



Patient With Implanted Pacemaker : General and Anaesthetic Considerations

KEYWORDS

Equipment; pacemaker; perioperative management

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ABSTRACT

The use of implantable pacemakers to treat heart problems is growing and as a result more patients with these devices are presenting for elective or emergency surgery. The complexity of these devices continues to increase with explosion in current technology and it is incumbent on anaesthesiologists to be familiar with current recommendations and essential tenets of these devices in the interest of patient safety. These patients should be managed with multidisciplinary individualized approach based on focused history, physical examination, interrogation of pacemaker before and after the procedure and reprogramming it, if required. Careful perioperative monitoring of ECG, pulse oximetry, arterial blood pressure, electrolyte and metabolic disturbances should be done. Emergency drugs, temporary pacing and defibrillation should be kept ready. Drugs and equipments interfering with pacemaker function should be avoided. Post procedure, continuous monitoring of cardiac rate and rhythm should be done along with consultation of a cardiologist.

Introduction:

The availability of better medical facilities and sophisticated diagnostic methods, has led to increased detection of electrophysiological disorders in patients and resultant growing use of pacemakers to treat these abnormalities. Currently more than 5,00,000 patients in the United States have pacemakers and nearly 1,15,000 new devices are implanted each year.^[1] Although, no definite figures are available, the number is also increasing in India. These patients may require one or more surgical procedures after receiving the pacemaker.^[2] Hence, the anaesthesiologist should be familiar with the general and anaesthetic implications of pacing and be able to monitor and maintain pacemaker function under surgical and anaesthetic conditions to ensure maximal patient safety.^[3,4]

This discussion presents the case of a patient with a permanent pacemaker for emergency surgery. Preoperative preparation, intraoperative management, and postoperative considerations for the patient with a permanent pacemaker are discussed.

Case Report:

A 60 year old male, weighing 60 kg, presented for emergency laparotomy for gut gangrene. He had a history of syncope 5 years back with complete heart block in electrocardiography (ECG) for which permanent pacemaker was implanted at the same time. The pacemaker was of VVI type (single chamber demand pacing). On general physical examination, blood pressure was 150/90 mm Hg and pulse was 70/minute. On systemic examination, murmur was noticed in the mitral area and chest was clear bilaterally. Airway evaluation revealed mallampati grade II and temporomandibular joint movements were normal. His blood investigations were within normal limits. His chest X-Ray showed intact leads of pacemaker and ECG showed sinus rhythm with all paced beats. His echocardiography revealed concentric left ventricular hypertrophy, mild mitral regurgitation, dilated left atrium, good left ventricular systolic function and left ventricular ejection fraction of 50%. Cardiologist opinion was taken. He opined that the patient

could be taken for surgery under high risk consent with minimum use of electrocautery.

General anaesthesia was planned for the procedure. Intravenous line was secured with 18 G cannula using Ringer lactate. Monitors were attached including HR, ECG, SpO₂, EtCO₂ and invasive blood pressure. Injection isoproterenol, atropine and defibrillator were kept ready. Patient was preoxygenated for 3 minutes using 100% oxygen. He was induced with injection fentanyl 100 µg and thiopentone sodium 300 mg intravenously. After loss of eyelash reflex, rapid sequence induction was done using rocuronium 60 mg intravenously. Endotracheal intubation was done using 8 mm internal diameter endotracheal tube. Anaesthesia was maintained with 100% oxygen in isoflurane. Muscle relaxation was provided with injection atracurium 5 mg intravenously as and when required. Surgeons were asked to use bipolar cautery instead of monopolar one. After relief of intestinal obstruction, nitrous oxide in oxygen (67:33) was started. Blood pressure, heart rate, oxygen saturation and electrocardiography were monitored throughout the procedure. The surgery lasted for 2 hours. Intraoperative and postoperative course was uneventful.

Discussion:

American Society of Anesthesiologists (ASA) Task Force^[5] recommends multidisciplinary individualized approach for anaesthetic management of patients with implanted pacemakers. A thorough preoperative examination should include complete medical history, relevant physical examination, review of all medical records, ECGs and chest X-rays and focused interview regarding the pacemaker. Detailed evaluation of the underlying cardiovascular disease responsible for the insertion of pacemaker, and other associated medical problems like coronary artery disease (50%), hypertension (20%) and diabetes (10%) should be done.^[6] The severity of the cardiac disease, the current functional status and medications of the patient should be known. The type of device can be defined from manufacturer's identification card or chest X-ray (visualization of integrity of leads and position of pacing box and electrodes) if no

data is available. Patient's dependency on device for pacemaker function can be interrogated by knowledgeable consultant with a programmer. Specific history, ECG and slowing the heart rate to a rate below that of the pacemaker by carotid massage, prolonged vasalva maneuver or small dose of edrophonium, esmolol or adenosine can be helpful to ensure effective sensing, pacing and mechanical capture.^[3,7] The functioning of the pacemaker can be determined by interrogation with cardiologist and manufacturer for battery life, battery impedance, lead performance, adequacy of current settings and perioperative recommendations. Reprogramming of the device to asynchronous mode is only done in pacemaker dependent patients who will be exposed to significant electromagnetic interference (EMI) during surgery.^[3] Magnet can also be placed over the device to convert it to asynchronous mode which persists for as long as the magnet remains in place over the pulse generator. Removal of the magnet results in reversion to baseline device programming, but its efficacy in modern pacemakers is questionable and unpredictable with potentially dangerous results.^[3] Rate modulation feature of modern pacemakers should also be suspended in the perioperative period because of inappropriate sensing.^[3] Metabolic and electrolyte abnormalities can affect pacemaker function. Severe alkalosis and acidosis will increase the threshold voltage and current requirements of ventricular stimulation. Acute hypokalemia caused by hyperventilation or diuretic therapy causes an increase in threshold and could lead to loss of capture. Acute hyperkalemia increases myocardial irritability and increases the risk for ventricular dysrhythmias, especially in the ischemic heart.

Intraoperative patient monitoring for cardiac rate and rhythm should be done with continuous electrocardiogram and peripheral pulse monitoring (pulse oximeter, direct palpation or by observation of arterial wave form in invasive arterial pressure monitoring). The presence of pacemaker is not an indication for insertion of pulmonary artery (PA) or central venous catheter (CVC).^[8] Insertion of the guide wire or CVC is potentially arrhythmogenic and dislodgement of freshly placed transvenous endocardial electrode can occur.^[8] Multipurpose PA catheter with pacing facilities can be used if absolutely necessary.

The anaesthetic technique should be according to proposed surgery and patient's underlying disease. Spinal or epidural anesthesia cause loss of sympathetic tone. Vasodilation will cause a decrease in venous return and systemic vascular resistance. Loss of cardioaccelerator fibers results in bradycardia. These can cause a patient who has an intrinsic rhythm prior to anesthesia to become hypotensive and pacemaker dependent. Induction can be done by intravenous agents that best maintain patient's cardiovascular status. We used thiopentone sodium for induction. Etomidate and ketamine should be avoided as these cause myoclonic movements.^[8] Neuromuscular blockade with succinylcholine can cause significant muscle fasciculations leading to complete inhibition of pacemakers because of oversensing, resulting in cardiac arrest in pacemaker-dependent patients.^[9] This can be avoided by using nondepolarizing muscle relaxants, defasciculating with them before giving succinylcholine or by temporary reprogramming of pacemaker to asynchronous mode.^[10] We used rapid sequence induction with rocuronium instead of succinylcholine. Narcotics and inhalational techniques do not alter current and voltage thresholds of the pacemaker. However, reduction in cardiac output and mean arterial pressure and pacemaker syndrome (syncope, breathlessness, postural hypotension)^[11] has been reported with potent inhalational

anaesthetics. We used isoflurane for maintenance of anaesthesia. Use of N₂O can cause pacemaker malfunction by increasing gas in prepectoral pacemaker pocket (loss of anodal contact) if the pacemaker has been implanted recently (<6 weeks).^[12] Positive pressure ventilation can cause dislodgement of pacemaker leads; therefore, pacemaker function should be verified, before and after initiating mechanical ventilation.^[13] Shivering should be avoided and temperature must be kept constant in 'temperature' rate responsive pacemakers.^[12] Electromagnetic interference (EMI) during surgery in a patient with pacemaker can cause ventricular fibrillation, myocardial damage, and increases in stimulation threshold leading to loss of capture.^[2] Bipolar cautery reduces this incidence by minimizing the electrical field size due to proximity of electrodes to each other. If unipolar cautery is to be used, the grounding plate should be placed close to the operative site and as far away as possible from the site of pacemaker, usually on the thigh and should have good skin contact. Electrocautery should not be used within 15 cm of pacemaker. Frequency of electrocautery should be limited to 1 second bursts in every 10 seconds to prevent repeated asystolic periods- short bursts with long pauses of cautery are preferred.^[14]

Emergency drugs such as isoproterenol, atropine or epinephrine should be available. External defibrillation/pacing pads connected to the monitor/defibrillator should be on standby. An anterior-posterior configuration of the pads is recommended because it is perpendicular to the usual axis of the leads, and theoretically minimizes the induction of current down the leads if the pads need to be used.^[5]

Cardiac rate and rhythm should be monitored continuously throughout the immediate postoperative period to ensure that the surgical procedure, especially electrosurgery use, has not resulted in undetected changes in pacemaker functioning. If the patient is not pacemaker dependent, changes in pacemaker function may not be detected until the demand mode is activated. Hence, pacemaker settings should be checked by the cardiology department prior to shifting the patient from post anaesthesia care unit.

Conclusion:

Proper anaesthetic management of a patient with implantable pacemaker involves multidisciplinary individualized approach with diligent evaluation, planning and monitoring. The evolution of current technology has increased the complexity of pacemakers with multiple modes of operation and programs making standardized management strategies inadequate. Different types of pacemakers require individual consideration. So it is incumbent on anaesthesiologists to be familiar with the different designs of pacemakers and the latest recommendations with their implementation in the interest of highest possible level of patient safety.

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