CASE REPORT

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Implantable cardioverter defibrillator during laser transurethral resection of the prostate

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ABSTRACT

Implantable cardioverter defibrillators have been instrumental in the health and safety of patients who are at increased risk of sudden death by ventricular tachycardia or fibrillation. Consensus on the perioperative management of cardiovascular implantable electronic devices has suggested that certain surgical interventions (including transurethral resection of the prostate) may interfere with the sensing capability of the device, thereby resulting in unforeseen adverse outcomes. However, improvements in the implantable cardioverter defibrillators have made it less susceptible to surgical interference. In addition, current guidelines recommend deactivation of the implantable cardioverter defibrillators to an asynchronous mode prior to most surgical interventions. We present the first two case reports in which implantable cardioverter defibrillators were not deactivated prior to GreenLight 180-W XPS laser-guided transurethral resection of the prostate. We left the implantable cardioverter defibrillators activated to allow them to detect and treat lethal arrhythmias by direct rather than extrinsic cardioversion. There was no cardiac arrhythmia incident in these two cases. Laser technology is not a documented source of electromagnetic interference in patients with implantable cardioverter defibrillators. There is no current evidence that links lasers to implantable cardioverter defibrillators malfunction. With increasing numbers of patients with implantable cardioverter defibrillators undergoing many different laser surgical procedures, further studies are warranted to analyze in depth the effects of laser therapy on implantable cardioverter defibrillators function and update in current guidelines.

Keywords: *implantable cardioverter defibrillator, greenlight laser transurethral, resection of the prostate, TURP.*

INTRODUCTION

Since the introduction of the implantable cardioverter defibrillators (ICD) in 1980, they have been instrumental in the health and safety of patients who are at increased risk of sudden death by ventricular tachycardia or fibrillation (1, 2). The purpose of an ICD is to prevent such events from occurring by sensing the rhythm of the patient's heart and delivering a measured shock if aberrant rhythms occur. Consensus on the perioperative management of cardiovascular implantable electronic devices has suggested that certain surgical interventions (including transurethral resection of the prostate [TURP]) may interfere with the sensing capability of the device, thereby resulting in unforeseen adverse outcomes (3). However, improvements in the ICD have made it less susceptible to surgical interference. In addition, the American Society of Anesthesiologists (ASA) has recommended deactivation of the ICD to an

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asynchronous mode prior to most surgical interventions (3, 4). The following presents the first case reports in which an ICD was not deactivated prior to GreenLight 180-W XPS laser-guided TURP.

CASE REPORT

This study was approved by Cleveland Clinic institutional board.

Case 1

A 59-year-old man with a past medical history of hypertension, hyperlipidemia, and coronary artery disease (previous myocardial infarction 2008) presented for an elective GreenLight laser XPS (AMS World Headquarters 10700 Bren Road West, Minnetonka, MN 55343, USA) prostatectomy in January 2012 due to obstructive benign prostatic hyperplasia (BPH). Past surgical history was significant for five-vessel coronary artery bypass graft (2008) after the myocardial infarction, required temporary intra-aortic balloon pump post bypass and subsequent ICD (Guidant E102 Teligen 100, Boston Scientific, 4100 Hamline Ave N St Paul, MN, 55122, USA) implantation for low ejection fraction. Previous surgery also included coronary endarterectomy along with bilateral iliac artery stenting (2009) and right lower extremity stent placed (2011). Medications at the time included clopidogrel 75 mg (held for five days prior to surgery) and aspirin 325 mg (held for seven days prior to surgery). Preoperative electrocardiogram (ECG) showed complete left bundle branch block. Cardiac evaluation led to cardiac catheterization, which revealed mild diffuse disease in the left anterior descending and left main coronary arteries, severe diffuse disease in the circumflex coronary artery, and complex 100 percent proximal lesion in the right coronary artery. Saphenous vein graft to the 1st diagonal was totally occluded, but all other vein grafts were widely patent. Current ejection fraction of 55% with normal wall motion was noted. After review of these findings and ICD evaluation the patient was determined to be optimized and medically cleared for surgery. As per electrophysiology service (EPS) recommendation, the ICD was intentionally not deactivated prior to the Laser TURP procedure. Standard ASA monitors, a BIS monitor, and axillary temperature were utilized throughout the procedure. An 18-gauge peripheral IV was placed prior to induction of general anesthesia. Anesthesia was induced with intravenous midazolam, lidocaine, fentanyl and propofol, followed by placement of a size 5 Supreme laryngeal mask airway (LMA) without difficulty. Sevoflurane was administered as the inhalational agent with a 2:1 air/oxygen mix throughout the case with no neuromuscular blockade. The patient was warmed with an air-warming blanket during the procedure, which lasted two hours and thirty-five minutes. The case was concluded without complication or any ICD activity noted, 1700 cc Lactated Ringer was administered, and an estimated blood loss was less than 100 cc. The LMA was removed from the patient without difficulty at the conclusion of the surgical procedure. The patient was then transported to the post-anesthesia care unit (PACU) awake and alert, and in stable condition. He was discharged on post-operative day one in stable condition with planned ICD follow up. Although post operative contact was attempted it was not achieved and patient was lost to follow up.

Case 2

A 63 year old man with past medical history significant for hypertension, congestive heart failure, and atrial fibrillation presented for an elective GreenLight laser XPS (AMS World Headquarters 10700 Bren

Road West, Minnetonka, MN 55343, USA) prostatectomy in May 2012 due to obstructive benign prostatic hyperplasia (BPH). Past surgical history included repair of an ascending aortic aneurysm with subsequent complete heart block requiring dual chamber pacing in 1990, as well as aortic valve and root replacement with an aortic homograft in 2008. Hisold ICD was replaced by a new ICD [Guidant N119 Cognis 100, Boston Scientific, 4100 Hamline Ave N St Paul, MN, 55122, USA] in January 2010. The last Echo in June 2009 showed an EF of 50%. Current medications included lisinopril 5 mg (held on the day of surgery), sotalol 80 mg, and aspirin 325 mg daily (held for five days prior to surgery). Preoperative ECG showed normal sinus rhythm with an atrial tracking electronic ventricular pacemaker. A preoperative transthoracic echocardiogram was performed and reported an ejection fraction of 55% with severe left atrial enlargement, moderate tricuspid valve regurgitation, and mild pulmonary hypertension (40 mmHg). Mild mitral valve regurgitation and mild aortic insufficiency were also noted. After examination of these findings and ICD evaluation the patient was deemed optimized and cleared for surgery. As per EPS recommendation, the ICD was intentionally not deactivated prior to the Laser TURP procedure. A 20-gauge peripheral IV was placed prior to induction of general anesthesia with standard ASA monitors. Anesthesia was induced after intravenous midazolam, fentanyl, and lidocaine, with propofol followed by rocuronium for muscle relaxation. Intubation was then performed without difficulty. Sevoflurane was used as the inhalational agent with a 1:1 air/oxygen mixture throughout the case. BIS monitor and esophageal temperature probe were used throughout the procedure. The patient was warmed with an air-warming blanket during the 104 minute procedure. The case was concluded without complication or any ICD activity noted, 800 cc of Lactated Ringer administered, and with an estimated blood loss less than 50 cc. The patient was extubated without difficulty upon emergence and was transported to the PACU awake and alert in stable condition. Upon meeting criteria for PACU discharge, the patient was discharged home in stable condition4 hours after arrival at PACU. His ICD was checked remotely approximately one month postoperatively. No episodes of ventricular arrhythmia were noted and three episodes of non-sustained ventricular tachycardia were reported. There were 10 total episodes of mode switch noted since last evaluation which was done about 2 months prior to the surgery. The post operative check was normal and did not suggest any impact from surgery.

DISCUSSION

Many complications have been documented in various fields of surgery regarding adverse consequences of failing to set an ICD to an asynchronous mode (5, 6). With ICD sensing, the pacemaker portion is generally set to sense the intrinsic rhythm of the patient's heart. If an ICD senses any change in rhythm that may harm the patient, it analyzes the rhythm, and potentially delivers a direct cardioversion shock. However, the ICD might mistake a stimulus from an outside electric source as an aberrant rhythm and cause unnecessary firing, which could lead to surgical delay or cancellation, extended hospitalization stay, re-admission for device management, and increased medical cost (7). Unipolar electrocautery is known to be the most common cause of electromagnetic interference (EMI), and can cause events such as complete pulse generator failure or asystole in a patient completely reliant on the device (8, 9). It is therefore important that anesthesiologists understand the rationale for, and the perioperative management of, an ICD. Guidelines clearly state that anti-arrhythmia functions should be suspended prior to most surgical procedures. The pacemaker component of the ICD should be switched to VOO, DOO, or VVI mode when a large amount of interference is expected. This mode switch re-programs the ICD so that it no longer senses the electrical signal from the heart, but rather paces the heart at a set rate.

The disadvantage of this approach is that it may lead to the loss of AV synchrony. If not, pacemaker mediated tachycardia can happen in a cardiac dual chamber pacing device in atrial tracking mode. As with pacemakers, ICD functions can be altered by placement of a magnet. However, the effect on their programming is unpredictable. Most of ICDs shut off tachydysrhythmia detection by placement of a magnet over them. Verification with the manufacturer is the only way to be certain what the response to magnet placement would be (4, 10, 11). TURP is regarded as the gold standard for surgical treatment in patients with bladder outlet obstruction secondary to BPH. However, despite its favorable short-term and long-term results, TURP-associated side effects include severe bleeding necessitating blood transfusion, and the risk of bladder irrigating fluid absorption (TURP syndrome) (12). Moreover, the use of electrocautery in TURP is often cited as a source of ICD interference (3, 4). Thus for a patient undergoing a TURP procedure using electrocautery, failure to comply with ICD guidelines may result in unintended complications (13, 14). To reduce perioperative TURP morbidity, numerous new laser techniques have been introduced into clinical practice. Potassium Titanyl Phosphate (KTP) laser (or GreenLight laser, named for the wavelength of light it emits) is a laser technique with promising results and potentially decreased perioperative complications compared to classic monopolar TURP. GreenLight laser is reported to provide results equivalent to those of standard monopolar TURP while decreasing duration of urinary catheterization and hospital stay, to cite two of several adverse events (15, 16).

Laser TURP has been suggested as a safer procedure to perform if there are cardiovascular concerns. This focuses on patients receiving anticoagulation to not need an interruption of anticoagulation for the surgical procedure, less potential of fluid absorption leading to TURP syndrome, and it minimizes blood loss (17, 18). A list of all the published medical literature of cardiovascular implantable electronic devices and EMI interactions is available in the 2011 Heart Rhythm Consensus Statement on Perioperative Management of ICDs (11). A list of known procedures and devices which cause EMI is shown in *Table 1* (19). Laser surgery has not been documented as, nor is it expected to be, a source of EMI in patients with ICDs (20). A recent in-vitro study showed that EMI emitted from widely used ophthalmic lasers does not lead to oversensing, inappropriate therapy, or change in the programming of certain ICDs (21). An extensive literature search by the authors showed no proven ICD in-

Table 1 - *A list of medical procedures and devices that can cause electromagnetic interference.*

Electrosurgery
MRI
LVAD
Radiation therapy
Cardioversion
TENS
Radiofrequency ablation
Lithotripsy
ECT

ECT, electroconvulsive therapy; LVAD, left ventricular assist device; MRI, magnetic resonance imaging; TENS, transcutaneous electrical nerve stimulation.

terference with lasers used in medicine due to the theoretical lack of interference with ICD and after consultation with EPS, the ICD in these patients were left in the activated state for the laser TURP. Although there were no complications with this particular surgery, it is important to note that the risk of adverse events would have remained if electrocautery had been needed during the procedure. Laser technology is not a documented source of EMI in patients with ICDs. With no current evidence that links lasers to ICD malfunction, we proceeded, the first reported cases of patients with an activated ICD undergoing laser TURP without cardiac arrhythmia incident. These cases are clinically significant in that the ICD was not deactivated; on the contrary, it was allowed to detect and treat lethal arrhythmias by direct rather than extrinsic cardioversion. A secondary benefit of leaving an ICD activated throughout the procedure is that it would likely prevent operating room delays that might result from alternately deactivating and reactivating the ICD perioperatively with increasing numbers of patients with ICDs undergoing many different laser surgical procedures, further studies are warranted to analyze in depth the effects of laser therapy on ICD function.

REFERENCES

1. Stojeba N, Steib A, Fournier S, Loewenthal A, Chauvin M. Anesthesia and implantable automatic defibrillator. Ann Fr Anesth Reanim. 1996; 15: 295-303.
2. Mower MM. Automatic implantable cardioverter-defibrillator: History and future developments. Z Kardiol 1995; 84: 123-6.
3. Rozner MA, Martin DE. Update on perioperative management of cardiovascular electronic devices (CIEDs): The heart rhythm society – ASA consensus statement. ASA 2012; 76: 48-50.
4. Practice advisory for the perioperative management of patients with cardiac implantable electronic devices: Pacemakers and implantable cardioverter-defibrillators. Anesthesiology 2011; 114: 247-61.
5. El-Gamal HM, Dufresne RG, Saddler K. Electrosurgery, pacemakers and ICDs: a survey of precautions and complications experienced by cutaneous surgeons. Dermatol Surg. 2001; 27: 385-90.
6. Smith TL, Smith JM. Electrosurgery in otolaryngology-head and neck surgery: principles, advances, and complications. Laryngoscope. 2001; 111: 769-80.
7. Stone ME, Salter B, Fischer A. Perioperative management of patients with cardiac implantable electronic devices. Br J Anaesth 2011; 107: 16-26.
8. Rubin JM, Miller ED Jr. Intraoperative pacemaker malfunction during total hip arthroplasty. Anesh Analg 1995; 80: 410-2.
9. Mangar D, Atlas GM, Kane PB. Electrocautery-induced pacemaker malfunction during surgery. Can J Anaesth 1991; 38: 616-8.
10. Izrailtyan I, Schiller RJ, Katz RI, Almasry IO. Perioperative pacemaker mediated tachycardia in the patient with a dual chamber implantable cardioverter defibrillator. AnesthAnalg 2013; 116: 397-310.
11. Crossley GH, Poole JE, Rozner MA, Asirvatham SJ, Cheng A, Chung MK, et al. The Heart Rhythm Society (HRS)/American Society of Anesthesiologists (ASA) Expert Consensus Statement on the perioperative management of patients with implantable defibrillators, pacemakers and arrhythmia monitors: facilities and patient management: executive summary. This document was developed as a joint project with the American Society of Anesthesiologists (ASA), and in collaboration with the American Heart Association (AHA), and the Society of Thoracic Surgeons (STS). Heart Rhythm. 2011; 8: 1-18.
12. Rassweiler J, Kuntz R, Hofmann R. Complications of transurethral resection of the prostate (TURP) – incidence, management, and prevention. Eur Urol 2006; 50: 969-79.
13. Kellow NH. Pacemaker failure during transurethral resection of the prostate. Anaesthesia 1993; 48: 136-8.
14. Lerner SM. Suppression of a demand pacemaker by transurethral electrocautery. Anesth Analg 1973; 52:703-6.
15. Bouchier-Hayes PA, Anderson P, Van Appledorn S, Bugeja P, Costello AJ. KTP laser versus transurethral resection: Early results of a randomized trial. J Endourol 2006; 20: 580-5.
16. Skriapas K, Hellwig W, Samarinas M, Witzsch U, Becht E. Green light laser (KTP, 80 W) for the treatment of benign prostatic hyperplasia. Minerva Urol Nefrol. 2010; 62:151-6.
17. Hanson RA, Zornow MH, Conlin MJ, Brambrink AM. Laser resection of the prostate: implications for anesthesia. Anesth Analg 2007; 105: 475-9.
18. Karatas OF, Alkan E, Horasanli K, Luleci H, Sarica K. Photoselective vaporization of the prostate in men with a history of chronic oral anti-coagulation. Int Braz J Urol 2010; 36: 190-7.
19. Misiri J, Kusumoto F, Goldschlager N. Electromagnetic interference and implanted cardiac devices: the medical environment (part II). Clin Cardiol. 2012; 35: 321-8.
20. Pinski SL, Trohman RG. Interference in implanted cardiac devices, part I. Pacing Clin Electrophysiol. 2002; 25: 1367-81.
21. Sher NA, Golben MP, Kresge K, Selznick L, Adabag S. An in vitro evaluation of electromagnetic interference between implantable cardiac devices and ophthalmic laser systems. Europace 2011; 13: 583-8.

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