Cardiac Implantable Electronic Device (CIED) Pearls for non-EP Practitioners

By: Oluwole John Abe, MD, FACC, FHRS

Cardiac Implantable Electronic Devices (CIED) are now quite prevalent in clinical practice. Nearly 10 percent of patients seen for non-cardiac issues will have an implantable cardiac device. It is imperative that health care providers have basic understanding of these devices and have enough information to answer common patient questions regarding them.

Types of Cardiac implantable electronic devices:
The most common Devices seen in clinical practice are:
- Implantable Cardioverter Defibrillators (ICD) and Biventricular ICDs (BVICD)
- Permanent Pacemakers (PPM)
- Implantable Loop recorders (ILR)

Implantable Loop recorders
Implantable Loop recorders are miniature flash drive sized or smaller devices with no therapeutic component. They only record cardiac rhythm hence no special care is required peri-operatively. Patients can have MRIs with loop recorders.

Implantable Cardioverter Defibrillators and Permanent Pacemakers
These can be single, dual or Biventricular devices depending on the number of leads. Patients vary in their requirement for pacing hence pacing spikes may not be noticeable on EKG or telemetry. In fact most ICDs are programmed not to pace at all, so there will be no pacing spikes on the EKG or telemetry. Biventricular ICDs are programmed to pace all the time.

Device Follow up:
- Following device implant, wound care is like any other surgical wound.
- It is recommended to prohibit driving and limit raising the limb on the implant side above the shoulder level for 2 to 3 weeks following implant. It is also customary to limit lifting to less than 15 pounds for the same period.
- Patients will follow up with implanting physician in one week. CIED check and education on remote monitoring will be done at that visit.
- The next device check will be in 1 month and thereafter every 6 months for pacemakers and every 3 months for ICDS. Alternate checks can be done remotely without office visit.
- The battery life is estimated at each visit. The longevity of these devices ranges from 5 to 10 years. Note: the battery is the entire generator.

What to do if a patient gets a shock from their ICD
- If it is the first ever shock, the patient should be seen in the Cardiologist/Electrophysiologist’s office the same day or in the ER if after-hours.
- If the patient receives more than one shock in an episode or more than one shock in a 24-hr period, they should go to the ER.
- For one shock in patients who have had previous shocks, the device can be remotely interrogated or the patient can be seen in the office in 24-48 hours.

Driving and ICDs
Driving is classified as private or commercial driving.
Private driving: Driving self, family or friends.
  - ICDs implanted for prophylaxis before a cardiac arrest or VT/VF episode are called primary prevention ICDs. Most ICDs are implanted for this reason. Driving is restricted for the first 2 to 3 weeks to allow healing of the lead in the heart to avoid dislodgement.
  - If a patient gets an appropriate shock, driving should be prohibited for 6 months.
  - For secondary prevention ICDs (ICD implanted for cardiac arrest, VT/VF), driving is prohibited for 6 months following device implant. If the patient does not get shocks in this period, then patients may be allowed to drive however they will be banned for 6 months if an appropriate shock occurs.

Commercial driving: Driving school buses, trucks, taxis, buses.
  - For commercial driving, ICD implantation for any reason means permanent driving ban.
  - Patients with cardiac arrest, VT/VF who refuse ICD implant are also prohibited from commercial driving.

Operating Room Pearls:
- Management of the CIED should be addressed with pre-op cardiac clearance.
- It is important to know if patient is pacemaker dependent. Knowledge of how much battery life the device has left is also very important. These are usually available in the office device check reports.
- If device has been checked within the last 6 months and you have access to the report, there is no need for a device check preoperatively.
- If the last device check was greater than 6 months ago or the last battery longevity was estimated at less than 6 months, then device needs to be checked preoperatively.
- There is no requirement for post-op check except if programming was changed pre-op.
- Pacemaker dependent patients with pacemakers need magnet application for cautery.
- Pacemaker dependent patients with ICDs need pre-op programing to DOO for cautery and post-op programing to normal setting as magnets do not affect pacing in ICDs.

Effects of Electrocautery on CIED
Bipolar electrocautery is generally safe if applied below the umbilicus. Precaution is necessary when electrocautery will be applied above the umbilicus. Electrocautery causes noise seen by device as cardiac activity.

Electrocautery and Pacemakers
False sensing of cautery noise as cardiac activity inhibits pacing. This can be very dangerous in pacemaker dependent patients as they can be without cardiac activity for as long as the cautery is turned on. Application of a magnet over the pacemaker solves the problem by ensuring continuous pacing without sensing.

Electrocautery and ICDs
Sensing of the noise caused by cautery leads to false sensing of VT/VF and delivery of inappropriate ICD shock. Cautery also inhibits pacing as with PPM because of false sensing of cautery noise as cardiac activity. Magnet application solves the inappropriate shock issue.
but for pacemaker dependent patients with ICDs, reprogramming the device to VOO or DOO mode is the way to get around cautery noise suppressing pacing.

Lithotripsy causes similar noise as electrocautery.

**Effects of Magnets on CIEDs**
- Magnet application inhibits pacemaker sensing hence there will be pacing all the time.
- Magnet application inhibits VT/VF sensing, leading to failure to detect or treat VT/VF.
- Magnet application does nothing to pacing function in ICDs. This is different from PPM in this regard.

**Common Household and Everyday Electromagnetic Interference (EMI)**
Common questions patients will ask healthcare practitioners relate to safety of use of common household equipment with their device. Here is a comprehensive but non-exhaustive list of household equipment and commonly encountered EMI.

### Safe

- Microwave
- Tanning Bed
- TV remote control
- Electric Blanket
- Heating pads
- Slot Machines
- Stud Finder
- Laser Leveler
- CPAP Machine
- CT and PET Scan
- Computers, laptop, tablets and fax machine

### Low risk. Generally safe (Keep at least 6 inches from the device)

- Cellphones
- Electric shaver
- Lawnmower
- Electric toothbrush
- Leaf blower
- Sewing machine
- Hair dryer
- Ultrasonic pest control
- Security badge scanner
- Wireless headsets
- Department store door security scanners –OK to walk through

### Moderate risk: Safe at arms length (24 inches from the device)

- Running motor
- Airport security scanners Notify TSA to do a pat-down instead
- Marine radio

### AVOID

- Magnetic mattress or magnetic chairs
- TENS Unit
- Arc welding
- Jackhammer
- Body fat measuring scales
- Diathermy
- Abstimulator
- MRI* There are MRI conditional ICDs and PPMs now but need cardiologist/EP supervision for scanning

As CIEDs become more prevalent in clinical practice, it is paramount for all health care practitioners to understand basic principles, which will enable them to effectively manage patients and answer common questions about the devices.