Basics of MRI Patient Screening

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MRI (Magnetic Resonance Imaging) utilization has rapidly increased over past two decades and has firmly placed itself as an invaluable tool for patient screening, diagnosis and treatment.

MR environment can be inherently risky due to presence of strong static magnetic field. Presence of static magnetic field of the main magnet, can be a significant hazard if ferro magnetic object is present in Zone 4. Projectile injuries in the presence of the magnetic field can cause serious and sometimes life-threatening damage to the patient or the staff and can impart significant damage to the scanner.

In addition, the Radio Frequency (RF) transmit and receive system present for generating and receiving signal, can also be a potential hazard along with the gradient system present in the magnet. These two forces can cause various effects on the body, especially in the presence of metal. They can induce conductivity in the tissue and can deposit heat energy that can lead to burns. MRI induced burns is one of the most common patient injuries noted after an MRI and is totally preventable with proper patient screening.

The key components of the MR Safety involve MR Site Safety, Patient Safety, and safety of the staff. American College of Radiology (ACR) publishes MR Safety Manual addressing various safety concerns around MRI Imaging (1).

MRI patient screening is the most important tool we have to keep our patients safe. ACR safety manual features a sample MRI patient screening form that can be utilized as a reference while creating a safety form for your institution (2).

To ensure patient safety in the MR environment, it is vital that we prescreen our patients prior to MRI and do risk assessment before undergoing MR procedure. It should be noted that history of prior MRI without any adverse event does not mean the patient is clear to have another MRI. The MRI screening form needs to be filled out prior to every new MRI.

Each question from the safety form needs to be answered. Responses to yes/no questions, if answered yes, should include further information as requested. Level 2 personnel must check and sign the completed form. Additional written or verbal information obtained for the screening

form should come from a reliable source and should be documented in writing and will become part of the medical record.

A. Non emergent, conscious patient (including research/volunteers):
When we talk about MRI patients, most commonly it is a non-emergent, conscious patient. The initial screening can be done by the nurse or scheduling staff and the screening form can be filed out by them to the best of their knowledge. The review of the screening form and rescreening is done by the Level 2 personnel, most commonly the MRI technologist. Final check before the patient is put in the scanner is done by Level 2 personnel. Please note that these patients must be screened twice, including at least once by a Level 2 MR personnel.

B. Non emergent, unconscious /unresponsive or mentally impaired patient:
If patient is unable to provide the history to complete the screening form, a family member or a guardian can complete the questionnaire. The Level 2 personnel should go through available patient records including surgical history, implant history and review of prior imaging in the system if present.

If there is no reliable history available, visual inspection for scars, sites of prior trauma and implanted devices should be performed. Screening plain films of the body can be done, if recent CT or MR studies are not available to evaluate for metallic foreign bodies, implants or devices. Plain films commonly obtained are of head/neck, chest, abdomen and pelvis, upper arms and thighs. Distal extremity X-rays are not routinely obtained, unless there is history of localized trauma or scarring present.

C. Emergent patient:
In case of a true emergency, the patient can be screened only once, by Level 2 personnel. Attempt must be made to fill out the screening form in most of the circumstances. In case of a rare exception, when a screening form is not filled out, mutual agreement with ordering physician and covering Level 2 MR physician is needed and is to be documented before patient is put in the scanner.

D. Pediatric patients:
All the pediatric patient, especially older children and teenagers should be screened twice by Level 2 personnel; once in the presence of a parent and once separately to make sure potential dangers are disclosed as much as possible.

Pediatric patients need to be changed into MR safe pocketless garments to make sure that metallic objects or toys or other unsafe items don't enter Zone IV. Pillows, stuffed animals and other comfort items from home, may represent potential risks and should be discouraged from entering Zone IV. If a comfort item is deemed necessary, it should be screened to ensure it's safety in MR environment.

F. Other specific patient conditions like pregnancy, fever:
Childbearing age patients need to be screened for pregnancy. ICU/unresponsive patient and pediatric patients should be screened for fever before being placed in the scanner.

G. Screening for implants and devices:

If presence of implant device is indicated on the screening form or in the medical record, it is necessary to accurately identify and verify the type of implant, location, exact make and model of the implant (including associated parts like wires). The verification and positive identification of the implant should be in written documentation. This may be found in the operative notes, device identification cards or physician notes. Prior MR screening forms also can be referred for this purpose.

Once positive identification is done, assessment of the implant for MR safety is to be done by accessing product information if available online, device information card or by directly contacting the manufacturer. For MR conditional devices and implants, exact conditions for the scanning as directed, should be followed (3). If there are untested implanted devices, then independent risk assessment may be necessary, though this is not a common scenario.

H. Screening for metal or foreign bodies:

If patient gives a history of injury with metallic foreign body, including bullets and shrapnel then further investigation must be done prior to entering Zone 3 (4). Reviewing patient history, available plain radiographs or CTs of the relevant anatomic region is recommended. If the metallic object is less than 2 cm in size the heating should not be an issue (5).

If the object is known to be or has potential to be ferromagnetic, then the anatomic location of the object relative to the vital organs needs to be considered due to potential of torque or translational injury under magnetic field. Timeline of the injury and associated scarring should be considered. Scarring would potentially limit movement of a ferromagnetic material and may limit possibility of injury.

I. **Potential orbital trauma and foreign body:**

All patients with a history of orbital trauma for potential ferromagnetic body or high clinical suspicion for orbital trauma (may be due to potential professional hazard) should undergo at least a signal orbital radiograph with additional views obtained as needed. If there is a CT of the head or orbit done after a traumatic event, then it needs to be reviewed for foreign body. Prior MRI examination also can be reviewed to look for susceptibility artifact from the foreign body around the orbits if available. But prior examination alone is not sufficient to clear the orbit.

J. Patient preparation and gowning:

All patients undergoing MR should remove all removable metallic personal items and devices. This included all on planted devices and pumps, metallic drug delivery patches if appropriate. All external jewelry, phones, body piercings, cosmetic material containing metallic particles like eye makeup should be removed All the patients should be provided with hospital issued pocketless scrubs that are MR safe. Undergarments should be changed into paper undergarments especially if the area is going to be under RF field. Facemasks if needed, should be free of metallic nose pieces and fibers.

K. Screening of the patients for Ferromagnetic Detector Systems (FMDS).

It is important that the patient is screened with a ferromagnetic detection device prior to entering Zone III and/or IV. Use of conventional metal detectors that do not differentiate between ferrous and non-ferromagnetic material is not recommended. Use of FMDS is a helpful adjunct to patient screening, especially for objects missed during standard screening, but cannot replace use of MR screening form and associated evaluation.

If an undetected ferromagnetic object is found on or in the patient, then it would need to be further evaluated before patient is deemed safe for Zone III and/or IV.

L. Full stop and Final check:

Full stop and Final check process should be implemented.

1. **Routine:** For a typical ambulatory patient, the MR technologist does verification of patient identification, type of exam to be performed, review and confirmation of appropriate screening, proper programming and removal of devices.

2. **Augmented:** This includes the verbal review by the supervising Level 2 MR personnel and acknowledgement of a second MR personnel. This includes all the elements of routine process along with screening of any support staff entering Zone IV. Careful visual inspection of the patient as well as accompanying equipment that will enter zone IV is needed.

M. Implant/Device/Object detected during MR examination:

Sometimes, even after thorough patient screening, signal distortion may be noted during scanning that may suggest presence of a foreign body or an implant that was not detected during screening. If that happens, notify the MR supervising physician. After consulting the physician and further investigation, if deemed safe, the exam may be continued. If safety of the patient is in question, the patient needs to be removed slowly out of the bore of the magnet. Care should be taken to make sure that the patient does not sit up immediately after being out of the bore of the magnet. Patient needs to be transferred away from the scanner without change of angle to avoid torque on the foreign body and potential displacement.

During MR scanning, if patient complains of pain, foreign sensation or feeling of burning/hot, patient evaluation is warranted before continuing to scan.

In summary, proper prescreening of the patient and full assessment of patient risk is a must, to ensure patient safety in MR environment. Thorough investigation of history of prior trauma, associated foreign bodies, presence of implants and devices should be done prior to exposing the patient to MR environment. A full stop and final check should be performed prior to every exam and an augmented final assessment is needed before scanning a complex patient. Continuous vigilance during MRI scanning will ensure patient safety during scanning so that, potential burns and other injuries are prevented.

References:

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Suggested Reading:

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