

Title: MRI Safety Events: Lessons Learned

Robert E. Watson MD: watson.robert16@mayo.edu

Highlights: Discussion of MRI safety related events and responses to them

Target audience: Those responsible for improving MR safety in clinical practice.

OUTCOME/Objectives: Apply insights gained from MRI safety events to individual practices

PURPOSE: To describe several MRI safety events in a large radiology department and resulting practice changes.

METHODS: An on-line safety event reporting form (1) allows timely reporting of adverse events and near misses. Approximately 2000 events are reported annually, about 10% related to MRI. These events are investigated by our MRI Safety Committee, and when appropriate, institutional Quality Management Services assists with a Root Cause Analysis (RCA). Several incidents and practice changes are described.

RESULTS

A: A pacemaker patient had been scanned with pacemaker protocol without incident previously. The pulse generator was explanted, but with retention of intracardiac leads. On screening, patient denied having a pacemaker, and was scanned without pacemaker precautions. The presence of the leads was noted afterwards, without known injury. To address the potential risk of retained leads, our MRI safety form and technologist screening was changed to, "Have you EVER had a pacemaker?"

B: A patient with a vagal nerve stimulator was scanned inadvertently in a body transmit coil rather than a transmit/receive head coil without recommended SAR limitations due to a flawed tech-to-tech handoff. No injuries were recognized. The device was noted on the MRI safety form. Handoff communication has been improved and technologists now review and sign the form as their last action before scanning.

C: A patient with a deep brain stimulator was scanned in a body transmit coil rather than the intended head transmit/receive coil without recommended SAR limitations. The device was not noted in the order or in clinical notes, the patient answered the MRI safety sheet obtusely, and denied presence of implanted devices (possibly related to cognitive issues). No injuries were recognized. The institution has devoted a large effort to establish a dedicated site in the electronic medical record to catalog implanted devices, including "blaze" alerts that point out the presence of high risk implanted devices in MRI to ordering providers. Technologists have been instructed to not proceed if ambiguities remain on the MRI safety form. Patient information about the hazards of implanted electronic devices in MRI has been augmented.

D: A patient with MRI unsafe tissue expanders gained introduction into the MRI scanner at which point excessive blowout artifact was noted. The patient was removed slowly from the magnet, without injury or expander repositioning. Multiple communication issues contributed to the event with several new protective barriers now being implemented. This device can be detected with a ferromagnetic detector screening device.

E: An MRI safe anesthesia cart being wheeled into MRI contacted and elevated a protective cover over a quench button, producing a quench. Quench button covers have been redesigned.

F: In our practice, nurses assess patients receiving minimal sedation prior to dismissal. Multiple patients were reported to have left without assessment, posing a possible safety risk to themselves or others. A wristband system, stating "Needs Nursing Dismissal" was implemented with near elimination of patients leaving the department without assessment.

G: A ferromagnetic endotracheal tube stylet left on the cart became a projectile when an intubated general anesthesia patient was transferred to MRI. No injuries resulted. A formal MRI safety "time out" has been instituted before proceeding into the magnet room, with placement of a dedicated wall-mounted box outside the scan room for ferromagnetic devices, including the ET tube stylet and laryngoscope blade.

H: A ferromagnetic eyeglasses case brought into MRI became a projectile, with no injuries. We now provide a dedicated single purpose brightly colored box outside the scan room door for gowned patients to leave any remaining articles immediately before scanning. Also, ferromagnetic detection systems for screening of ambulatory patients are now installed across the practice.

I: A patient's crutch containing ferromagnetic material was brought into the magnet room, and become a projectile. There were no injuries. Tech to tech handoff issues contributed to the incident. Re-emphasis of departmental policy regarding introduction of metallic objects into the magnet room followed.

J: An emergency anesthesia case was performed over the weekend and non-routine staff removed an empty ferromagnetic oxygen canister from the patient's cart, leaving it unsecured not far from the scan room door. Due to the hazards of these tanks in MRI, our institution has committed to replacing the ferromagnetic tanks with aluminum tanks.

K: Institutional MRI service personnel replaced an electronic switch in a dock pedestal base. When returning the motor and attached cover into the magnet room, it became attracted to the bore, but was physically restrained and secured with straps without it becoming a projectile. The magnet was ramped down and installation completed. This event prompted a thorough evaluation of processes and procedures employed by the service group, with multiple improvements now implemented, including more stringent attention to training and maintenance of competencies.

DISCUSSION: Event reporting at our institution has become widely accepted, allowing important safety events to be identified and critically reviewed through the RCA process. RCA results, solutions, and practice improvements are shared with the department, which fosters additional reporting and engagement. As MRI patient throughput continues to increase, with more patients harboring potentially MRI unsafe electronic devices, continued practice changes and efforts will be necessary.

CONCLUSION: A robust event reporting system, RCA of MRI safety incidents, and subsequent engagement of staff and the institution in solutions and practice improvements can lead to incremental improvements in MRI safety (2).

REFERENCES:

1. Schultz SR, Watson RE, Prescott SL, et al., Patient safety event reporting in a large radiology department. *AJR Am J. Roentgenol.* 2011 197: 684-688.
2. Kanal E, Barkovich AJ, Bell C, et al., ACR guidance document on MRI safe practices: 2013. *JMRI* 37:501 – 530, 2013.