

Inappropriate Implantable Cardioverter Defibrillator Shock Due to Electromagnetic Interference while Showering

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Inappropriate shocks are a serious and still unresolved problem associated with implantable cardioverter defibrillators (ICDs) that have been associated with increased mortality and impairment of quality of life [1] despite advances in device safety.

We report a case of electromagnetic interference (EMI) while showering that resulted in an inappropriate ICD discharge.

PATIENT DESCRIPTION

An 87-year-old patient with ischemic cardiomyopathy and paroxysmal atrial fibrillation received an ICD after an episode of aborted out-of-hospital sudden cardiac death at age 75 years. He had his ICD replaced at age 82 years and then, at age 86 years, he experienced multiple inappropriate shocks secondary to a lead fracture. Because the left subclavian vein was occluded, he had a new lead (Biotronik Plexa Pro MRI S DX 65/15, USA) implanted through the right subclavian vein and connected to a right sided Biotronik ICD (Rivacor 5 VR-T DX). ICD detection and treatment were programmed in three ventricular tachycardia (VT) zones: VT1 monitor zone set at 150 beats/minute (bpm), VT2 set at 188 bpm, number of intervals detected (NID) = 16 and ventricular fibrillation zone set at 222 bpm and NID = 18/24. In the VT2 zone, anti-tachycardia pacing algorithms were 1 burst and 1 ramp protocol

followed by cardioversion. In the ventricular fibrillation zone, biphasic defibrillation shocks were programmed. Bradycardia parameters were set to VDD mode at a lower rate of 50 and an upper rate of 130 bpm. Ventricular sensitivity was set at 0.8 mV.

One year after implantation, while showering, the patient experienced an unexpected electrical shock, which was followed by a shock delivered shortly after by his ICD. Subsequent investigation did not reveal evidence of any ICD system malfunction. However, an interrogation of the episode did reveal high frequency artefacts on the ventricular channel, which had a typical pattern of EMI consistent with 50 Hz alternating current. This electrical noise was erroneously interpreted as ventricular fibrillation by the ICD, so the device delivered a 40 Joules shock [Figure 1]. The artefacts disappeared after shock delivery.

A suspicion of EMI through electrical current leakage in the bathroom was raised, and a subsequent technical inspection confirmed improper grounding of nearby electric equipment. After proper grounding was secured, no electrical shocks were reported during showering.

COMMENT

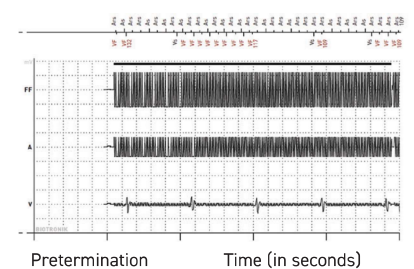
Inappropriate shocks are reported in 13% of patients with an ICD. A history of atrial fibrillation and age younger than 70 years were independent predictors of an increased chance of inappropriate shocks [2]. Recently, in patients followed with remote monitoring, the occurrence was 9% [1]. EMI has been found to be a rare cause of inappropriate shocks [3].

Figure 1. Stored electrogram from the patient's implantable cardioverter defibrillator

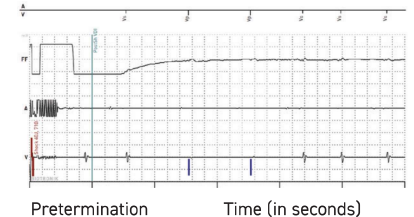
First line: marker annotations, second line: far-field electrogram, third line: atrial electrogram, fourth line: ventricular electrogram

EMI = electromagnetic interference, ICD = implantable cardioverter defibrillator, VF = ventricular fibrillation

[A] High frequency artefacts are noted together with the physiologic ventricular electrogram channel in a typical pattern of EMI consistent with 50 Hz alternating current. The non-physiological noise that is seen on all channels is bigger on the far-field channel (FF) and atrial channel (A) compared to the ventricular (V) channel. It was erroneously interpreted as VF by the ICD that delivered a 40 Joules shock.



[B] ICD tracing before and after ICD discharge (arrow). Following ICD shock delivery, the patient evidently moved away from the EMI source and the EMI artefacts disappeared from the ventricular electrogram.



We found two case reports of inappropriate ICD shock related to EMI during showering like our case. In these cases, EMI was due to an insufficiently grounded electrical system, which was erroneously interpreted as VF [4,5].

CONCLUSIONS

Rigorous inspections are needed to verify correct grounding of electrical devices, such as ICD, in a patient's home, thus reducing the risk of inappropriate ICD shocks.

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If you have knowledge, let others light their candles in it.

Margaret Fuller (1810–1850), American journalist, editor, critic, translator, and women's rights advocate

Capsule

Microbial peptides activate tumor-infiltrating lymphocytes in glioblastoma

Microbial organisms have key roles in numerous physiological processes in the human body and have recently been shown to modify the response to immune checkpoint inhibitors. **Naghavian** and colleagues addressed the role of microbial organisms and their potential role in immune reactivity against glioblastoma. The authors demonstrated that HLA molecules of both glioblastoma tissues and tumor cell lines present bacteria-specific peptides. This finding led the authors to examine whether tumor-infiltrating lymphocytes (TILs) recognize tumor-derived bacterial peptides. Bacterial peptides

eluted from HLA class II molecules are recognized by TILs, although very weakly. Using an unbiased antigen discovery approach to probe the specificity of a TIL CD4⁺ T cell clone, they showed that it recognizes a broad spectrum of peptides from pathogenic bacteria, commensal gut microbiota and also glioblastoma-related tumor antigens. These peptides were also strongly stimulatory for bulk TILs and peripheral blood memory cells, which then respond to tumor-derived target peptides.

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Eitan Israeli

Capsule

Spontaneous controller secrets revealed

Individuals who spontaneously control human immunodeficiency virus (HIV) infection without antiviral treatment have provided critical insights into natural HIV immunity. **Collins** and co-authors studied CD8⁺ T cells in spontaneous controllers of HIV to better understand the mechanisms involved in HIV control. The authors examined the phenotypic, transcriptomic, and functional features; spatial localization; and clonotypic compartmentalization of peripheral and lymph node (LN)-resident CD8 T cells. Controllers displayed antigen-specific proliferation and cytolytic potential that were

different from noncontrollers. Within controllers, T cell receptor analysis confirmed shared clonotypes detected in both peripheral and LN CD8⁺ T cells, although the latter had a gene signature enriched in effector and inflammatory chemotaxis functions. CXCR5⁺ follicular CD8⁺ T cells enriched in controllers expressed cytolytic effectors near HIV RNA foci in germinal centers. These findings provide insight into how HIV-specific lymphoid cells mediate control of HIV in LNs.

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