Management of patients with implantable cardioverter defibrillator needing radiation therapy for cancer

Editor—Stone and colleagues 1 published an excellent review on ‘Perioperative management of patients with cardiac implantable devices’ focusing on management during surgery. They also covered electromagnetic interference (EMI) on cardiac implantable electronic devices (CIEDs) in non-surgical settings, such as monitoring of evoked potentials, shivering, magnetic resonance imaging, electroconvulsive therapy, and radio frequency ablation or lesioning. Unfortunately, the management of patients with CIEDs, particularly implantable cardioverter defibrillators (ICDs), during radiation therapy is not included. ICDs are increasingly used in patients with cardiomyopathy and decreased left ventricular function and these patients may be referred for radiotherapy instead of surgery, if a susceptible malignancy is diagnosed. EMI from radiation therapy and its effects on different pacemakers and ICDs have been investigated both in vitro and in vivo, 2 3 and suggest that irradiation of a pacemaker or ICD may result in potentially lethal problems. Much less experience in managing this risk during radiation therapy than in the surgical context is available and some advice from an experienced group like Stone and coworkers would be helpful.

As a Cancer Institute, we had to face the problem and set up the following protocol which we outlined according to decisions and actions proposed: 1 

Before radiotherapy in patients with ICDs:

- investigate and obtain documentation on the cardiac disease which led to the CIED implant and if the patient is pacemaker-dependent or non-pacemaker-dependent;
- contact the producer of the device and ask for information about the ‘in vitro’ and ‘in vivo’ data during radiation exposure (i.e. maximum allowed dose to the ICD and possible outcomes due to its irradiation), if available;
- during radiotherapy planning, define location and shape of ICD on CT adopted images. Make sure that the device does not receive a direct, unshielded irradiation. If the device is outside the collimated beam, minimize the dose to the ICD as low as reasonably achievable, and anyway respect the prescribed dose limits (if available) to the ICD. Alternatively, have the device either temporarily or permanently moved;
- calculate the maximal cumulative dose to the ICD;
- alert the cardiologist (patient’s cardiologist, the cardiologist of the institution, or both) to establish who is in charge of controls of the ICD before the treatment, between treatment sessions, and after the treatment;
- ensure the presence of a trained anaesthetist cardiologist and the availability for backup source of pacing and defibrillation during the treatment sessions;
- inform patient about the specific problem, the possibility of malfunction of the ICD caused by radiation therapy, and the necessity of repeated controls of the device.

During the treatment session:

- evaluate the dose absorbed by the ICD by thermoluminescent dosimetry or diode measurements in addition to treatment planning calculations. Perform measurements during the first three treatment sessions. If anatomical changes occur during radiotherapy, in vivo dosimetry should be repeated;
- patients should have continuous ECG monitoring during their radiotherapy sessions;
- apply a magnet to the ICD in order to protect the patient by deactivating temporarily the arrhythmia detection function and the risk of inappropriate defibrillation, if applicable to the specific ICD model.

Between—after treatment sessions:

- check ICD function and settings after session (ECG) and provide formal interrogation of the ICD as agreed before starting the treatment (between treatment sessions and after completing the treatment);
- ensure re-programming if necessary.

The few treatments applied to date according to this protocol did not show major derangements in ICD settings and no clinically evident adverse events. Comments and integrations to our protocol would however be very welcome.

Declaration of interest

None declared.

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2 Hurkmans CW, Scheepers E, Springorum B, Uiterwaal H. Influence of radiotherapy on the latest generation of implantable
the numerous external sources of potential interference. We learn more about the interaction between CIEDs and device, only through the use of established protocols when the location of RT delivery is distant to the implanted device. While we agree that there is little concern for patients undergoing radiation therapy (RT), especially for patients undergoing radiation therapy (RT), especially when the location of RT delivery is distant to the implanted device, only through the use of established protocols will we learn more about the interaction between CIEDs and the numerous external sources of potential interference.

**Declaration of interest**

A.F. has performed consulting work for and has received honoraria from Medtronic, Boston Scientific, St Jude Medical, and Spectranetics. A.F. has also received research support from Medtronic and St Jude Medical.

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**Titration of electroconvulsive therapy: the use of rocuronium and sugammadex with adjunctive laryngeal mask**

Editor—Regarding general anaesthesia for titration of electroconvulsive therapy (ECT), where three to four inductions of grand mal seizures are planned, it may be prudent to update the standard method of repeated boluses of succinylcholine and periods of apnoea. With the availability of rocuronium, a rapid-acting neuromuscular blocking agent, and now sugammadex, a rapid reversal agent for steroidal-based neuromuscular blocking agents, this combined with adequate airway management allows for an equally time-efficient alternative.

My colleagues and I have anaesthetized a 37 yr old, 65 kg male, who suffered from major depression with suicidal tendency and family history of malignant hyperthermia. The patient refused to have a muscle biopsy and hence an anaesthetic avoiding triggering medications was used. More than 50 sessions of ECT were conducted at our hospital. Anaesthesia was induced with propofol (1 mg kg\(^{-1}\)) and rocuronium (0.6 mg kg\(^{-1}\)), three re-titrations were performed, in which a laryngeal mask with bilateral gauze bit blocks were used to aid airway management. Neuromuscular junction activity was monitored until a reduction in train-of-four to two out of four before ECT. The initial seizure modification was deemed adequate, with subsequent ECTs free of physical seizure but adequate seizure recorded by EEG. The use of a laryngeal mask allowed for pressure-controlled ventilation throughout the 20 min period, reliably lowered \(P_{\text{CO}_2}\) to 4 kPa and avoided periods of apnoea without disruption of EEG recording. Reversal with sugammadex 3 mg kg\(^{-1}\) was given immediately upon conclusion of procedure. The recovery conditions were clinically similar to patients post general anaesthesia for day-case procedures.

The abovementioned technique was utilized successfully for this patient during standard singular ECT as well, given his contraindication to succinylcholine. We learnt that it took 2 min of ventilation before reaching an appropriate train-of-four reduction and spontaneous ventilation was reliably established within a minute, upon immediate administration of sugammadex, even though the singular ECT period was about 7 min (column 3, Fig. 1). This compared favourably with the standard succinylcholine technique which usually takes 6 min as was the case as charted in two patients (columns 1 and 2, Fig. 1).

The advantage of rocuronium and sugammadex over repeated boluses succinylcholine can be deduced from its well-documented side-effect profile. This combination also has advantages over other neuromuscular blocking agents such as atracurium with reversal with neostigmine and atropine as demonstrated in column 4 (Fig. 1). The onset of rocuronium (0.6 mg kg\(^{-1}\)) is quicker than other neuromuscular blocking agents such as atracurium (0.5 mg kg\(^{-1}\)) and from our experience more effective in modifying the grand mal seizure. The availability of sugammadex allows for a near instantaneous reversal (column 5, Fig. 1); therefore, there is no need to wait for return of train-of-four before reversal (~12 min), should the psychiatrist decides that three ECTs were enough instead of four.

My colleagues and I have found the adjunctive use of a laryngeal mask airway to be useful in several clinical scenarios, exemplified by titration of ECT in this report. It is also useful in patients with difficult to manage airway with a bag and mask, such as patients with a beard or morbidly obese patients. The laryngeal mask allows for better control of \(P_{\text{aCO}_2}\) which may aid to lower the seizure threshold. Importantly, it avoids the period of apnoea to which elderly patients with ischaemic heart disease or morbidly obese patients who tolerate low \(P_{\text{aO}_2}\) poorly.

Currently, it is cost limited due to the expense of sugammadex. However, it is justified in patients with...