CASE REPORT

Sleeping with the fishes: electromagnetic interference causing an inappropriate implantable cardioverter defibrillator shock

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SUMMARY

A 60-year-old man with a cardiac defibrillator implanted due to previous ventricular fibrillation arrest and ischaemic cardiomyopathy received a shock while cleaning his fish pond. At the time, his immersed arm was close to a submersed water pump, but the patient was asymptomatic. As a result of the shock he lost consciousness, but collapsed backwards, away from the pond. Interrogation of the device revealed a high-frequency artefact that was sensed by the device and triggered a shock. Device parameters were otherwise normal. Subsequently, the submersed water pump was found to be the source of an external alternating current leak and was identified as the likely cause of the inappropriate shock due to electromagnetic interference (EMI). Awareness of potential sources of EMI along with evaluation of data with a detailed clinical history is warranted in all cases.

BACKGROUND

Inappropriate shocks are a significant source of morbidity in patients with implantable cardioverter defibrillators (ICDs). These may be due to intrinsic or extrinsic factors. Extrinsic factor such as electromagnetic interference (EMI) is estimated to lead to inappropriate shocks in 2% of all patients with an ICD. Sources of EMI are all around in the modern world and it can be difficult to detect a source. Knowledge of potential sources is therefore valuable.

CASE PRESENTATION

A 60-year-old man with a cardiac defibrillator (VVI Medtronic—MAXIMO II VRD284VRC and Guidant Europe lead), implanted due to previous ventricular fibrillation (VF) arrest and ischaemic cardiomyopathy, received a shock while cleaning

Figure 1 Intracardiac electrogram from implantable cardioverter defibrillator showing artefact sensed as ventricular fibrillation (VF) followed by shock therapy being delivered.

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his fish pond. At the time, his immersed arm was less than a metre away from a submersed water pump, and the patient was neither aware of any palpitations nor had any other warning symptoms. As a result of the shock he lost consciousness, but fortunately collapsed backwards, away from the pond.

INVESTIGATIONS

Interrogation of the device revealed a high frequency, 50 Hz artefact that was sensed by the device and triggered a 35 J shock (device electrogram, [figure 1](#)). The parameters were normal with a sensitivity of 0.3 mV, R wave 7 mV, and ventricular and shock impedances 750 and 55 Ω , respectively.

OUTCOME AND FOLLOW-UP

The 50 Hz artefact noted on the device raised suspicions of the inappropriate sensing of alternating current (AC; in the UK this is 240 V, 50 Hz). A more detailed history revealed that the patient had personally upgraded the water pump in his fish pond the week before. Electrical testing of the submersed water pump found an external alternating current leak and was identified as the likely cause of the inappropriate shock due to EMI. This was repaired with appropriate earthing and he has remained well with no further shocks to date.

DISCUSSION

After excluding lead and device problems, EMI causing inappropriate shocks is well recognised. With technology becoming more common in all aspects of daily life, an increasing number of potential sources are being identified. A single centre case series suggested that 2% of all patients with defibrillators experienced an inappropriate shock due to EMI over a 16-year period.¹ A single report had described 60 Hz interference leading to an inappropriate defibrillator shock to a patient who was fitting a new water pump.² While frequent and regular maintenance of such water pumps would make current leaks less likely, other household appliances have been found to cause EMI while operating normally.³

If the source of the inappropriate EMI cannot be identified then the sensitivity of the device could be decreased or the cycle length of the VF detection trigger zone changed. This may, however, potentially compromise the normal working of the device and awareness of potential sources of EMI, along with evaluation of data with a detailed clinical history is warranted in all cases.

Learning points

- ▶ Patients with implantable cardioverter defibrillators can get inappropriate shocks which have significant morbidity.
- ▶ A careful history around the circumstances when the shock was received is important.
- ▶ Awareness of sources of electromagnetic interference in the modern world is important to advise patients on how to minimise risks of further shocks.

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