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Keywords

CRT-D; Cardiac Resynchronization Therapy Defibrillator; Anesthesia; Arthroplasty; Heart Failure; Left Ventricle; Electromagnetic Interference

Abbreviations

CRT-D: cardiac resynchronization therapy-defibrillator

LVEF: left ventricular ejection fraction

CIED: Cardiovascular implantable electronic devices

LV: left ventricle

CHF: chronic heart failure

EMI: electromagnetic interference

Case Report

Octogenarian with Severe Left Ventricular Dysfunction and Cardiac Resynchronization Therapy-Defibrillator Device: Successful Anesthesia Management for Hip Arthroplasty

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Abstract

Cardiac resynchronization therapy has emerged as a key component in management of advanced heart failure with reduced ejection fraction in selected subset of geriatric patients. The burgeoning burden of comorbidities, complexity of these devices and aging population presenting for surgeries necessitates peri-operative physicians to be cognizant and confident to handle these challenging cases. Limited literature about anesthesia management of patients implanted with these devices add to the situational challenge. We present a case of elderly gentleman with ischemic cardiomyopathy and cardiac resynchronization therapy-defibrillator device who underwent hip replacement under general anesthesia. Understanding the disease and the device are the crucial and definitive exigencies to manage such cases.

Introduction

Cardiovascular Implantable Electronic Devices (CIED) comprising of pacemakers, implantable cardioverter defibrillators, Cardiac Resynchronizing Therapy (CRT) devices and implanted rhythm monitors have emerged as lifesaving and life prolonging gadgets. Amongst them CRT, the most sophisticated type of CIED has promisingly surfaced as non-pharmacological therapy in Chronic Heart Failure (CHF). Rapidly developing technologies and expanding number of patients with these devices coming for noncardiac surgeries coerce understanding of these devices and the fundamentals behind the therapy. Many anesthesia practitioners lack the knowledge, experience, and requisite programming devices to independently manage these patients perioperatively which potentially can lead to deleterious patient effects and device damage. Concomitantly extremes of age, Left Ventricular (LV) dysfunction, rhythm disturbances and associated comorbidities additionally make these cases as high risk. Although the devices encountered nowadays are of increasing complexity, the vast majority of procedures can be safely performed in patients [1].

Case Presentation

An 83-year-old male (weight 65kg/height 164cm) presented to emergency department with left side unstable closed intracapsular sub-capital fracture neck of femur due to trivial fall. His medical history included Acute Myocardial Infarction (AMI) 28 years ago managed conservatively, followed by another episode of AMI 14 years back when he underwent coronary artery bypass with 3 grafts. After few years he had frequent hospitalization due to recurrent pulmonary edema and subsequent paroxysmal atrial fibrillation which did not resolve with diuretics and amiodarone. Transthoracic echocardiography revealed Left Ventricular Ejection Fraction (LVEF) of 22% with extensive regional wall motion abnormality. He received Quadra Assura MP™ CRT-D (St Jude Medical/Abbott, lake forest, IL, USA) device in left pectoral region 3 years back. Post CRT-D insertion his cardiac function improved to New York Heart Association class III and hospital admission reduced. He was non-smoker and non-alcoholic with diabetes mellitus 2 on oral hypoglycemics for past 5 years. Patient was scheduled for uncemented hip arthroplasty under general anesthesia after evaluation by a multi-disciplinary team of cardiologist, anesthetist, surgeon, intensivist and electrophysiologist. His daily medications included tab torasemide 10 mg, tab spironolactone 25 mg, tab amiodarone 100 mg on alternate days and tab acenocoumoral 0.5 mg od. Device interrogation done 6 months before revealed 67% battery status and 96% pacing /sensing activity, satisfactory leads and pacing threshold; and pulse width within normal limits. Latest echocardiography disclosed dilated left atrium and ventricle, LVEF of 22%, regional wall motion abnormality with thinning and akinesia of mid antero-septum, apical septum, apex, basal and mid inferior and inferolateral wall; while only basal anterior and basal anterolateral wall were contracting, rest all segments were hypokinetic. Electrocardiogram (ECG) shows an atrial sensed biventricular paced rhythm pattern (figure 1) and chest x-ray (figure 2) revealed device with leads in situ and no signs of pulmonary edema. Rest laboratory parameters were grossly acceptable (table 1).

Table 1: Preoperative laboratory parameters

Investigation	Values	Units
Hemoglobin	12.8	g/dl
S.Urea	49	mg/dl
S.creatinine	1.3	mg/dl
S.Sodium	139	meq/L
S.Potassium	4.4	meq/L
S.bicarbonate	25	meq/L
INR	1.2	
aPTT	28.6	seconds
HbA1C	7.8	%

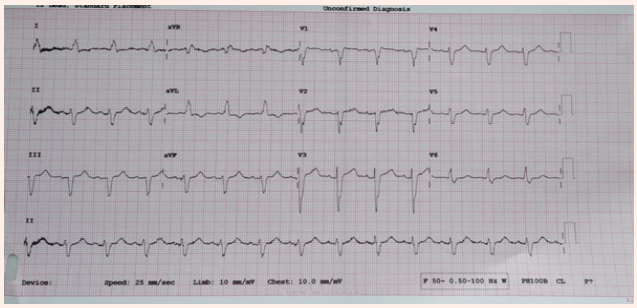

Figure 1: Electrocardiogram showing atrial sensed biventricular pacing at 84 beats/min

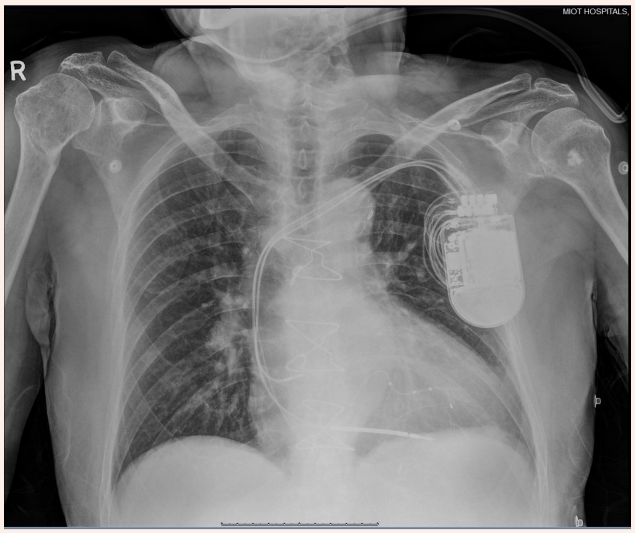

Figure 2: Chest radiograph: CRT-D device with generator in left pectoral region and leads in right atrium, right ventricle and coronary sinus with clear lung fields

The CRT-D device was programmed before induction of anesthesia with pacing (DDD) modality changed to DOO and defibrillator function de-activated. Instead, Automatic External Defibrillator (AED) pads were attached on right infraclavicular and left inframammary region. Apart from antithrombotic all cardiac medications were administered as usual. Right internal jugular catheter was inserted with local anesthesia under ultrasound and fluoroscopic guidance with the guidewire manipulated carefully to avoid entangling with the leads. Catheter was fixed at the junction of right atrium and superior vena cava. Radial artery was cannulated for invasive Blood Pressure (BP) and pulse monitoring. The filter on the ECG monitor was put on diagnostic mode to display pacing spikes. Induction of anesthesia and the tracheal intubation were uneventful, using intravenous fentanyl 200 µg, etomidate 10 mg, midazolam 1 mg and 35 mg of atracurium. Anesthesia was maintained with sevoflurane (0.9-0.8%) in oxygen-air. Hypotension was managed by norepinephrine infusion and phenylephrine boluses to target mean arterial pressure above 70 mm Hg (figure 3). Electrosurgical plate was inserted to contralateral thigh and surgical team was requested to announce and minimally use monopolar electrosurgery with short burst only. Surgery was successfully concluded in lateral position with no adverse events or interactions occurring between the electrosurgery and CRT-D settings. The total anesthesia and surgical time were 1h and 35min and 1 h and 5 min respectively. Totally 400ml of crystalloid was infused with around estimated 200ml blood loss.

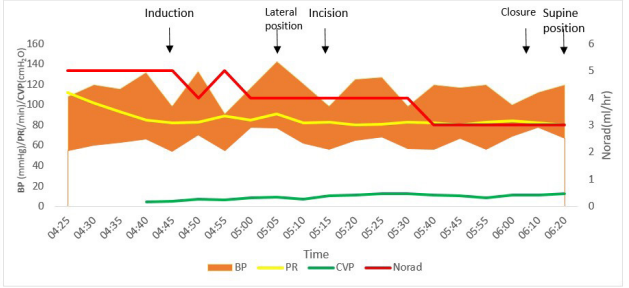

Figure 3: Anesthesia chart of CRT-D patient undergoing hip arthroplasty. BP blood pressure, PR pulse rate, CVP central venous pressure, Norad noradrenaline infusion (6 mg/50 ml)

Patient was gradually awakened and successfully extubated in the intensive care unit with warming blanket to prevent shivering. After weaning off vasopressors and reassuring surgical wound drains the CRT-D device was reprogrammed with defibrillator function activated while AED pads were discontinued. Device interrogation revealed no ventricular or atrial arrythmia episodes. Post operative pain was controlled with intravenous fentanyl and paracetamol. Intensive cardiac monitoring was continued till he was transferred to the ward on day 2. He was safely discharged of day 8 without any deterioration of cardiac function.

Discussion

Cardiovascular diseases affecting older adults disproportionately, contribute to disability and diminish their quality of life. Geriatric population is predisposed to developing CHF as a result of age-related changes in the cardiovascular system, hypertension, coronary artery disease and valvular heart disease [2]. The incidence and prevalence of HF rises steeply with age, the mean age at first diagnosis being 76 years, with about half of this patient having a LVEF of less than 50%. [3] CRT has been shown to reduce sudden cardiac death and heart failure hospitalizations along with improvement in symptoms, quality of life and functional class in selected elderly population. It is a validated strategy for improving cardiac pump function through biventricular pacing in patients CHF with LVEF< 35 %, inter-ventricular conduction delay and mechanical dyssynchrony, who are symptomatic despite optimal medical treatment. CRT can be achieved with a device designed only for pacing (CRT-P) or with the added capability for defibrillation (CRT-D) [4]. Traditionally CRT the most complex type of CIED device with different sensors and automatic algorithms, have been clubbed with general CIED practice advisories, therefore its clinical data on the peri-operative management and outcome are limited. Furthermore, CRT carriers are older with frequent comorbidities and are implanted for advanced CHF, which itself is a known independent risk factor for unfavorable outcomes [5].

Patient assessment and Anesthesia

In addition to a thorough cardiovascular history and physical examination, specific consultation and recommendation from cardiology and CIED team (physicians, technicians, electrophysiologist, device manufacturer) about indication for implantation, type, function, underlying rhythm, response to placement of magnet, interrogation and management of the device needs to be elicited. The peri-operative team including the surgeons and anesthetist need to communicate the exact nature of the procedure to the CIED team, including possible sources of Electromagnetic Interference (EMI), surgical position, anesthetic plan, drugs, fluid and electrolyte management, availability of telemetry perioperatively, and expected postoperative management [6]. The optimal anesthetic management must assess the patient's

pathophysiology and clinical status, select anesthesia based on the kind of surgery and cardiac function, bolster perioperative monitoring, evading myocardial depression, and maintain optimization of fluid and hemodynamics. In general, anesthetic drugs have no direct effect on CIED functioning. We planned and administered standard anesthesia approach with short acting drugs having minimal cardiovascular effects. Even though graded epidurals have been successfully used in cardiomyopathies and low LVEF, but we refrained due to apprehension of further afterload reduction. Similarly isolated case reports advocate Cardiac Output (C.O) monitors like FloTrac/Vigileo™ system for haemodynamic control in such cases [7]. We abstained from using as it has been shown inaccurate in patients with low C.O, especially those with a cardiac index<2.2 L/min/m^2 and a high systemic vascular resistance [8]. General guidelines on anesthetic technique advise avoiding hyperventilation with resultant hypokalemia, muscle fasciculations and shivering, acid-base balance shifts, intravascular volume overloading, and large volume blood transfusions. Adjunctive medications that have direct and indirect effects on C.O should be administered with caution to prevent precipitating CIED events perioperatively. Pulse oximeter or arterial line is mandatory for beat-to-beat display and correlation with ECG artefacts and electrical interference. Equipment for emergency transcutaneous pacing or defibrillator are obligatory especially if the device has been reprogrammed. Upper body central venous catheters if required should be placed under fluoroscopy guidance to avoid lead damage and false detection [9]. Post operatively monitoring and pacing/defibrillation back up should continue along with access to cardiopulmonary resuscitation equipment till the device is tested and re-programmed to the original mode. Perioperative management largely relies on determining the patient's CIED dependence and EMI potential. Resulting adverse outcomes due to EMI may be clinical (hypotension, arrythmia) or CIED associated like rate interference, pulse generator damage, lead-issue damage, inappropriate shock, and electrical reset mode.5 Bipolar electrosurgery does not cause EMI unless applied directly to a CIED. Monopolar electrosurgery used for cutting, coagulation and dissection is the most frequent cause of EMI although the risk is nearly nil for below umbilicus and lower extremities procedure. It should be used in short burst of 5 seconds and current pathway should be kept farthest possible from the device [10]. We agree that our surgical requirements did not demand CRT programming, but expected considerable use of monopolar and difficulty in magnet fixation due to lateral position made us circumspect. A historic staple of CIED perioperative management has been the application of a clinical magnet made of ferrous alloy. CRT-D devices pose specific dilemmas for perioperative management because the devices provide close to 100% biventricular pacing, and the addition of a high-voltage coil indicates that magnet application will not result in asynchronous pacing. Even though our patient had "adequate" underlying rhythm, turning off pacing feature in CRT-D may affect hemodynamic stability as ventricular pacing optimizes stroke volume and asynchronous mode may be pro-arrhythmic [11]. Clinical magnets have not widely used for these cases perhaps due to the unfamiliarity with the variable response of CRT-D to magnet application [12]. CRT carriers are predominantly under-represented in CIED clinical trials hence need for preoperative reprogramming and interrogation are often equivocal and the device's complexity limits generalization [5].

Conclusion

In conclusion, for administering safe anesthesia to fragile elderly patients with severe LV dysfunction and CRT-D device, understanding the disease and the device, implementing the proper settings; and peri-operative communication and planning with the team is imperative for a rewarding outcome. Anesthetist specially trained in handling these devices can provide efficient and safe peri-operative care in such cases [13,10]. The perioperative CIED management should be individualized depending on economic, procedural and personal set up of the hospital unit to devise a safe surgical approach.

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References

1. Stone ME, Salter B, Fischer A (2011) Perioperative management of patients with cardiac implantable electronic devices. BJA 107(1): 16-26.
2. Rich MW (1997) Congestive heart failure in older adults: epidemiology, pathophysiology, and etiology of congestive heart failure in older adults. J Am Geriatr Soc 45(8): 968-974.
3. Mehta PA, Cowie MR (2006) Gender and heart failure: a population perspective. Heart 92(3): 14-18.
4. Strisciuglio T, Stabile G, Pecora D, Arena G, Caico SI et al (2021) Does the age affect the outcomes of cardiac resynchronization therapy in elderly patients? J clinic med 10(7): 1451.
5. Niedermeier A, Vitali-Serdoz L, Fischlein T, Kirste W, Buia V, et al. (2021) Perioperative Sensor and Algorithm Programming in Patients with Implanted ICDs and Pacemakers for Cardiac Resynchronization Therapy. Sensors (Basel) 21(24): 8346.
6. Costa A, Richman DC (2016) Implantable devices: Assessment and perioperative management. Anesthesiol Clin 34(1): 185-99.
7. Kammura Y, Fujita A, Karashima Y, Nakayama S, Shirozu K, et al. (2020) Anesthetic management of laparoscopy-assisted total proctocolectomy in a cardiac sarcoidosis patient with a cardiac resynchronization therapy-defibrillator: a case report. JA Clin Rep 6(1): 1-5.
8. Maeda T, Yoshitani K, Inatomi Y, Ohnishi Y (2014) Inaccuracy of the FloTrac/Vigileo™ system in patients with low cardiac index. Journal of Cardiothoracic and Vascular Anesthesia 28(6): 1521-1526.
9. Chakravarthy M, Prabhakumar D, George A (2017) Anaesthetic consideration in patients with cardiac implantable electronic devices scheduled for surgery. Indian J Anaesth 61(9): 736-743.
10. Crossley GH, Poole JE, Rozner MA, Asirvatham SJ, Cheng A, et al. (2011)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: 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 8(7): 1114-1154.
11. Cronin B, Birgersdotter-Green U, Essandoh MK (2019) Perioperative interrogation of Boston Scientific cardiovascular implantable electronic devices: A guide for anesthesiologists. J Cardiothorac and Vasc Anesth. 33(4): 1076-1089.
12. Jacob S, Panaich SS, Maheshwari R, Haddad JW, Padanilam BJ, et al. (2011) Clinical applications of magnets on cardiac rhythm management devices. Europace 13(9): 1222-1230.
13. Ellis MK, Treggiari MM, Robertson JM, Rozner MA, Graven PF, et al. (2017) Process improvement initiative for the perioperative management of patients with a cardiovascular implantable electronic device. Anesth Analg 125(1): 58-65.