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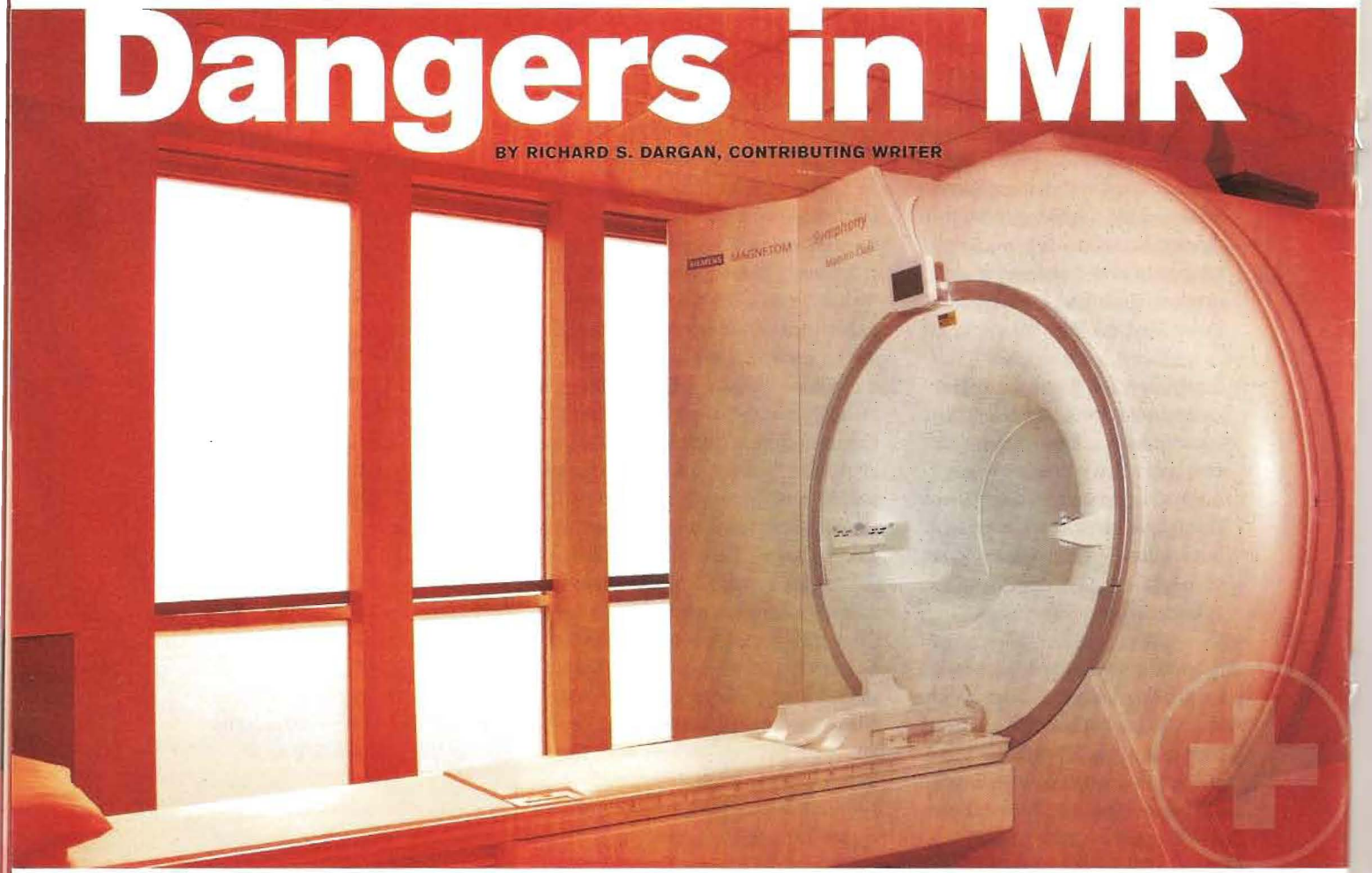
Dangers in MR

BY RICHARD S. DARGAN, CONTRIBUTING WRITER



Magnetic resonance may not expose patients to ionizing radiation, but it has dangers of its own, for both patients and R.T.s.

The powerful magnet can pull large ferrous objects into the bore of the machine with deadly force. Pacemakers and other implanted medical devices can be disabled or dislodged by the magnetic field. Radiofrequency pulses that help create images can badly burn a patient.

"MR is the only modality in radiology where simply walking into a room could kill someone," said Stephanie Cannon, B.S., R.T.(R)(CT)(M)(MR), a diagnostic imaging applications specialist at Invivo in Atlanta.

The number of reports of MR accidents, injuries and adverse events has climbed at an alarming rate in recent years, according to a recent report from Tobias Gilk, M.Arch., architect, president and MR safety director at Mednovus, in Leucadia, Calif., and Emanuel Kanal, M.D., FACR, from the University of Pittsburgh Medical Center. Tobias and Dr. Kanal analyzed data from the Manufacturer and User Facility Device Experience, the Food and Drug Administration's adverse events tracking system. The product code for MR listed only 40 records of adverse events in 2004. Five years later, that number had almost quintupled to 193 adverse events.

"If it doesn't use radiation, it falls under the radar," said Cathy Dressen, M.H.A., R.T.(R)(MR), affiliate relations program manager at ASRT. "There have been far more incidents than what's been reported."

"MR is the only modality in radiology where simply walking into a room could kill someone."

Today, MR is being used in emergent care and trauma settings. It's been converted from a diagnostic imaging tool to a platform for minimally invasive procedures, with different safety demands.

In fact, when Tobias and Dr. Kanal extrapolated 2008 data from Pennsylvania, they estimated a whopping 7,400 adverse events that year nationwide, with most events falling into one of three categories: hearing damage, burns and injuries from projectiles.

The increase in MR-related accidents is partly due to changes in the way it's used, according to Tobias.

"The typical MR patient 20 years ago was the so-called 'walkie-talkie' patient," he said. "They came in under their own power with low acuity types of injuries. Today, MR is being used in emergent care and trauma settings. It's been converted from a diagnostic imaging tool to a platform for minimally invasive procedures, with different safety demands."

MR's role in surgeries, biopsies and treatments necessitates more equipment and personnel in the magnet room, even as the magnets themselves have become more powerful. Today's 3T magnets are twice as powerful as the older 1.5-T versions.

All of these changes put added pressure on MR technologists.

"There are so many things to be aware of," said John Deans, R.T.(R)(MR), MR supervisor at Presbyterian Healthcare Services in Albuquerque, N.M. "Not just screening the patient but making sure no one walks in with things they shouldn't."

"It's an electromagnet," noted Stephanie. "People don't realize that it's *always* running. We put signs up, but people sometimes get complacent."

An MR technologist's role in safety starts well before the actual exam. MR technologists must carefully screen patients for any items that might cause problems in the magnet room.

"We go through three different checklists before bringing a patient into the suite," said Janice Fairhurst, R.T.(R)(MR), an interventional MR specialist at Brigham and Women's Hospital in Boston, who works with a ceiling-mounted MR unit that can be pulled into the operating room. "We pat ourselves down, remove any pagers or cell phones. There's a checklist prior to draping the patient. And then we do another one before the magnet is brought in."

Certain types of clothing and tattoos can make a patient susceptible to burns due to a concentration of electrical currents from conducting materials placed in the radiofrequency field.

"Lower quality tattoos that have metal flakes in the ink can heat and make the patient's skin welt up," John said. "They can get burned because they have T-shirts with glitter in them."

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Burns also can occur from contact with parts of the machine, making padding and positioning aids essential to keep patients away from active RF elements. The technologist also must ensure separation and insulation between patients and their own body parts (i.e., hands and thighs) to avoid "kissing tissue" accidents. Electrical conductors such as ECG leads and cables must be removed before an exam.

"You want to be careful how you position the patient," added Stephanie. "You can't have any bare skin touching inside the MR bore. Most technologists already know that, but that doesn't mean they don't have to hear it again."

The screening process calls upon a technologist's observational skills and attention to detail. Patients sometimes are reluctant to admit the presence of implants. If they aren't cognitive, the technologist must get pertinent information from friends and family members. A simple bit of absentmindedness from a patient can have dramatic consequences, as Stephanie found out.

"There was this little old lady, as sweet as can be, and we were preparing to scan her ankle," she recalled. "We asked her three or four times to pat her pockets, make sure she didn't have anything in there. She kept saying she didn't have anything. When we finally brought her into the room, something silver whizzed past my nose. It was a pair of nail clippers that had been in her pocket. It took two of us to pull it off the bore."

Often a technologist must engage in some detective work to determine the status of potential hazards inside the body. Stephanie has made numerous calls to local gun shops to find out if bullets lodged inside patients were magnetic.

> At least twice we've checked things that were sold to us as 'MR safe' and found them to be ferromagnetic.

The status of implanted items like pacemakers and clips often proves elusive, according to John.

"If an aneurysm clip in the brain is not MR-safe, it can twist and torque and rip the blood vessel," he said. "The problem is, the surgery reports you get are very vague. There are times when we're calling all over the country to try and get the information."

Hearing damage resulting from sustained exposure to the loud noises of the MR machines is perhaps the easiest accident to prevent. Patients are provided with earplugs, but the technologist should never assume they're being worn properly.

"Make sure the patient understands how to put the earplugs in, and make sure the plugs are seated in the ear correctly," said Tobias, who also works for RADIOLOGY-Planning, a company based in Kansas City, Mo., that designs radiology, nuclear medicine and radiation therapy facilities for health care providers. "Have them use ear muffs if they cannot get the plugs to fit properly."

Screening any equipment that goes into the room is another essential safeguard. Materials that are ferromagnetic, or susceptible to magnetization, can turn into deadly missiles in the MR room, a fact that became clear in 2001 when the magnet pulled an oxygen tank into the bore, killing a 6-year-old boy. Most facilities label materials, but double-checking is still essential.

"We always check equipment with the handheld magnet," said Janice. "At least twice we've checked things that were sold to us as 'MR safe' and found them to be ferromagnetic. You can never become complacent, even when the equipment comes from the manufacturer as nonferrous."

Controlling access to the MR suite is another critical safety element, especially as the expanding role of MR in medicine has brought into the suite many people who are insufficiently trained in MR safety.

"You have to have strong-willed people working in MR," said John. "Sometimes, physicians will try to say it's safe to do an exam, and the patient will end up getting hurt. I've had to yell at people to keep them from coming into the room."

"When things become projectiles, it's not just the patient but the staff that's in danger," added Cathy. "The techs are the gatekeepers. They absolutely need to speak up. Unfortunately, physicians aren't always willing to listen."

Cathy saw this firsthand when she was working in the MR suite and an anesthesiologist attempted to bring a pump into the room.

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"I told him it wasn't safe," she remembered. "I turned my back on him for a second and he brought it in anyway. The pump flew into the bore and hit with an incredible thump. It dented the machine. Thankfully the patient wasn't in the scanner. After that, the technologists were empowered. When they said 'no,' it meant 'no.'"

"It's grossly unfair to say technologists are responsible for MR safety exclusive of anyone else," Tobias said. "Technologists

Stay Informed

MR Safety Resources

To access the American College of Radiology MR safety site and its 2007 whitepaper, visit www.acr.org/secondarymainmenucategories/quality_safety/mrsafety.

Architect Tobias Gilk blogs on MR safety at www.mrimetaldetector.com/blog.

You will find a comprehensive resource for MR safety maintained by Frank G. Shellock, Ph.D., at www.mrisafety.com.

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can't deploy access control to the suite in and of themselves. We can't rest the entire burden of safety on them. It's unfair to the technologist and excuses the people with the responsibility to create an appropriate environment."

Through his work on the MRI Safety Committee for the American College of Radiology, Tobias helped produce the ACR Guidance Document for Safe MR Practices, a white paper on MR safety. The paper has been revised and updated twice since it was published in 2002. A 2011 edition is expected shortly. Part of Tobias' efforts involve promoting the four-zone MR standard, in which zone one is the entire planet and zone four is the room housing the MR unit.

"That means two spaces at minimum between the world at large and the room with the magnet," Tobias said. "You have screening activities in zone two, and a doorway between zones two and three."

The 2010 edition of the Guidelines for Design and Construction of Health Care Facilities included, for the first time, extensive physical environment safety protections pertinent to the unique safety aspects of MR. The Joint Commission began referencing the 2010 edition as its standard for hospital buildings just this year.

"The four-zone principle has been out there since 2002," said Tobias. "But since publication of the code in 2010, it's really been adopted and promulgated."

The new building guidelines have one major flaw, however: they do nothing to address design problems in facilities housing the nation's 12,000-plus legacy MR scanners.

"A lot of existing facilities don't have a zone two to zone three threshold," noted Tobias. "They share a corridor with radiology. All you need to do is pass through one door and you're in zone four. This puts a greater burden on technologists to control access and monitor who goes in and out."

In some cases, facilities can shuffle the location of the door in the magnet room and have the control room function as a zone three space. But getting facilities to make changes is not easy.

"There are almost always options to adapt a facility," said Tobias. "The challenge is cost — out-of-pocket costs like paying for a door, plus lost revenue from scanning 10 to 15 patients a day. The design and construction problems tend not to get addressed till the magnet is replaced."

Tobias believes that pressure from accrediting bodies and state licensing boards could force reluctant facilities to adopt safety measures.

"I've never heard of a state threatening to pull a license because of unsafe conditions," he said. "Usually it's a fine and a warning to not do it again. Meanwhile, these easily preventable accidents keep recurring."

Recent evidence suggests the FDA is taking notice. This past October, the agency held a two-day MR safety workshop in Silver Spring, Md. Sessions covered strategies to minimize risk to patients and staff in the MR environment, including working with ferromagnetic detectors and scanning patients with MR-compatible implants.

"It's a big deal that the FDA is looking into it," said Cathy. "There can never be enough public awareness. The 2007 ACR document is a very, very good resource. The FDA might be the pathway to making more changes."

Whatever changes occur, one thing is certain: Technologists will remain the ultimate stewards of MR safety.

"The technologist plays the most critical role in all of this," said Tobias. "They are the eyes, ears and hands of the institution at the point of care."