Ferromagnetic Metal Detectors Improve MRI Safety

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The risk posed by the strong magnetic field of superconducting MRI scanners might be the next big public and regulatory safety concern we face as diagnostic imagers. While MRI has been considered the "safe" modality, and radiation exposure from diagnostic imaging has occupied public and professional center stage for years, adverse events in MRI continue to increase disproportionately relative to the number of scanners installed. Based on FDA data, adverse events in MRI increased 465% between 2004 and 2012, and it is widely believed that such events are significantly underreported. As of July 1, 2015, The Joint Commission will require facilities to collect data on incidents involving unintentionally introducing ferromagnetic objects into the MRI scanner room, including whether such events caused harm. Such incidents include projectiles, but this directive potentially also applies to unrecognized MR-unsafe ferromagnetic objects that might be reset (e.g., infusion pumps) or dislodged (implants and shrapnel).

The usefulness of conventional metal detectors in the MRI screening process has been controversial and has never been recommended by the ACR. Conventional metal detectors vary in their sensitivities and may not detect tiny but potentially dangerous metal objects, and their use is operator dependent. Despite these known limitations, some MRI centers use a conventional hand-held metal detector as a problem-solving tool in daily practice.

The development of metal detectors that differentiate between ferromagnetic and non-ferromagnetic materials represents an important advance in MRI safety. Unlike conventional metal detectors, ferromagnetic metal detectors (FMD) operate by actively monitoring their ambient magnetic field, with the alarm being triggered by distortion in the field from ferromagnetic objects. FMD have been endorsed by the ACR since 2007. These devices, which can take the form of portals, stand-alone pillars, or handheld units, are simple to use and reliable. At least one FMD vendor has developed an electronic log to document alarm events, facilitating compliance with the new Joint Commission surveillance requirement. FMD are remarkably sensitive, providing an important additional layer of security to the standard MRI screening process for patients and staff, but these detectors pose some unique operational challenges of their own.

One pervasive problem with FMD is their alarming with metallic attire worn by MRI staff (uniforms, shoes, lanyards, underwires). Without removing all ferromagnetic materials, staff may falsely conclude it is their clothing that is alarming the FMD and ignore the alarm, when, in fact, it is from another object (such as a phone in their pocket). Therefore, some facilities using FMD require MRI staff to remove all ferromagnetic objects from their attire (in the words of the Weill Cornell Medical Center, to go "ferromagnetically naked"). Although a relatively easy practice standard to adopt for MRI personnel and patients, this requirement becomes more challenging to enforce with other hospital personnel who only occasionally work in the MRI environment (e.g., nurses, anesthesiologists)—and it is these infrequent workers who constitute the greatest risk of causing ferromagnetic projectile events.

Another limitation of FMD is that some medical equipment otherwise considered MRI-safe actually contains small amounts of ferromagnetic material that will trigger an alarm. For example, GE detachable MRI tables contain ferromagnetic materials in their wheel bearings, lift cylinder, and cables. Consequently, stretcher-bound patients pose special problems. Inpatient facilities may consider using a handheld FMD to screen patients on a detachable table before they enter the MRI scanner room.

However, the patient must be turned to be evaluated completely, which is not always possible. Also, the only handheld FMD device on the market contains a magnet, so cannot be used around the orbits or implanted pacemakers and other similar devices.

Finally, FMD were intended to detect ferromagnetic objects on the skin surface and not within the body. Nevertheless, the effectiveness of any FMD is based on the distance between object and detector, and many FMD are sensitive enough to provide an impressive additional (but still incomplete) layer of MRI screening for implanted devices.

Projectile events are potentially deadly, preventable, but continue to happen despite our best efforts to recognize and avert them. Ferromagnetic metal detectors (FMD) represent an important enhancement for maintaining a safe MRI environment, although cannot completely supplant standard MRI screening and safety protocols.

References

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