Unfortunate Hand Positioning Yielding Inappropriate Defibrillator Shock: Another Paradigm of a Guilty Association Between Patient Awareness and Occupational Hazard

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ABSTRACT: A 64-year-old patient had a cardiac resynchronization therapy defibrillator implanted 4 years ago for dilated cardiomyopathy. He recently had an inappropriate shock as a result of an electrical leak from a refrigerator causing electromagnetic interference. An analysis of the patient case and a discussion of the features of this specific paradigm of inappropriate therapy are presented.

KEYWORDS: Arrhythmia, Defibrillator, inappropriate

Introduction

The basic function of implantable cardioverter defibrillators (ICDs) is to monitor patient’s intrinsic rhythm and to intervene in case of detection of malignant ventricular arrhythmias. ICDs are highly effective in reducing mortality due to malignant ventricular arrhythmias, whether in primary or in secondary prevention of sudden cardiac death.¹,² Inappropriate ICD therapies (ITs) are relatively common adverse events in patients with ICDs, occurring in 12% to 21% of patients.³ The main cause of IT is supraventricular arrhythmia with a rapid ventricular response, followed by oversensing of artifacts and noise, electromagnetic or myopotential interference, T wave oversensing, and cross-chamber sensing.⁴

In this article, we present a case of IT following an electrical leak from a refrigerator, a leak transmitted via a metallic table on which the patient leaned on during his working shift.

Case Presentation

A 64-year-old patient had a cardiac resynchronization therapy defibrillator (CRT-D; Iforia, Biotronik) device implanted 4 years ago for dilated cardiomyopathy. The device was initially implanted as primary prevention in the setting of heart failure, with left bundle branch block and an ejection fraction at 29%. The patient works in a supermarket in an area related to fruits and vegetables, with regular physical activity estimated to be of mild intensity. Recently, when the patient felt tired, he leaned on a metallic table which was in direct contact with adjacent non-grounded refrigerators. His left hand was in contact with the table, and he felt a kind of tingling. Soon after, the patient felt a kind of blast that projected him away from the table. Suspecting that something was wrong with his device, he quickly came to the emergency department seeking medical advice.

In the emergency department, the patient was anxious with a pulse rate of 75 beats/min and blood pressure of 110/75 mm Hg. Device interrogation showed normal pacing and sensing parameters along with normal impedances. Detection of ventricular fibrillation was set for a rate above 222 beats/min along with a detection counter of 8 out of 12 (Figure 1). Of note, a 40-J shock was delivered for an episode detected as ventricular fibrillation, concomitant with the patient event timing that occurred at work. Markers analysis (Figure 2) showed detection of a very fast (RR interval = 109 ms) ventricular event on the left ventricular (LV) channel with intermittent sensing of the same event on the right ventricular (RV) channel. Electrograms and markers (Figure 2) showed a very high frequency noise on all channels, compatible with an electrical source yielding electromagnetic interference, which was mostly evident on the LV channel. The intermittent detection of the noise on the RV channel explains the intermittent RV paced events.

Discussion

The detection function in ICDs is a complex function that involves complex algorithms with multiple interacting parameters,
including R wave amplitude, ventricular rate, QRS morphology (wavelet), onset, and stability.\(^4\) In the present case, it was evident that oversensing was the cause of IT, as the markers on the LV and RV channels showed noise-like detection originating from electromagnetic interference. Although noise sensing was more evident and persistent on the LV channel, it was intermittent and less marked on the RV channel. This is probably related to the fact that the LV lead is more epicardial and can more easily detect electromagnetic interference originating from outside. However, it was only when 9 consecutive ventricular events were sensed on the RV channel that the episode was declared ventricular fibrillation and an inappropriate shock was delivered.

Avoiding potential sources of electromagnetic interference is essential to avoid IT in patients with ICD or CRT-D. Cases of IT resulting from electromagnetic interference have been reported in patients recipient of ICDs.\(^5,6\) Patient education and awareness regarding the risks of electromagnetic interference are necessary. In the present case, an occupational hazard (electrical leak) generated the inappropriate shock, and we informed the patient about the risks of coming into direct contact with machines or tools that may have a faulty electrical leak. In addition, we proceeded to change the ventricular fibrillation detection counter from 8 out of 12 to 12 out of 16, such a feature is recommended to reduce the risk of IT.\(^7\) In addition to the above-cited issues and more importantly, grounding of electrical equipment is essential to avoid potential hazards related to an electrical leak, particularly IT in patients with ICDs.\(^5,6\)

**Conclusions**

Patients with ICDs should be aware of the risks of electromagnetic interference and the subsequent potential IT. The present case is a new paradigm of a guilty association between an occupational hazard generating electromagnetic interference and a lack of patient awareness leading to oversensing and causing an inappropriate ICD shock.

**Author Contributions**

AK made all the paper.

**Informed Consent**

Written patient consent to publish the case study has been obtained.

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