

CASE REPORTS

Electromagnetic Interference in an Implantable Loop Recorder Caused by a Portable Digital Media Player

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The implantable loop recorder has been shown to be a cost-effective tool for diagnosis of intermittent cardiovascular symptoms such as syncope and palpitations. Electromagnetic interference in these recorders may be caused by commonly encountered electronic devices such as antitheft electronic surveillance systems and magnetic resonance imaging cameras. In this report, we describe interference in two patients with implantable loop recorders from a portable digital media player. (PACE 2008; 31:1345–1347)

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Introduction

The implantable loop recorder (ILR) has been shown to be a cost-effective tool for diagnosis of intermittent cardiovascular symptoms such as syncope and palpitations.^{1,2} The ILR (Medtronic, Inc., Minneapolis, MN, USA) is generally implanted subcutaneously in the left pectoral region. In this location, it may be subject to interference from commonly encountered electronic devices such as electronic surveillance systems and magnetic resonance imaging (MRI) cameras.^{3,4} Electromagnetic interference (EMI) in pacemakers caused by a media player (iPod; Apple, Cupertino, CA, USA) has recently been described.⁵ In this report, we describe interference in two patients with an ILR caused by an iPod.

Case Report

A 32-year-old man presented with history of recurrent unexplained syncope. Physical examination, electrocardiogram (ECG), multiple external loop recordings, tilt table testing, and electrophysiological testing failed to disclose the cause of his symptoms. An ILR (Reveal Plus) was implanted in the left pectoral region. Due to the recent reports in the media on interference in permanent pacemakers caused by iPods, the patient enquired whether or not it was safe for him to use an iPod.

The ILR was interrogated through the programmer with the telemetry wand over the device. The iPod (Third Generation) was turned on and placed in the ipsilateral shirt pocket a few centimeters away from the implant site. With the wand

positioned on the device for interrogation, interference was noticed on the telemetry ECG channel, while the surface ECG on a bedside monitor remained unchanged. The artifact on the monitor screen had an abrupt onset and termination, synchronous with the turning on and off of the iPod and was highly reproducible. The native QRS complexes in the telemetry ECG were either missing or distorted during the interference (Fig. 1). On interrogation of the ILR after the test, there were no patient-activated events recorded.

In the next test, the iPod was first turned off and left in the shirt pocket and the activator was placed over the ILR. On pressing the white activator button, the green light readily blinked. On interrogation of the device one patient-activated event was recorded and showed normal rhythm without any interference. However, when the iPod was playing, the device could not be activated in spite of 10 attempts. On pressing the white button, the yellow light blinked, indicating failure to capture an event. This was confirmed by reinterrogation of the device, which did not show any additional patient-activated events.

In view of these observations, we approached a second patient with an ILR to look for interference with an iPod. A 72-year-old woman had syncope while driving resulting in minor injuries. Electrocardiogram showed left anterior fascicular block and a right bundle branch block. A tilt table test was negative. Left ventricular ejection fraction was normal. Cardiac catheterization did not show any evidence of coronary artery disease. Electrophysiology study was also nondiagnostic. She was discharged home and continued to have recurrent episodes of palpitations and near syncope. Eight months after the initial syncopal episode, she underwent implantation of a Reveal Plus ILR. The ILR was programmed in the same way as the first patient.

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Figure 1. Real time telemetry ECG recordings of implantable loop recorder are shown. They were obtained using the programmer with the wand over the ILR. Panel A shows baseline recording and panels B and C, during iPod exposure. Panel A shows normal rhythm without any noise, Panel B shows high-frequency spikes, and Panel C shows blanking.

Telemetry interference similar to Figure 1 was duplicated in this patient. When the iPod was turned on and left next to the ILR and the activator switch pressed, the activator light consistently blinked yellow. On two out of 10 attempts, the light blinked green, indicating successful capture of ECG. However, interrogation of the ILR afterward did not show any captured events. Failure to capture events with the light turning green was reconfirmed one more time.

Discussion

The Reveal Plus is a battery-powered, leadless device. It stores up to a maximum of 42 minutes of retrievable, high-fidelity time- and date-stamped ECG for review. The prolonged battery life of 14 months ensures long-term outpatient evaluation of infrequent symptoms such as syncope or palpitations.⁶ The Reveal Plus can either automatically detect and store significant bradycardia or tachycardia events, or may store ECG when the patient activates the device by a small handheld radiofrequency activator.⁶

Previous reports have described EMI in ILR caused by electronic article surveillance systems (EAS) as well as MRI.³ De Cock et al. described failure of the activator to capture an event after passing through an EAS gate. In another report, Gimbel et al. demonstrated safety of performing

MRI in patients without harm to the patient or the ILR.⁴ However, they reported artifact resembling an arrhythmia recorded in the ILR.

The ILR activator is a small handheld radiofrequency device that must be placed in close proximity to the ILR and a switch pressed to capture an ECG. The activator has two small lights (yellow and green) to indicate to the patient whether an event was captured successfully. A green light indicates successful storage and a yellow light indicates failure and that the patient can reattempt capturing the ECG.

The activator communicates with the ILR at a frequency of 100–250 kHz. The iPod also emits electromagnetic radiation in this range with field strength of approximately 1 mGauss. This may explain the telemetry interference as well as the inability of the activator to communicate with the ILR. While telemetry interference is not of any clinical significance, failure of the activator to capture an event or false impression to the patient that an event has been captured may reduce the effectiveness of this useful device.

This is a relevant clinical issue because iPods are the most common media players in the world. iPods are used for entertainment and often carried in a breast shirt pocket, which may put it close to an ILR and prevent a patient from capturing the ECG during a symptomatic episode. It is possible that other media players may also cause

similar interference. Physicians prescribing these implantable devices as well as patients with these

devices should be aware of the potential of this type of electromagnetic interference.

References

1. Krahn AD, Klein GJ, Norris C, Yee R. The etiology of syncope in patients with negative tilt table and electrophysiologic testing. *Circulation* 1995; 92:1819–1824.
2. Krahn AD, Klein GJ, Yee R, Norris C. Final results from a pilot study with an implantable loop recorder to determine the etiology of syncope in patients with negative noninvasive and invasive testing. *Am J Cardiol* 1998; 82:117–119.
3. De Cock CC, Spruijt HJ, Van Campen LMC, Plu AW, Visser AC. Electromagnetic interference of an implantable loop recorder by commonly encountered electronic devices. *Pacing Clin Cardiol* 2000; 23:1516–1518.
4. Gimbel JR, Zarghami J, Machado C, Wilkoff BL. Safe scanning, but frequent artifacts mimicking bradycardia and tachycardia during magnetic resonance imaging (MRI) in patients with an implantable loop recorder (ILR). *ANE* 2005; 10:404–408.
5. Patel MB, Thaker JP, Punnam SR, Jongnarangsin K. Pacemaker interference with an iPod. *Heart Rhythm* 2007; 4:781–784.
6. Krahn AD, Klein GJ, Skanes AC, Yee R. Insertable loop recorder use for detection of intermittent arrhythmia. *Pacing and Clin Cardiol* 2004; 27:657–664.