Learning From Others: A Case Report From the Anesthesia Incident Reporting System

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Review of unusual patient care experiences is a cornerstone of medical education. Each month, the AQI-AIRS Steering Committee abstracts a patient history submitted to the Anesthesia Incident Reporting System (AIRS) and authors a discussion of the safety and human factors challenges involved. Real-life case histories often include multiple clinical decisions, only some of which can be discussed in the space available. Absence of commentary should not be construed as agreement with the clinical decisions described. Feedback regarding this article can be sent by email to **airs@asahq.org**. Report incidents or download the AIRS mobile app at **www.aqiairs.org**.

2019-1: 'Press the pedal to the metal'

An otherwise healthy 3 y/o male was receiving general anesthesia via LMA for an MRI brain/total spine/whole body … the patient was brought out of the bore slightly in preparation for removal of LMA. The staff anesthesiologist and senior resident were attending to the patient … when a new CA-1 resident brought the PACU gurney into the room. The gurney (with Drager Monitor and oxygen cylinder) got within 4 feet of the MRI core before the MRI technician noticed (both staff anesthesiologist and senior resident had their backs to the door). All staff immediately jumped into action to push the gurney back out of the MRI room before anything could be pulled into the MRI core. Despite the gurney and all items on it being unsafe for the MRI environment, nothing impacted the patient and he proceeded through the recovery process normally. Despite having had 1) hospital-mandated MRI-safe training in his intern year, 2) a cursory introductory lecture by the staff anesthesiologist in the morning before the start of any cases (about removing anything metal from on your person at the beginning of each case), and 3) working with several other pediatric patients in the MRI scanner that day (to learn the usual routine of taking the patient out of the scanner on the MRI table), the CA-1 had a momentary lapse in judgement and situational awareness. This event could have had catastrophic consequences and put the lives of three people in jeopardy (the patient, staff anesthesiologist and senior resident).

Discussion

It was truly fortunate that no harm came to this patient or to any of the providers. Pediatric anesthesiologists are all too familiar with these hazards, but this is often not true at adult institutions where it is uncommon to perform anesthesia in the MRI area. In this case, the unsafe situation was initiated by a member of the team who was not very familiar with the safety issues in MRI, a scenario that can occur at any institution. MRI scanning appears to be increasing across the country for several reasons. There are growing concerns regarding radiation exposure associated with CT scanning. Exposure is cumulative over one's lifetime, and pediatric radiologists and specialists, in particular, have shifted from using CT to MRI scanning such that MRI scans are now performed more frequently than CT scans. MRI-guided procedures are commonly performed, and cardiac imagining with MRI is now a routine part of many evaluations. We are also witnessing the growth of intra-operative MRI scanning in the neurosurgical O.R.s. In other words, MRI safety should be everyone's business.

In 2015, ASA updated its Practice Advisory on Anesthetic Care for Magnetic Resonance Imaging. The powerful magnetic fields present in the MRI environment pose special problems for those charged with caring for patients in it. The presence of ferrous objects, however, is not the only safety hazard present. The MRI area itself poses challenging environmental safety concerns – providers are often not in the same room as the patient, lighting can be quite dim, the noise from the scanner is loud and can make it difficult to hear the monitors and the room cannot be warmed, posing potential problems with hyperthermia or hypothermia, especially in the pediatric population. Standard large-bore infusion and syringe pumps are not MRI-compatible, which can create incredible logistical issues. MRI-safe infusion pumps are available, but these pumps do not offer the same safety features (guardrails, libraries, order interoperability) that standard pumps offer. Metal screening processes for both patients and providers must be thorough and meticulous, especially if there are implants such as pacemakers, orthopedic hardware and such.

Situations such as the one described are not unusual and one does not have to search very hard to find case reports of patient injury and death or images of a multitude of objects that were drawn to the magnet. Education of all personnel who work in the MRI area should be mandatory. Many institutions have online courses or videos that are required of staff while others conduct didactic sessions. Simulation sessions can also be useful in emphasizing the need for metal safety. In this case, the resident had received mandatory education and

"just-in-time" training in the morning. So why did the resident cause a potentially unsafe situation?

Education and training are exceedingly weak interventions and will often fail, as in this case, because we are all human and our memories will not always retain knowledge, nor will we be reliably able to put such knowledge into practice. One should consider stronger interventions such as the examples illustrated in the table below. The resident was in an unfamiliar environment and his role in the process may have been poorly defined. Since residents are not commonly assigned to MRI, they might not be the best individuals to bring a gurney into zone IV, and some consideration should be given to creating a more standardized process. This would increase the likelihood of recognizing an MRI-safe gurney from one that is not. While there was education regarding metal safety, one might presume that the resident assumed that a gurney in the MRI area was safe to bring into zone IV. Only gurneys that are MRI-safe should be readily available, and all unsafe gurneys should not be placed anywhere near the scanner. One could take a step further by specifically designating the location of an MRI-safe gurney and perhaps craft a visual cue indicating that this gurney is indeed MRI-compatible.

In this case, there were other pieces of equipment (monitor, oxygen tank) on the gurney that posed a significant risk to the patient. If a patient is transported to the MRI area with these items, they should be removed from the immediate area to avoid having them accidentally introduced into zone IV. Aluminum oxygen tanks are readily available and should be the only tanks allowed near the scanner. Some institutions have visual cues (tape, stickers, etc.) that clearly show that an oxygen tank is MRI-safe.

Many institutions now have metal detectors in the entryway to zone IV and, in some cases, to zone III. These detectors vary in their sensitivity and can also cause many false alarms with various pieces of clothing or attire such as eyeglasses, underwire brassieres and clog-type footwear. To combat this, some institutions have adopted very stringent attire policies that may include provisions such as banning of jackets, mandatory scrub attire and taping of all pockets to avoid small metallic objects from being introduced into zone IV. A metal detector would have prevented this incident.

Cardiac arrest or other crisis situations are particularly challenging in the MRI environment. Since many pieces of resuscitation equipment are not MRI-safe, the general rule of thumb is to adopt and teach a "scoop and run" practice should an emergency arise. The ASA practice guideline recommends three steps: 1) remove the patient as quickly as possible out of the magnet room (zone IV), performing CPR if needed; 2) call for help; and 3) move the patient to a predesignated area outside of zone IV but close enough that resuscitation will not be unduly delayed. There are also two types of MRI tables, one in which the table is permanently fixed to the magnet and another that can be undocked from the magnet. All personnel who may be asked to move a patient out of zone IV in an emergency should be aware of the configuration of the table in their MRI suites. If an emergency occurs in a young child or a small adult, one could easily pick up the patient and move to an MRI-safe environment. In adult-size patients, undocking a bed is clearly much faster than moving an MRI-safe gurney into zone IV and transferring the patient.

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Strength of Interventions

Weaker Actions	Intermediate Actions	Stronger Actions
Double check	Checklists or cognitive aid	Architectural or physical plant changes
Warnings and labels	Increased staffing or reduced workload	Tangible involvement and action by leadership in support of patient safety
New procedure, memorandum, or policy	Redundancy	Simplify the process or remove unnecessary steps
Training and education	Enhance communication (e.g., checkback, SBAR)	Standardize equipment and process of care map
Additional study or analysis	Software enhancement or modifications	New device usability testing before purchasing
	Eliminate look-alike and sound-alike drugs	Engineering control of interlock (forcing functions)
	Eliminate or reduce distractions	

IV. How will you know the risk is reduced? Ask frontline staff involved in the defect whether the interventions reduced the likelihood of recurrence of the defect. After the interventions have been put in place, complete the "Describe Defect" and "Interventions" sections and have staff rate the interventions.

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Mock codes should be routinely conducted in the MRI area. While newer facilities often have readily accessible MRI suites, older facilities tend to place MRI scanners in available space, which may be in remote areas not easily accessible or not well-known to hospital personnel. This can become an issue every July when new housestaff arrive. In-hospital code teams are typically led by the ICU team, and new members should always be oriented early to the layout of the hospital.

Consideration should also be given to having only MRI-safe versions of laryngoscopes and oxygen tanks in the immediate area around zone IV. While there is very little disagreement about what can and cannot be brought into zone IV, there is considerable variation among institutions as to what can and cannot be brought into zone III. All personnel who have access to zones III and IV should clearly understand the restrictions for zone III at their respective institutions.

Anesthetic care in MRI suites is increasing in frequency and education, and training and processes should be well-defined for all personnel. There are significant potential risks posed by the unusual environment, and contingency plans should be clearly articulated in order to avoid catastrophic accidents.

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