8 mV; and lead impedance, 1429 Ω. Ventricular tachyarrhythmia detections were programmed only in the VF zone above 188 bpm. Therapy consisted of only ICD shocks. Sensitivity of the R wave was set at 0.3 mV.

Two years later, he complained of two ICD shocks during a dance party. The possibility of lead fracture or electromagnetic interference was completely excluded after several examinations. Intracardiac electrograms showed that all delivered shocks were inappropriate therapies due to TWOS. The R wave amplitude was 8.0 mV, which was slightly decreased compared to that at implantation, but we could not observe TWOS. Although we performed various challenging tests (exercise, body position, and drinking) (Fig. 1A, B), TWOS was not reproduced. Considering the situation of the ICD shocks (singing and dancing while drinking), we performed a body twisting test. TWOS was reproduced by body twisting (semi-sitting position with twisting to the right) (Fig. 1C) after exercise or isoproterenol (ISP) infusion. The TWOS disappeared when the sensitivity was changed from 0.3 mV to 0.9 mV (Fig. 1D). The ventricular sensitivity threshold was set at 0.9 mV, and defibrillation testing was performed to ensure no undersensing. The defibrillation test demonstrated good VF detection. The patient has not suffered from inappropriate ICD therapies due to TWOS for a period of 4 years despite participating in some dance parties.

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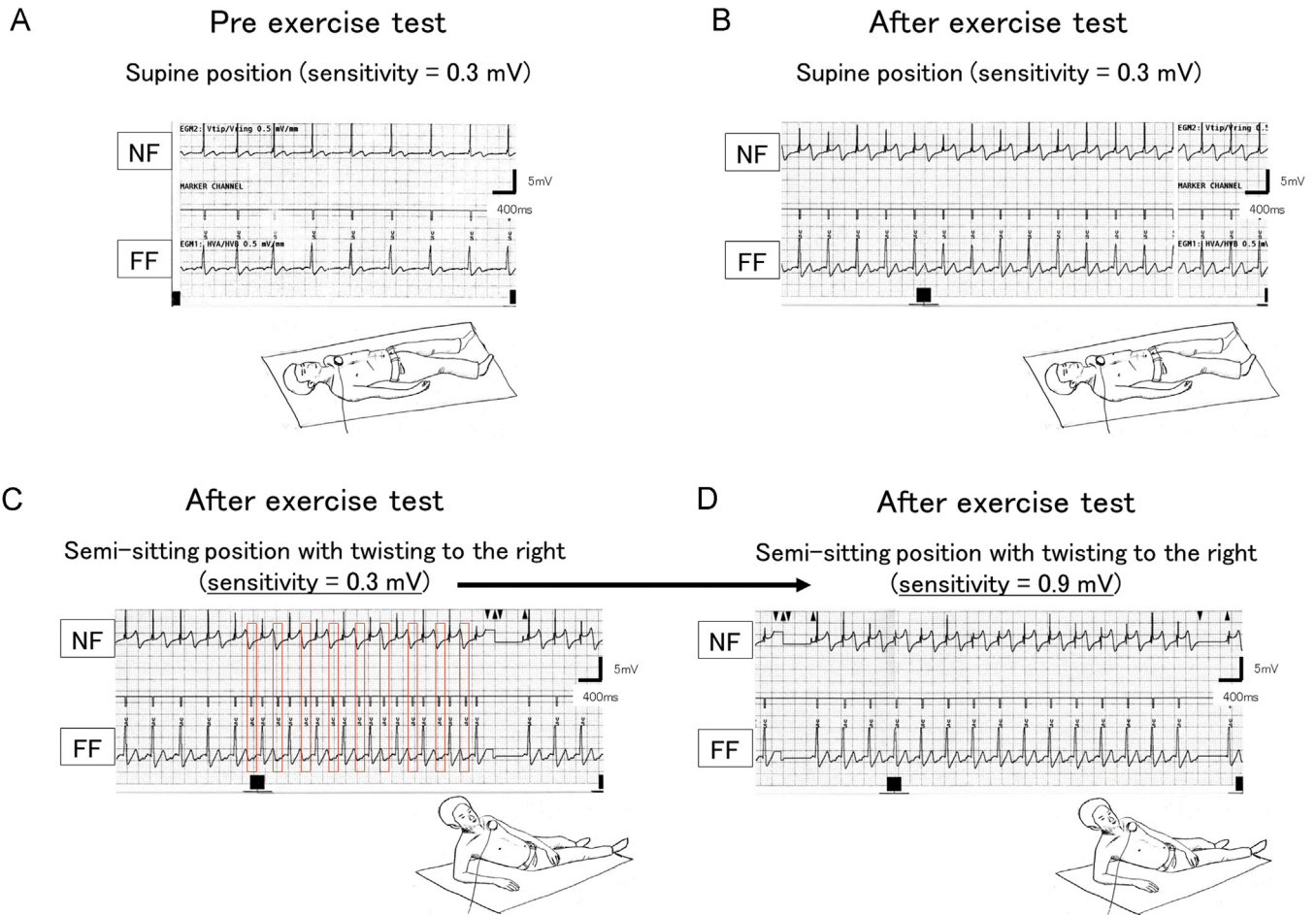


Fig. 1. (A) T wave oversensing was not appeared before an exercise test. (B) T wave oversensing was not appeared after an exercise test in the supine position. (C) T wave oversensing was reproduced by a semi-sitting position with twisting to the right after an exercise test. (D) T wave oversensing disappeared after setting the ventricular sensing threshold to 0.9 mV. FF=far field, NF=ear field.

3. Case 2

A 30-year-old man was referred to our hospital with the complaint of repeated syncope. After several examinations, he was diagnosed as having Brugada syndrome. A single chamber ICD (Lumax 340 VR-T, Biotronik Inc., Berlin, Germany) was implanted. A dedicated bipolar dual-coil ICD lead (Lincox TD 65/18, Biotronik Inc.) was used. The pacing threshold was 0.2 V at 0.5 ms; R wave amplitude, 7.0 mV; and lead impedance, 755 Ω at implantation. Ventricular tachyarrhythmia detections were programmed only in the VF zone above 200 bpm. Therapy consisted of one anti-tachycardia pacing followed by ICD shocks. Sensitivity of the R wave was set at 0.8 mV. A remote monitoring system (Cardio-Messenger, Biotronik Inc.), which was used with a land line, was set up in his bedroom immediately after discharge. Three months after discharge, we received an emergency e-mail for VF detection. An intracardiac electrogram obtained from a web site showed that the ICD misdiagnosed sinus tachycardia as VF due to TWOS, and antitachycardia pacing was delivered but not ICD shocks. The patient was asked to visit our outpatient clinic the next day. The possibility of lead fracture or electromagnetic interference was completely excluded after several examinations. He was taking a bath while performing stretching exercises during the inappropriate ICD therapies. The R wave amplitude was 5.0 mV, which was slightly decreased compared to that at implantation, but we

could not observe TWOS. Although we performed various challenging tests (exercise and body position) (Fig. 2A, B), TWOS was not reproduced. Considering the situation of the ICD shocks (stretching in a hot bath), we performed a body twisting test. TWOS was reproduced by body twisting (standing position with twisting to the left) after exercise or ISP infusion (Fig. 2C). The TWOS disappeared when the sensing filter was switched from standard mode to enhanced T wave suppression mode (Fig. 2D). After switching the filter setting, the patient has not suffered from inappropriate ICD therapies due to TWOS during a period of 2 years despite taking a bath while performing stretching exercises every day. Appropriate ICD shocks were successfully delivered after 2 years.

4. Discussion

This report is, to the best of our knowledge, the first report of unusual cases with TWOS that were reproduced only by body twisting immediately after exercise or ISP infusion.

TWOS has been the main cause of ventricular oversensing followed by inappropriate ICD therapies. Some algorithms to differentiate the T wave from the R wave have been developed, and the proportion of TWOS has been decreased [4]. The clinical impact of case 1 may be limited because of the old generator. If

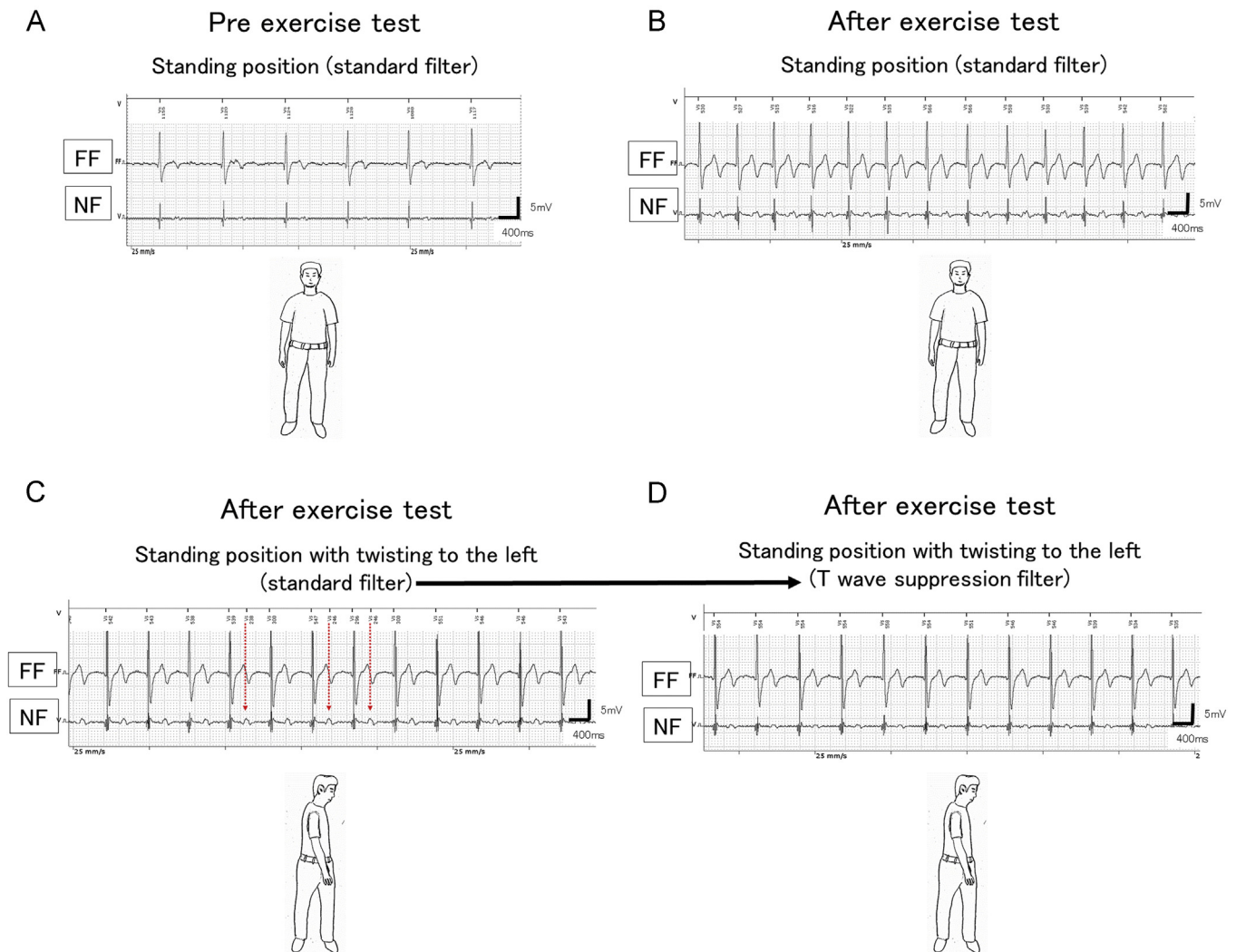


Fig. 2. (A) T wave oversensing was not appeared before an exercise test. (B) T wave oversensing was not appeared after an exercise test in the standing position. (C) T wave oversensing was reproduced by a standing position with twisting to the left after an exercise test. (D) T wave oversensing disappeared after switching the sensing filter from standard to enhanced T wave suppression mode. FF=far field, NF=near field.

TWOS appeared, the management could be difficult. TWOS is likely to be observed during sinus tachycardia but not at rest. Several methods to avoid TWOS, such as changing the sensitivity, adding a new lead, exchanging the kind of generator, and changing the filter setting, have been reported. However, we experienced a prior case in which TWOS could not be reproduced despite of several examinations such as an exercise test, electrophysiological test, and body position test. At that time, we did not think of performing a body twisting test after an exercise test or ISP infusion. We changed the sensitivity threshold without clear evidence. However, TWOS reappeared. As in our prior case, only sensitivity changing without any evidence often fails to prevent TWOS [1–3]. Therefore, it is important, but sometimes difficult, to reproduce TWOS in order to manage TWOS by a noninvasive method. In our two cases, we could reproduce TWOS by body twisting after an exercise test or ISP infusion. We accidentally found TWOS in the first case during movement to the supine position after an exercise test.

We do not have a clear idea why body twisting after an exercise test or ISP infusion can reproduce TWOS. However, we speculate that body twisting causes changes in the position of the heart in the body, the cavity of the right-sided heart, and the lead position against the heart. These changes may influence the sensing

property of an intracardiac electrogram. A body twisting test after an exercise test or ISP infusion would be helpful for the diagnosis and management of TWOS.

An enhanced T wave suppression mode was very effective to manage TWOS and was able to detect induced and spontaneous VF correctly. On the other hand, it has been reported that Biotronik devices connected to integrated bipolar ICD leads from other manufacturers had an increased risk for oversensing [5]. Thus, it may be reasonable to facilitate employing the enhanced T wave suppression mode, especially in patients with integrated bipolar ICD leads.

Conflict of interest

All authors declare no conflict of interest related to this study.

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