

# Devices off the Deep End:

## A Case Series of Electromagnetic Interference Associated with Swimming Pools

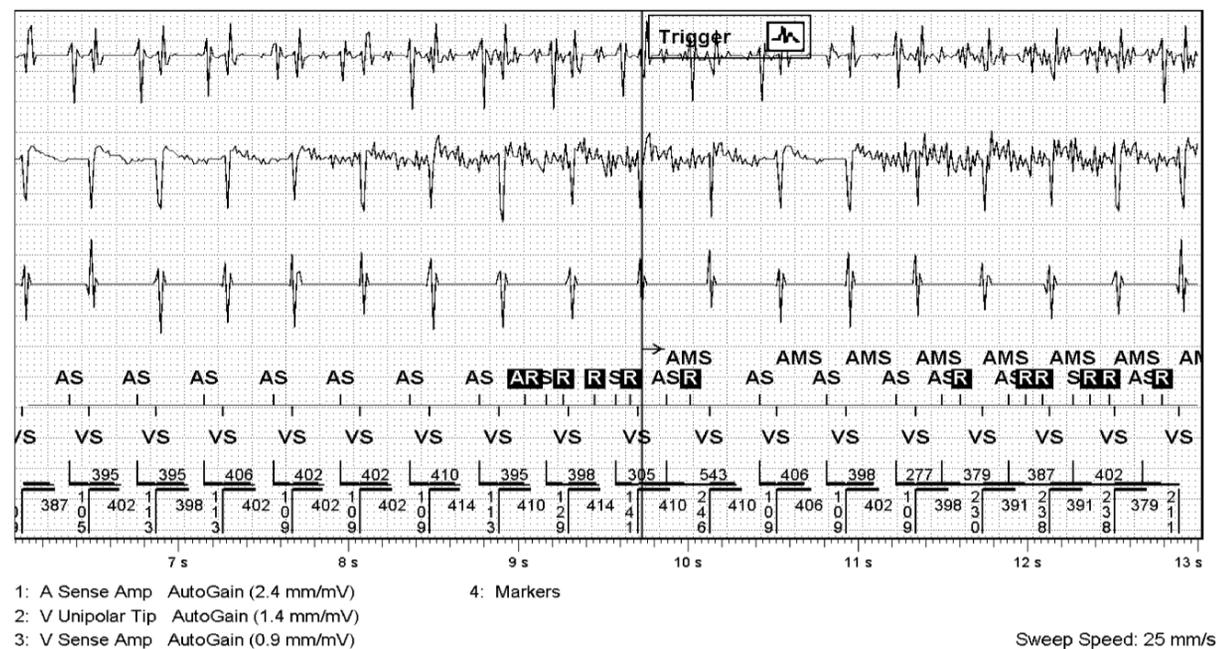
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### BACKGROUND

Cardiac electronic implantable devices have the potential to be disrupted by nearby external electromagnetic fields. This disruption is termed electromagnetic interference (EMI), and the inappropriate sensing of the external environment may lead to over sensing which can lead to inhibition of pacing, unwarranted defibrillation or use of tachy-therapies. Swimming in a pool is typically a benign activity, however, if the pool is not appropriately grounded or bonded, the accumulated energy in the water from electrical components may lead to EMI and device malfunction. We report two cases of EMI from a swimming pool that resulted in altered device activity. This series highlights the importance of patient education and environmental awareness.

### Case 1

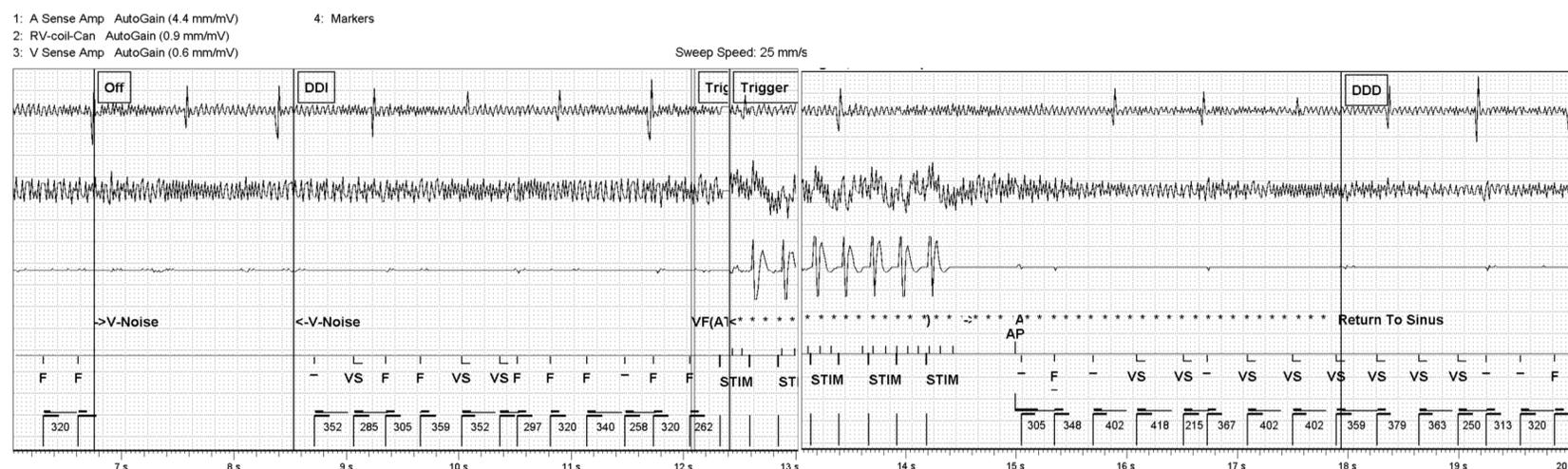


### CASE PRESENTATIONS

**Case 1:**  
The first patient is a young female with a history of hypoplastic right heart syndrome s/p Fontan palliation and symptomatic bradycardia s/p epicardial bipolar dual chamber pacemaker implantation. Interrogation of her device demonstrated EMI on the atrial lead mimicking atrial fibrillation. The EMI can be seen on the ventricular lead as well, but it was below the sensing threshold. The device mode switched to inhibit these impulses, noted in the strip as AMS. She was in a backyard pool during this captured time.

**Case 2:**  
The second patient is a middle-aged male with a history of high degree AV block and polymorphic VT s/p CRT-D implantation. After returning from vacation, he reported being lightheaded while swimming in a pool. The interrogation demonstrates EMI on the atrial and ventricular lead that was inappropriately interpreted as VF and subsequently treated with anti-tachycardia pacing (ATP). He fortunately did not receive inappropriate defibrillation.

### Case 2



### DISCUSSION

Our cases demonstrate complications of EMI. The first case demonstrates that EMI can lead to inappropriate mode switching due to the device interpreting the over-sensed noise as atrial fibrillation. Atrial fibrillation has potentially devastating consequences in Fontan palliation patients and knowledge of atrial arrhythmias is critical for their management. Additionally, EMI on pacemakers can lead to inhibition of pacing or pacemaker syndromes from inappropriate mode switching. In case two, we see consequences of EMI on a patient with an ICD due to both inappropriate inhibition of ventricular pacing and inappropriate delivery of ATP from ventricular oversensing of EMI. Both of these events are potentially life threatening in patients with ICDs.

Inappropriate ICD discharges have been reported in 10-20% of cases and EMI is a common cause.<sup>1</sup> In addition to the pro-arrhythmic effects of inhibition of pacing and inappropriate tachy-therapies, EMI lowers quality of life in patients with cardiac electronic implantable devices. EMI from swimming pools has been reported in multiple case reports<sup>1-4</sup>, but our is the first to show both inhibition of pacing and delivery of tachy-therapies in a pacemaker-dependent ICD patient from a swimming pool.

EMI from swimming pools has been reported with improperly grounded pool lights<sup>2</sup>, alternating current leakage from a submerged electric motor in the swimming pool<sup>3</sup>, and from saline chlorination systems using electrolysis to generate chlorine<sup>4</sup>. In addition to traditional sources of EMI, swimming pools are an important topic to include in patient education.

### REFERENCES

1. Makaryus, JN, Angert-Gilman, J, Yacoub, M, et. al. "Inappropriate Implantable Cardioverter-Defibrillator Shocks." *Texas Heart Institute Journal* 2014;41(1):61-3.
2. Iskandar, S, Lavu, M, Atoui, M, et. al. "Electromagnetic Interference in a Private Swimming Pool" *Indian Pacing and Electrophysiology Journal* 2015(15)293-295.
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4. Lloyd, M, Wight, J, et. al. "Swimming pool saline chlorination units and implantable cardiac devices: A source for potentially fatal electromagnetic interference." *Heart Rhythm Case Reports* 2019(5):260-261.