

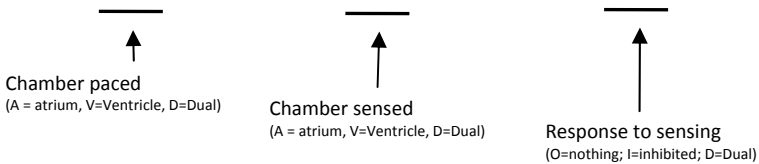
IMPLANTABLE CARDIAC DEVICES

It is not uncommon to see patients with pacemakers and Automatic Implantable Cardioverter Defibrillators (abbreviated as AICDs or ICDs) for preoperative evaluation. Perioperative management of these devices requires both knowledge of how these devices function normally, as well as an understanding of the particular risks posed by surgery, to both the patient as well as the device.

Pacemakers

Pacemaker device types are classified by the chamber(s) paced: atrial, ventricular, dual chamber (atrial and ventricular), and biventricular. Many modern pacemakers have a rate adaptive mechanism to allow the pacer to adjust to physiologic demands of the patient.

Pacemaker Nomenclature



A fourth letter, "R", is often added for a rate adaptive mechanism (i.e. increases rate with activity).

Most Common Pacing Modes

- VVI** senses and paces the ventricle.
- VVIR** same as VVI, but with rate adaptive mechanism.
- DDD** both atrium and ventricle are sensed and paced individually.
- DDDR** same as DDD, but with rate adaptive mechanism to alter atrial pacing.

Implantable Defibrillators

Modern implantable defibrillators respond to tachyarrhythmias (including fibrillation states) by means of anti-tachycardia pacing, low energy synchronized shocks, or high energy unsynchronized shocks. All AICDs now have pacing capability, for use in the event of bradycardic states.

Electromagnetic Interference (EMI)

Electromagnetic sources, such as electrocautery used during surgery, or intraoperative defibrillation, can interfere with implanted cardiac devices, causing improper rhythm sensing, accidental reprogramming, improper defibrillator shock delivery or other adverse effects. Additionally, device components can be damaged by EMI, and myocardial burns can occur at the contact point with lead electrodes. Unipolar diathermy is more hazardous than bipolar, and should be avoided whenever possible.

Approach to the patient with a cardiac device

Preoperative Checklist:

1. Device **identification**.
 - a. Pacer, defibrillator, or both? Note that some patients will describe their defibrillator as a "pacemaker", and this may (or may not) be erroneous.
 - b. Document the manufacturer and model. An identifying card is typically carried by the patient, and can be very helpful.

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- c. Date of implantation, or re-implantation if the generator has been replaced.
 - d. If uncertain, check for scars and consider chest radiograph or electrocardiogram to further elucidate the presence and/or nature of the device.
2. Identify the programmed **pacing mode** if the device is a pacemaker.
3. Document the name of the patient's **cardiologist** that manages the device, along with their phone number.
4. Determine when the **last interrogation** of the device was, and, if possible, obtain a copy of those results. The patient preferably should have an interrogation within three months of planned surgery. If the battery is near end of life, elective surgery should generally be postponed until the battery is replaced.
5. Obtain an **electrocardiogram** along with a rhythm strip. This will help to determine the underlying rhythm, and if the patient is pacemaker dependent.
6. Try to determine if the patient is **pacemaker dependent**. The ECG may be helpful, but only provides a small peek at the rhythm and is not necessarily diagnostic. An interrogation report is most helpful. A history of prior ablation therapy or symptomatic bradycardia may suggest pacer dependence.

Perioperative management:

Pacemaker reprogramming to a nonsensing (asynchronous) mode (e.g. VOO) should be considered if:

- a. Significant amounts of EMI are expected intraoperatively.
- b. Unipolar diathermy (electrocautery) is required during surgery.
- c. The patient is pacemaker dependent.
- d. The pacemaker has a rate adaptive mechanism that responds to minute ventilation by transthoracic impedance. Cardiac monitors can cause these devices to errantly interpret minute ventilation as double the actual value, thus inappropriately increasing the rate of pacing during a procedure.

Pre-Anesthesia Clinic has a form and protocol for notifying the Cardiology Electrophysiology Service, and they will typically handle the arrangements for device reprogramming. Make sure to notify the Pre-Anesthesia Clinic if perioperative device reprogramming is necessary. If a device requires reprogramming, this should be ideally performed in the preoperative staging area just prior to surgery. The device should be programmed back to its original settings in the recovery room immediately following surgery.

Pacemakers do not require reprogramming when:

- a. The procedure is far from the location of the pacemaker, e.g. below the waist.
- b. Minimal or no EMI is expected intraoperatively.
- c. The patient is substantially not pacemaker dependent.

Automated defibrillators should be SWITCHED OFF during surgery to prevent inappropriate shock delivery. External defibrillator pads should be placed on the patient's chest for the duration of the procedure and until the device is reactivated postoperatively.

Intraoperative Recommendations:

When electrocautery is required, bursts should be kept brief, with minimal energy settings if possible. Grounding pads should be placed in a location away from the device and leads, and placed to avoid current across the device.

Postoperative Issues:

The Cardiology Service will generally reprogram and interrogate the device postoperatively to the device's original setting. If the patient has special physiologic needs (e.g. unstable, hypotensive, etc.), an alternate setting may be programmed in by Cardiology. The patient may later require further reprogramming when those needs are no longer required. The patient's primary electrophysiologist should be notified if the patient's device programming is different from the original settings at the time of discharge.

If there is any concern about device malfunction or damage postoperatively, an interrogation of the device should be performed promptly.

If the patient is stable in recovery, telemetry monitoring on the floor is not generally required, although care should be tailored individually to each patient.

Electrolytes, particularly potassium, should be followed postoperatively since pacing thresholds can be affected by electrolyte disturbances.

Magnets

The use of magnets on implanted cardiac devices perioperatively should be avoided for several reasons. Magnets have a tendency to fall off or mysteriously "disappear" in the operating room. Additionally, the increasing complexity of these devices has resulted in significant variation in how each device model responds to the presence of a magnet. A magnet may produce asynchronous pacing, either continuously or for a brief period, or may not produce any effect whatsoever. A magnet in combination with EMI could potentially result in unplanned reprogramming of the device. Given the significant potential for harm to the patient, magnet use in the operating room is not recommended.

References:

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3. Fleisher LA, Beckman JA, Brown KA, et al. ACC/AHA 2007 guidelines on perioperative cardiovascular evaluation and care for noncardiac surgery: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines. *Circulation*. 2007;116:e418-e500.