How to Manage the Pacemaker Patient Undergoing MRI

Take-home Messages:

- The use of magnetic resonance imaging (MRI) raises concerns about potential adverse effects in patients with implanted cardiac devices (eg, pacemakers). Patients undergoing MRI are at risk for consequences due to, eg, changes

in capture threshold, tissue heating, pacemaker-induced ventricular arrhythmia, and asystole.

- Until ≈10 years ago, most centers were not performing routine MRI on patients with implanted cardiac devices. Device companies and manufacturers have researched, modified, and tested devices for Food and Drug Administration

(FDA) approval so that MRI can be safely performed on patients with pacemakers.

- Cardiac devices used in or near the magnetic resonance (MR) environment are labeled as MR Conditional or MR Nonconditional. MR Conditional devices can be used safely only under specified conditions provided in the labeling.

The safety labeling of the device should be matched with the MRI environment for conditions such as static field strength and specifics about the lead and generator.

- MR Nonconditional implanted devices do not meet specific labeling for FDA approval. A pulse generator that is MR Conditional with abandoned or fractured leads

in place is considered MR Nonconditional.

- Before performing MRI on patients with MR Conditional devices, identify the device (eg, pulse generator) and check for the presence of abandoned or epicardial leads by reviewing medical records, calling the device

manufacturer, or performing a chest x-ray.

- Device interrogation and evaluation of, eg, the leads, pacing threshold, and impedance values should be performed before the patient enters the MRI scanner.
- For pacemaker-dependent patients, the pacemaker should be programmed to a nonsensing mode

(VOO or DOO) and implantable cardioverter-defibrillator therapies should be turned off during the scan.

- Patients should be monitored with electrocardiography and pulse oximetry. Devices should be reprogrammed after imaging.
- Data support that MRI at a magnetic field strength of 1.5 T can

be safely performed on patients with MR Nonconditional devices. Appropriate protocol and device programming should be followed. For pacemaker-dependent patients, the device should be set to DOO or VOO mode. For patients who are not pacemaker-dependent, a nonpacing mode (eg, OVO or ODO mode) should be used. Adequate

staffing and measures should be set in place in case there is a need to rapidly program the device (due to, eg, inhibition of pacing, battery failure).

- MRI at a magnetic field strength of 3 T is becoming more prevalent. Routine MRI for patients with MR Conditional devices should be performed at a magnetic field

strength of 1.5 T because most of the devices were tested using 1.5 T.

- Patients with MR Conditional and MR Nonconditional implanted cardiac devices can safely undergo MRI when appropriate precautions and protocol are followed. But many centers do not have the resources, additional staffing, or

expertise to offer MRI for patients with MR Nonconditional devices.

- The presence of abandoned, fractured, or epicardial leads is still considered a relative contraindication for MRI, except at a few select research centers. “But if it’s the best test, the bottom line is that we should get that test with the

appropriate safety precautions," says Dr. Russo.

References

1. **Nazarian S, Hansford R, Rahsepar AA, et al.** Safety of magnetic resonance imaging in patients with cardiac devices. *N Engl J Med*. 2017;377(26):2555-2564.
2. **Russo RJ, Costa HS, Silva PD, et al.** Assessing the risks associated with

MRI in patients with a pacemaker or defibrillator. *N Engl J Med*. 2017;376(8):755-764.