

Patient Safety Tip of the Week

January 7, 2020

Even More Concerns About MRI Safety

Seems like we’ve been writing a lot about MRI safety in the last several months. But there’s even more. You’ll recall our November 5, 2019 Patient Safety Tip of the Week [“A Near-Fatal MRI Incident”](#) about a serious MRI accident in Sweden. It turns out that a Swedish national survey on MR safety compared with CT has suggested a false sense of security ([Hansson 2019](#)).

Sweden has no formal system for reporting MRI-related incidents, so the authors surveyed all sites performing MRI or CT and had a 60% response rate for MR workers and 90% for all hospitals/facilities with MR units, likely providing a good representation of nationwide experience. Overall, 200 MR safety incidents and 156 CT safety incidents over a 12-month period were reported by the 529 participants.

More MR workers (73%) than CT workers (50%) were confident in being aware of any incident occurring at their workplace. However, it turns out that 69% of MR workers (83% for CT) were not aware of reported incidents at their hospitals. Those results indicated that a high proportion of MR personnel were sure that they would have been aware of any incident occurring in their own department yet, in reality, incidents did occur without their knowledge. The authors conclude that a false sense of security exists for MR.

Incidents related to MRI most often involved the static magnetic field, the radiofrequency field, and the gradient magnetic field (projectiles, implants, and burns), whereas incidents related to CT most often involved radiation or contrast.

Actual human injury was more common in CT incidents, but in all MR cases, potential (worst-case scenario) severity scores were higher than actual severity scores for human injuries, but unchanged for CT. 16% of reported MR safety incidents were given the highest potential (worst-case scenario) severity score.

Five incidents involving human injury were related to burns, and three to projectiles. However, 19 incidents involving material injuries were related to projectiles.

The data they collected on incidents involving projectiles is particularly striking. The following items were reported in 6 or more incidents in a 12-month period: scissors or knife, walker, wheelchair, bed, infusion pump, oxygen tank, and metal object in pocket. Projectiles reported in fewer incidents included ventilator or monitor, cart or cleaning cart, crutches, keys, phone, forceps, laryngoscope, sharp object, magnetic object, equipment part, glasses, hair clip, hair pin, basket lid, rescue stretcher, screw, vacuum cleaner.

The authors point out the importance of involving in MR safety endeavors all who may come in contact with the MRI suite or unit, including radiographers, radiologists, personnel from other departments accompanying patients to MR units, administrative staff, janitors, and firemen. (Note that we have emphasized in several columns the importance of training firemen, police, and other first responders.) They note that leaving out any one piece might jeopardize security and possibly lead to a catastrophe.

Hansson et al. note that MR safety screening checklists are not enough to prevent all adverse events. Because severe adverse events still exist, are poorly shared within the team, and are preventable, they recommend the following action steps:

1. identify potential risk zones
2. design specific educational programs dedicated to every category of professionals that work in or might visit MR sites with a focus on vigilance of MR personnel on potential mistakes made by other professionals, potential misunderstandings, or knowledge gaps
3. state clear MR safety procedures including screening forms that are confirmed with an interview just before entering the MR scanner room
4. facilitate rigorous but easily manageable incident reporting systems with focus on prevention and learning from mistakes

In a video on MRI safety from the recent RSNA 2019 conference ([RSNA 2019](#)), Dr. Emanuel Kanal discussed the importance of having structure and standardization for all MRI programs. The key components of such programs were outlined in a guideline put together by a coalition of societies and organizations dealing with MRI that included a delineation of responsibilities for the management of MRI facilities ([Calamante 2016](#)). That document outlined a suggested organizational oversight structure, including a magnetic resonance medical director, magnetic resonance safety officer, and magnetic resonance safety expert. Each has their own assigned roles and tasks. Dr. Kanal noted that an American Board of MR Safety was established in 2015 and certifies individuals for the above positions by means of exams. He noted that over 2500 individuals have already been certified.

Dr. Kamal did comment on the near fatal event that we discussed in our November 5, 2019 Patient Safety Tip of the Week “[A Near-Fatal MRI Incident](#)”, noting that the investigation is still incomplete but that ferromagnetic materials in the weighted vest likely played a role. He also alluded to a second incident in an MR unit in which weights attached to someone’s ankles were involved. But he also noted that, while we often focus

on projectile incidents in MRI safety, there are many other issues, such as burns, neural excitation, etc.

A Swedish expert on MRI safety recently discussed issues related to projectiles and other events ([Owman 2019](#)). Screening for metal is important, but you shouldn't rely on just one method for screening. For example, most MRI practices fill out a special screening form, but some also require the patient change from street clothes into known MRI-safe clothing. The MR radiographer needs to interview the patient right before entering the examination room to check that the patient has fully understood the information, and there must never be any unknown circumstances. If there are, further investigations must be done. These procedures are very important and must never be excluded. She also discusses use a ferromagnetic detector as a support to the screening procedure. Such a detector is a good asset if you want to reduce the risk of something being accidentally taken into the room. At the same time, it is important to know that while a ferromagnetic detector may increase MRI safety, it should never replace any of the ordinary screening procedures used.

She also discussed the importance of identifying every implant. That is essential to find out if the MRI examination can be performed on a patient with a certain implant and, if so, how it can be done safely. Implants may become heated during MRI scanning and heating injuries have increased due to the use of more efficient and powerful methods and scanners. Occasionally, they are also caused by a lack of MRI safety competence regarding how to position the patient, etc.

She also notes the importance of teamwork in the MRI suite. Working alone with MRI examinations and equipment should never be an option, and all members of the scanning team must have a high level of MRI safety skills. (The danger of working alone in an MRI suite was apparent in our November 5, 2019 Patient Safety Tip of the Week “[A Near-Fatal MRI Incident](#)”.)

One thing that we are always struck by in reports about safety issues in the MRI suite is that most of the reported adverse events are related to the MRI itself and related processes. Contrast that to all the issues we've discussed in our multiple columns on patient safety issues in the radiology suite. The vast majority of those are not related to the imaging process itself, but rather to the fact that sick patients with complex medical conditions are being brought to the radiology suite and problems tend to involve issues like medications, IV lines mix ups, falls, oxygen issues, sedation, monitoring, patient or test misidentification, unexpected clinical deterioration, and many others. See our October 22, 2013 Patient Safety Tip of the Week “[How Safe Is Your Radiology Suite?](#)” for details. Surely, many of the same incidents occur in MRI suites.

An example of a patient safety issue only indirectly related to MRI was a study that showed most children who undergo MRI while under anesthesia experience hypothermia at some point during the procedure ([Cronin 2019](#)). Using MRI-compatible temperature monitoring, the researchers found that 63% of patients less than 8 years of age exhibited hypothermia (median temperature less than 36°C) at some point during MRI. Most

instances of hypothermia occurred early, particularly during anesthesia induction and prior to the initiation of the MRI scan, and then improved during the scan. That was ascribed to the fact that the scanning environment is typically kept cool, with a low humidity, and heat loss to the surrounding environment typically occurs after induction of anesthesia. Later, body temperature tends to increase during the MRI scan secondary to MR radiofrequency heating.

The researchers did not find any increase in perianesthetic complications or an impact on PACU length of stay. However, the study was limited to children undergoing outpatient procedures. It is quite conceivable that sicker, more vulnerable inpatients might be impacted by such hypothermia. The authors, therefore, recommend interventions for these patients should be focused on maintaining normothermia during the anesthesia induction and prior to initiation of the MRI scan. MRI-compatible continuous temperature monitoring is important for managing temperature for these anesthetized patients.

For a modality that has now been around since the late 1970's, we still continue to learn about new patient safety risks associated with its use.

Some of our prior columns on patient safety issues related to MRI:

- February 19, 2008 “[MRI Safety](#)”
- March 17, 2009 “[More on MRI Safety](#)”
- October 2008 “[Preventing Infection in MRI](#)”
- March 2009 “[Risk of Burns during MRI Scans from Transdermal Drug Patches](#)”
- January 25, 2011 “[Procedural Sedation in Children](#)”
- February 1, 2011 “[MRI Safety Audit](#)”
- October 25, 2011 “[Renewed Focus on MRI Safety](#)”
- August 2012 “[Newest MRI Hazard: Ingested Magnets](#)”
- October 22, 2013 “[How Safe Is Your Radiology Suite?](#)”
- October 21, 2014 “[The Fire Department and Your Hospital](#)”
- August 25, 2015 “[Checklist for Intrahospital Transport](#)”
- August 2016 “[Guideline Update for Pediatric Sedation](#)”
- October 2016 “[MRI Safety: There’s an App for That!](#)”
- January 17, 2017 “[Pediatric MRI Safety](#)”
- August 8, 2017 “[Sedation for Pediatric MRI Rising](#)”
- March 2018 “[MRI Death a Reminder of Dangers](#)”
- March 2018 “[Cardiac Devices Safe During MRI But Spinners!?](#)”
- November 2018 “[OMG! Not My iPhone!](#)”
- April 2, 2019 “[Unexpected Events During MRI](#)”
- September 2019 “[New MRI Hazard: Magnetic Eyelashes](#)”
- October 15, 2019 “[Lots More on MRI Safety](#)”
- November 5, 2019 “[A Near-Fatal MRI Incident](#)”
- November 2019 “[ECRI Institute’s Top 10 Health Technology Hazards for 2020](#)”

Some of our prior columns on patient safety issues in the radiology suite:

- October 16, 2007 “[Radiology as a Site at High-Risk for Medication Errors](#)”
- February 19, 2008 “[MRI Safety](#)”
- September 16, 2008 “[More on Radiology as a High Risk Area](#)”
- October 7, 2008 “[Lessons from Falls....from Rehab Medicine](#)”
- October 2008 “[Preventing Infection in MRI](#)”
- March 17, 2009 “[More on MRI Safety](#)”
- March 2009 “[Risk of Burns during MRI Scans from Transdermal Drug Patches](#)”
- August 11, 2009 “[The Radiology Suite...Again!](#)”
- January 2010 “[Falls in the Radiology Suite](#)”
- August 2010 “[Sedation Costs for Pediatric MRI](#)”
- January 25, 2011 “[Procedural Sedation in Children](#)”
- February 1, 2011 “[MRI Safety Audit](#)”
- October 25, 2011 “[Renewed Focus on MRI Safety](#)”
- March 13, 2012 “[Medical Emergency Team Calls to Radiology](#)”
- August 2012 “[Newest MRI Hazard: Ingested Magnets](#)”
- October 22, 2013 “[How Safe Is Your Radiology Suite?](#)”
- February 25, 2014 “[Joint Commission Revised Diagnostic Imaging Requirements](#)”
- July 2014 “[New MRI Risks: for Staff!](#)”
- July 1, 2014 “[Interruptions and Radiologists](#)”
- November 2014 “[More Radiologist Interruptions](#)”
- October 21, 2014 “[The Fire Department and Your Hospital](#)”
- June 23, 2015 “[Again! Mistaking Antiseptic Solution for Radiographic Contrast](#)”
- August 25, 2015 “[Checklist for Intrahospital Transport](#)”
- March 22, 2016 “[Radiology Communication Errors May Surprise You](#)”
- August 2016 “[Guideline Update for Pediatric Sedation](#)”
- October 2016 “[MRI Safety: There’s an App for That!](#)”
- January 17, 2017 “[Pediatric MRI Safety](#)”
- August 8, 2017 “[Sedation for Pediatric MRI Rising](#)”
- November 14, 2017 “[Tracking C. diff to a CT Scanner](#)”
- March 2018 “[MRI Death a Reminder of Dangers](#)”
- March 2018 “[Cardiac Devices Safe During MRI But Spinners!?](#)”
- April 2018 “[Radiologists Get Fatigued, Too](#)”
- May 2018 “[Cost of Interrupting a Radiologist](#)”
- November 2018 “[OMG! Not My iPhone!](#)”
- December 11, 2018 “[Another NMBA Accident](#)”
- April 2, 2019 “[Unexpected Events During MRI](#)”
- September 2019 “[New MRI Hazard: Magnetic Eyelashes](#)”
- October 15, 2019 “[Lots More on MRI Safety](#)”

- November 5, 2019 “[A Near-Fatal MRI Incident](#)”
- November 12, 2019 “[Patient Photographs Again Help Radiologists](#)”
- November 26, 2019 “[Pennsylvania Law on Notifying Patients of Test Results](#)”

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