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Commentary

Perioperative Management of Patients with Implantable Cardioverter Defibrillators

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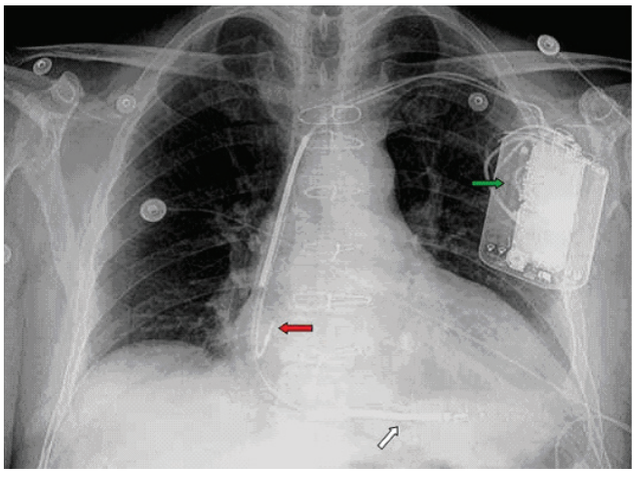
The first successful implant of an automated internal defibrillation system was described in 1980[1]. Since then the number of indications for implantable cardioverter defibrillator (ICD) therapy has grown and the number of implants has risen rapidly[2]. As a result, growing numbers of patients with ICD's are presenting for surgery, potentially giving rise to uncertainty about device management, especially in emergency settings. We have collated manufacturers' recommendations, professional guidance and the relevant literature to provide support for surgical decision-making when faced with a patient with an ICD (figure).

Electromagnetic interference (EMI) is the main safety concern that arises when patients with ICD's undergo surgery. Theoretically EMI from diathermy devices can interfere with ICD sensing which may result in spurious detection of a ventricular arrhythmia (oversensing) and delivery of a defibrillator shock. Other potential risks to the ICD include reprogramming, temporary inhibition of pacing functions or irreversible damage to the internal circuitry[3].

Two types of surgical diathermy are in common use: monopolar and bipolar of which the former is more widely used in practice. Monopolar electrical current enters the patient via an active electrode. The current travels through the patient and returns to the generator via a dispersing ground electrode. The active electrode usually discharges current through a surgical instrument. If the diathermy unit is activated prior to contact between the active electrode and the surgical instrument, the electric current may arc through the air toward the instrument and demodulate the electronic signal. Such a signal may be over sensed by the ICD resulting in an inappropriate discharge. Bipolar diathermy involves the flow of current between two tips of a bipolar forceps. Current passes from the active electrode at one tip through the patient (but only at the diathermy site) to the dispersive electrode at the other forceps tip. Therefore the theoretical risk of EMI associated with bipolar is substantially less than with monopolar diathermy.

Diathermy is not the only potential medical source of EMI; others include magnetic resonance scanners, radiofrequency ablation, lithotripsy, radiation therapy and transcutaneous electronic nerve stimulation (TENS) units[3]. Non-medical sources include anti-theft surveillance devices, slot machines, electric razors, showering and even household items such as washing machines. Interference with ICD functions has been described with all of these aforementioned technologies but studies that have addressed specifically the interaction



Chest X-Ray appearances of a dual chamber ICD. Green arrow: battery and pulse generator. Red arrow: right atrial appendage lead (bradycardia sensing and pacing). White arrow: right ventricular lead (bradycardia sensing and pacing, anti-tachycardia pacing and defibrillation).

between surgical diathermy and ICD's found no evidence of oversensing, reprogramming or device damage. This is a limited evidence base, the largest series involving 45 patients undergoing a variety of elective surgical and interventional procedures[4] and no studies have been performed in the emergency setting. Nonetheless it may be concluded that as a result of progressive refinements in ICD design (titanium shielding, signal filtering, interference rejection circuits and noise rejection functions) the risk of a harmful interaction between surgical diathermy and an ICD is very small.

When a patient with an ICD comes for elective surgery, pre-procedural planning can be undertaken to minimise the risk to the patient, operators and device[3, 5-7] (Table). Reprogramming to monitor mode involves deactivation of the ICD's ability to sense and treat ventricular tachycardia and ventricular fibrillation. It allows electrical signals to be recorded throughout the procedure but no action will be taken should they be interpreted as a ventricular arrhythmia. Clearly under such circumstances arrhythmias should be treated as they would in a patient who does not have an ICD. Arrhythmic

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Table:
Perioperative ICD management recommendations[7]

Elective Surgery

- Establish the device manufacturer and program from the patient-held card
- Arrange interrogation of the ICD, if not performed within the last six months
- If diathermy will be required, reprogram the ICD pre-operatively to monitor mode. Bipolar diathermy is preferred and low energy short bursts are desirable
- If monopolar diathermy is essential, low energy, short bursts are preferred. Diathermy cables and the grounding electrode should be remote from the ICD
- Arrange for ICD interrogation post-operatively

Emergency Surgery

- Where possible follow elective surgery guidance
- If the device can not be switched to monitor mode pre-operatively
  - Restrict diathermy usage and where possible use bipolar diathermy
  - Ensure that cardiopulmonary resuscitation facilities are available
- If an appropriate ICD shock occurs, correct any reversible causes
- If recurrent ICD shocks occur, follow standard CPR guidelines
- Arrange for ICD interrogation post-operatively

precipitants (hypoxia, hypotension, metabolic derangements) should be corrected and standard cardiopulmonary resuscitation measures should be implemented in the event of cardiac arrest. If external defibrillation is required the risk of damage to the ICD and myocardial injury will be minimized if an antero-posterior (A-P) pad position is adopted. If this is not possible, the pads should be placed at least 10–15 cm from the ICD.

If a patient presents with a life-threatening surgical emergency[7], preoperative ICD interrogation and reprogramming may not be available. This should not be interpreted as a contraindication to emergency surgery. Rather, the diathermy precautions outlined in the Table should be followed. As previously mentioned the risk of a harmful interaction between surgical diathermy and ICD's appears to be largely theoretical and a much greater risk is likely to be caused by delay or deferral of potentially life-saving surgery in patients with surgical emergencies.

Despite the exponential increase in ICD implants, there is limited expert guidance about the best perioperative management of patients with ICD's, especially in emergency settings. However the available published information suggests that surgical diathermy poses a substantially smaller hazard than many other medical and indeed non-medical electromagnetic sources.

The authors have no conflict of interest.

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