

## **NON CONDITIONAL CIEDS**

### **PURPOSE**

- To ensure patients with cardiac implanted electronic devices (CIEDs) are appropriately evaluated to safely undergo MRI.
- To decrease the incidence of patients being inappropriately denied MRI due to the presence of CIEDs.

### **GENERAL COMMENTS**

- Permanent pacemakers (PPMs) and implantable cardioverter defibrillators (ICDs) are collectively known as cardiac implanted electronic devices (CIEDs).
- Issues related to MRI of CIEDs include device movement, excess heating, electric current induction, electromagnetic interference, abnormal reed switch behavior, power-on reset activity and battery depletion.
- The first MR conditional CIED was approved by the FDA in 2011.
- Circumstances that make a CIED nonconditional include:
  - Not specifically labeled MR conditional
  - Manufactured before 2011
  - At least one nonconditional component (generator or lead)
  - Components from different manufacturers
  - Broken or abandoned intracardiac (ventricular or atrial) leads
  - Permanent epicardial lead(s) (temporary epicardial leads are OK to scan)

### **DEFINITIONS**

- Asynchronous pacing is a pacing mode where the device delivers stimuli at preset intervals independent of intrinsic cardiac signals.
- Inhibition pacing is a pacing mode where the device only delivers stimuli when no intrinsic cardiac signals are sensed.
- Antitachyarrhythmia therapies include therapies delivered by a device that can terminate arrhythmias (examples include anti tachycardia pacing and defibrillation).
- Pacing capture threshold is the minimum electrical stimulus needed to consistently depolarize or “capture” the myocardium.
- Lead impedance is a measure of the resistance to current flow through the device’s leads. Decreased lead impedance increases the drain on the battery.
- Sensing amplitude is a measure of a device’s ability to detect cardiac signals.

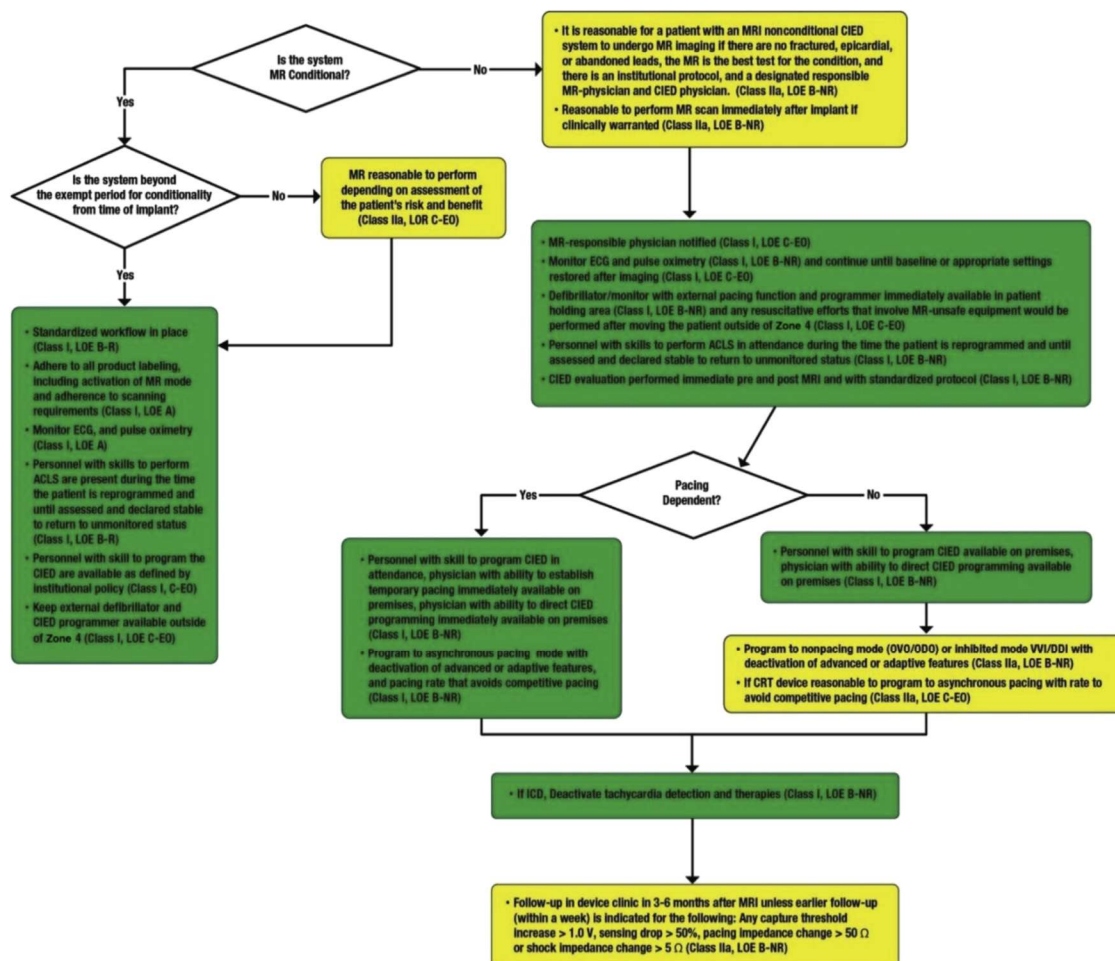
## **GENERAL CIED GUIDELINES**

- If a cardiology approval form with settings specific is required for a certain CIED, the approval form is to be completed by a cardiologist prior to the MRI being scheduled. Inpatients may have the treating cardiologist complete the form. Please use the vendor-specific signature form if available. This form is to be scanned into PACS.
- All CIED patients must have chest radiography within the past **6 months** to assess for broken or abandoned intracardiac (ventricular and atrial) leads and permanent epicardial leads. Outside chest radiography within 6 months is acceptable for review if images are available in PACS (i.e. outside reports without accompanying images are not acceptable).
- The MRI technologist must research the CIED and complete the Cardiac Implanted Electronic Device form (MI-0664). The supervising radiologist will then review the form and supporting documentation and determine whether to proceed with the MRI.
- A CIED that has been researched and approved within the past **6 months** does not need a new form MI-0664 completed provided:
  - There have been no changes to the CIED since the last MRI.
  - The CIED's conditions can be met on the MRI scanner to be used.
- The MRI technologist will arrange for the appropriate personnel (ACLS certified nurse, device vendor) to be present for imaging (as applicable).
- For STAT and routine MRIs during normal hours, the MRI technologist will call the pacemaker nurse at 388-1820 and inform him/her that a patient needs cardiology clearance.
- Informed consent is not required for CIED patients undergoing MRI.
- Chest, cardiac and thoracic spine MRIs are allowed.
- Repeat / follow-up MRIs are allowed.
- MRI of a patient with a recently implanted CIED is allowed provided MRI is the most appropriate modality to answer the clinical question.

## **GUIDELINES SPECIFIC TO MR NONCONDITIONAL CIEDS**

- Patients with nonconditional CIEDs are only imaged on the Riverside hospital scanners and only on weekdays during normal business hours (due to the requirement of an electrophysiologist to be immediately available).
- The supervising radiologist must review the indication for the MRI and prior imaging to assess whether the MRI is the best imaging modality or if another modality will adequately answer the clinical questions.
- If approved by the supervising radiologist, an altered, unconscious, sedated or intubated patient with an MR nonconditional CIED can undergo MRI provided the implant conditions can be met.

- Pre and Post Scan Evaluation of the CIED
  - 1) Must be performed by qualified personnel.
  - 2) Prior to entering Zone 4, the CIED will be placed into the appropriate mode for MRI (see below section on non-pacing-dependent versus pacing-dependent patients).
  - 3) Following the MRI, the CIED will be placed back into normal operating mode.
  - 4) The CIED will be interrogated before and after the MRI.
- For non-pacing-dependent patients:
  - 1) Personnel with the ability to reprogram the CIED must be present in the MRI control room throughout the examination.
  - 1) The CIED must be programmed to non pacing mode (OVO/ODO) or inhibited mode (VVI/DDI) and advanced/adaptive features must be deactivated.
  - 2) If CRT device, it is reasonable to program to asynchronous pacing with a rate that avoids competitive pacing.
  - 3) Tachyarrhythmia detections should be disabled in ICD patients.
- For pacing-dependent patients:
  - 1) Personnel with the ability to reprogram the CIED must be present in the MRI control room throughout the examination.
  - 2) The CIED must be programmed to asynchronous pacing mode (VOO/DOO/AOO), advanced/adaptive features must be deactivated, and a pacing rate set that is faster than underlying rate to avoid competitive pacing.
  - 3) Tachyarrhythmia detections should be disabled in ICD patients.
- Monitoring of Vital Signs & EKG
  - 1) Continuous pulse oximetry and heart rate must be monitored by an ACLS trained nurse.
  - 2) Vitals signs must be documented in the EMR before the CIED is placed into imaging mode, every 15 mins during the MRI and following reprogramming of the CIED back into normal operating mode.
- A crash cart, external defibrillator and the CIED programmer must be readily available during the examination but kept outside of the scanner room.
- Advise the patient to follow-up with his/her cardiologist in 3-6 months following the MRI for device check unless follow-up within 1-week following the MRI is indicated due to any of the following:
  - 1) Any capture threshold increase of  $\geq 1.0$  Volts.
  - 2) P-wave or R-wave amplitude decreases  $\geq 50\%$ .
  - 3) Pacing lead impedance increase/decrease  $\geq 50$  Ohms.
  - 4) High-voltage (shock) lead impedance increase/decrease  $\geq 5$  Ohms.



Flowchart for Patients with Pacemakers and Defibrillators

### CARDIAC DEVICE CONTACT INFORMATION

- Electrophysiology office during normal hours – 308-1820
- Electrophysiology after hours – call operator and ask for the EP doctor on call
- Electrophysiology Lab – 308-3630
- Pacemaker Nurse – 308-1820
- Medtronic Rep – 1-800-MEDTRONIC (633876642)
- Boston Scientific Rep – 1-800-CARDIAC (2273488)
- Abbot / St Jude – 1-800-PACE ICD (7223423)
- Biotronik – 1-800-547-0394