

# Patients With Implantable Cardioverter Defibrillator: Are They Suitable For Ambulatory Surgery?

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## Introduction

Implantable cardioverter defibrillators (ICD) are increasingly placed worldwide. These devices deliver three types of treatment: anti-bradycardia and tachycardia pacing, cardioversion, and defibrillation. However, literature regarding their perioperative management is sparse and of limited quality. Because these patients pose significant perioperative challenges and are at an increased risk of complications, the suitability of ambulatory surgery in this patient population remains controversial. This review discusses the potential challenges and optimal perioperative care of patients with ICD.

## Perioperative Concerns

One of the major concerns in the perioperative care of ICD patients is the effect of electromagnetic interference (EMI) generated by external sources (e.g., diathermy) on ICD function. The ICD may interpret EMI as ventricular fibrillation or tachycardia and inappropriately deliver shocks. In addition, EMI can potentially damage the device, internal circuits (i.e., leads), and site of lead implantation, as well as cause failure to pace and/or defibrillate, or lead to complete device malfunction. Nevertheless, modern ICDs are more sophisticated and less susceptible to malfunction including their response to EMI.

## Preoperative Considerations

Preoperative evaluation specific to ICDs includes determination of the type and model of the device, either from patient's history, chart review, device card, chest radiograph or from the manufacturer's help line. Adequate device function and patient's dependence on antibradycardia pacing (e.g., history of symptomatic bradyarrhythmia or syncope, successful AV nodal ablation, no evidence of spontaneous ventricular activity with the device programmed to VVI mode at the lowest possible programmable rate) should also be determined.

Although all patients receive periodic follow-up for interrogation and testing of the ICD, it is recommended that these devices be examined within 30 days prior to surgery. This will allow determination of battery status and device function as well as information about current programming.

## Preoperative Reprogramming Versus Magnet Use

Inappropriate shock delivery due to EMI may be avoided either by reprogramming or application of a magnet over the device. The American Society of Anesthesiologists (ASA) Advisory for the perioperative management of patients with cardiac rhythm management devices as well as the American College of Cardiologists (ACC)/American Heart Association (AHA) guidelines on perioperative cardiovascular evaluation and care for noncardiac surgery recommend that the tachyarrhythmia treatment algorithms of the ICD should be programmed off prior to surgery. However, these recommendations contradict those by the manufacturers and recent reports.

Most ICD manufacturers recommend that if EMI is likely a magnet may be used to suspend tachyarrhythmia detection. However, there are differences between manufacturers with respect to position of the magnet as well as responses to magnet application. For example, the correct position of magnet placement Medtronic devices is directly over the ICD while that for St. Jude Medical devices is off-center such that the curve of the "donut" magnet is over the top or bottom end of the device. In addition, certain manufacturers (e.g., Medtronic, St. Jude Medical, and Biotronik) require that the magnet remain on the device during the period of deactivation. In contrast, other ICD devices (e.g., Boston Scientific, formerly Guidant) have different responses to magnet application. Of note, some ICDs may be programmed to IGNORE the placement of a magnet and therefore will continue to deliver therapy even if a magnet is properly positioned over the device. Because of these variable responses to magnet, it is critical to verify ICD program (and response to magnet), preoperatively.

Unlike a pacemaker, the bradycardia pacing operation of an ICD is not forced to pace asynchronously with magnet placement, and therefore, EMI exposure could cause pacemaker dysfunction. Thus, patients who are pacemaker-dependent should have their devices reprogrammed to an asynchronous pacing mode. In addition, reprogramming is recommended in surgical procedures within 15 cm of the ICD generator (Figure 1).

### **Intraoperative Considerations**

When performing electro-surgical procedures on patients with ICD, some basic precautions must be taken including immediate availability of external defibrillation and pacing options. In addition to heart rate and rhythm, plethysmography waveform of pulse oximetry should also be continuously monitored. The artifact filter on the ECG monitor should be disabled, as it will allow detection of pacemaker discharge. Because patients with ICDs are at a higher risk of perioperative arrhythmia and may require therapy, preoperative placement of external defibrillation/pacing pads is recommended.

Because reprogramming or magnet application will not protect a device and internal circuitry from EMI-induced internal damage, it is important to reduce EMI as much as possible. Considerations to reduce EMI include use of bipolar diathermy or ultrasonic scalpel. If monopolar electrosurgical diathermy must be used, minimal power setting, "cutting" rather than "coagulation" current, and short, intermittent and irregular diathermy bursts are recommended. In addition, the grounding pad should be placed such that the current flow will not intersect the pacing system. For example, patients undergoing head-neck surgery should have the grounding pad placed on the shoulder contralateral to the device (not the thigh) while those undergoing breast and axillary surgery should have the pad placed on the upper arm.

If ventricular tachycardia or ventricular fibrillation develops eliminate all sources of EMI. If a magnet is in place, simply remove it to restore previously programmed detection and therapy settings. Of note, for some devices (e.g., Boston Scientific devices) reapplication of magnet may be necessary to restore ICD function. If the device has been programmed off preoperatively, it has to be reprogrammed by a skilled individual.

If all fails external shock must be performed, by placing the defibrillator pads or paddles preferably 15 cm from the device in an anterior-lateral or anterior-posterior position. Importantly, clinically appropriate energy output should be used regardless of the presence of ICD. Patients who receive external shock must have their devices interrogated after surgery.

### **Postoperative Considerations**

After the completion of the procedure, removal of the magnet will automatically restore the device to its previous settings. Because magnet use allows immediate reactivation of the device after surgery, tachyarrhythmia therapy remains disabled for the least time that reduces the overall unprotected time. Obviously, devices that were reprogrammed off prior to surgery will have to be turned on after surgery (Figure 2). Device interrogation is recommended if diathermy was used within 15 cm of the device or lead system or if there were intraoperative complications. The ASA Advisory recommends that all patients with ICD should have their devices restored and interrogated prior to discharge from the recovery room.

### **Future Considerations**

Sophisticated device self-monitoring capabilities as well as internet-based or wireless remote monitoring of ICDs has allowed automatic checks and reliable monitoring of device performance. In future remote monitoring may be used for preoperative ICD interrogation either from patients home or ambulatory surgery facility. Similarly, it could be used to interrogate the device postoperatively. Thus, number of controversies surrounding the perioperative care of ICD patients may be eliminated.

### **Summary**

Suitability of ambulatory surgery in a patient with ICD would depend upon appropriate patient selection based on the severity of cardiac disease and other co-existing diseases, procedure selection based on extensiveness of the surgery and site of surgical procedure, and suitability of the ambulatory surgery facility.

The ASA and ACC/AHA recommendations to reprogram the ICDs preoperatively were probably based on early generation devices and need to be updated as significant advances in ICD technology have made these devices safer and less susceptible to EMI. In addition, increased understanding of ICD functions as well as awareness of potential EMI-related problems can further reduce ICD-related complications, and improve perioperative safety in this patient population. It is necessary that anesthesia practitioners involved in the care of ICD patients appreciate that response to magnets varies and understand appropriate magnet application including situations in which magnet use is not advisable. Perioperative communication with the patient's cardiologist and surgeon is critical in reducing adverse outcome.

### **References**

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Figure 1: Preoperative considerations in a patient with implanted cardioverter defibrillator (ICD)

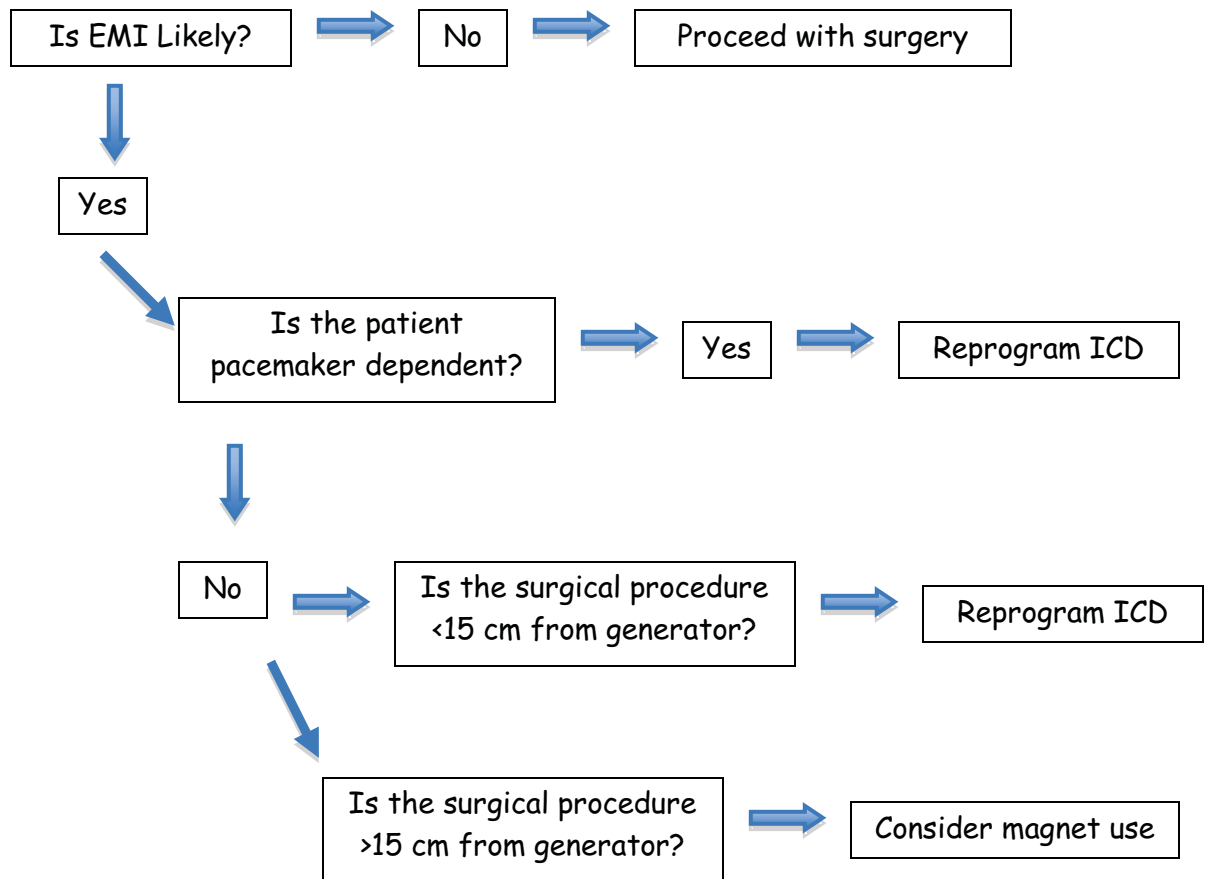


Figure 2: Postoperative considerations in a patient with implanted cardioverter defibrillator (ICD)

