

MRI SAFETY JEOPARDY (Technologist Edition)

Questions

For MRI Safety Week, 2009

Provided Courtesy of Mednovus, Inc.

www.Mednovus.com

PowerPoint MRI Safety Quiz available for free download from

http://mrimetaldetector.com/media/proving_grounds/MRI_safety_week.html

Welcome to MRI Safety Jeopardy. The game is played by selecting a category, a point value, and 'answering' by asking the appropriate question that would produce the provided statement. Your responses must be in the form of a question.

When a statement is read, signal when you believe that you have the correct response. If you do, you get the number of points indicated. If you don't have the correct response, your competitors will have the opportunity to signal, and respond. The person who answers the question correctly gets to select the next question category and point value.

Good luck!

FORCES

Forces 10 -

What is the gantry (or the MR magnet, or bore, or scanner)?

The electromagnetic coils inside the MRI scanner produce a magnetic field which is necessary for MRI imaging. In the vast majority of MRI scanners, this magnetic field is active all the time (24 hours / day). Turning the magnet off is possible, but typically requires specialized equipment and advanced planning, or an emergency 'run-down' which has the potential of damaging the magnet. Either option typically requires days to turn the magnet back 'on' and get it ready for scanning.

Forces 20 -

What are translational (or missile or attractive) force and rotational (or torque or twisting) force?

When in a magnetic field, ferromagnetic materials are subject to magnetic forces that both try to rotate the object into alignment with the poles of the magnetic field and try to attract the ferromagnetic object to the strongest part of the magnetic field.

Forces 30 -

What is "isocenter" or "in the middle of the MRI" or "imaging volume"

Torque effects are a product of the B_0 (static magnetic) field strength. The field strength is greatest near or at the imaging volume (in the center of the MRI)

Forces 40 -

What is "isocenter" or "in the middle of the MRI" or "imaging volume"

Attractive / translational effects are a product of the spatial gradient of the MRI's magnetic field. These forces increase, dramatically, as you approach the magnet, but actually drop rapidly to zero where the magnetic field strength is homogeneous, which occurs in the volume at the center of the MRI where we image patients.

Forces 50 -

What is the "Lenz Effect"?

Any electrically-conductive material can develop magnetic field 'eddy currents' when in high strength magnetic fields. This can sometimes offer some resistance to movement for larger non-magnetic (e.g.: aluminum) objects when close to the MRI's magnetic field.

PROJECTILES

Projectiles 10 –

What are projectile or missile accidents?

An ECRI Institute poll of its members in 2005 found that projectile accidents were more common than all other MRI accident types, combined! In 2008, the VA's National Center for Patient Safety published their average cost (not including lost procedure revenue or legal expenses) for projectile accidents at \$43,172 per event.

Projectiles 20 –

What is 'Stainless Steel'?

Some stainless steel alloys are inherently ferromagnetic. Others, classified as Austenitic, start out non-ferromagnetic but, as a result of heating, shaping or other stresses, may become ferromagnetic. Simply because something is identified as 'stainless steel' does not tell us anything about the object's safety near the MRI.

Projectiles 30 –

What is 'False.'

While the TV show 'House' may have taken a LOT of dramatic license by showing ferromagnetic foreign bodies 'blasting' out of a patient's body in the MRI, magnetic energies (and the translational forces they induce in ferromagnetic materials) do penetrate the body. And thank goodness they do, otherwise MR imaging wouldn't be possible.

Projectiles 40 –

What is Zone 4 (the MRI scanner room)?

For most contemporary clinical MRI systems the active shielding constrains the magnetic field so effectively that projectile risks are limited to the room with the MR magnet. Some older systems (and some contemporary research systems) have magnetic fields that can cause rotation and displacement even outside the MRI room. In all cases, persons and equipment should be screened for ferromagnetic threats before approaching the MRI room.

Projectiles 50 –

What are 'ferromagnetic detectors' or 'ferromagnetic-only detectors' (e.g.: 'Mednovus SAFESCAN® products')

Although conventional metal detectors are considered by experts, including Dr. Kanal, to be "useless" for pre-MRI screening, many professional organizations, including the American College of Radiology, the American Society of Healthcare Engineers, the UK's Medicine and Health Regulatory Agency (MHRA) have all recommended the use of ferromagnetic detectors for MRI pre-screening. In the Joint Commission's MRI Sentinel Event Alert, they gave ferromagnetic detection as a specific example of a way to improve patient screening.

POTPOURRI

Potpourri 10 –

What is 'MR Conditional'?

This label, as well as the explanation as to the specific conditions for safe use, should be affixed to every tested MR product, device, appliance and piece of equipment in the MRI suite. For objects too small to have the conditions attached, product literature with the conditions for safe use should be readily available.

Potpourri 20 –

What is 'sound pressure', 'volume', 'banging' or 'gradient noise'?

It is known that some FDA approved scans may be loud enough to cause hearing damage. For this reason, it is important to provide hearing protection for MR patients as well as any clinical provider or visitor who remains in the magnet room during the imaging process.

Potpourri 30 –

What is 'False'.

While some vendors distinguish their non-ferrous, aluminum, oxygen cylinders by leaving the body silver, other vendors market strongly ferromagnetic cylinders that are painted silver or grey. The color of the body of a portable cylinder has NO SIGNIFICANCE relative to the projectile safety of that cylinder.

Potpourri 40 –

What is 'non-RF-reactive' or 'doesn't heat from RF energy'.

In fact, the new MR Safe classification is so restrictive that almost no contemporary implants or devices can be classified as such. Anything with the new 'MR Safe' designation would present no physical hazards under ANY MR conditions.

Potpourri 50 –

What is Spatial Gradient?

This factor, more so than magnetic field strength, quantifies the force that acts on a ferromagnetic material to attract it to a magnet. Certain MR Conditional devices have conditions relative to maximum allowable spatial gradient. It is critical to know the unique value of the maximum spatial gradient for each MR system you have.

HEATING

Heating 10 -

What are burns?

Like sunlight, RF energies during MR imaging typically 'bathe' the patient. And like a magnifying glass does to sunlight, certain positions or materials inside the bore can focus RF energies creating the potential for heating.

Heating 20 -

What are leads for patient monitoring (ECG, pulse oximetry, etc...)?

Any electrically conductive wire in the bore with the patient should be insulated from direct contact with the patient and should be positioned so that it is straight and exits the bore in a direct path. Leads should not be run under patients and loops should be specifically avoided.

Heating 30 -

What is padding / insulation?

Contact with the RF coils in the bore wall is one of the primary causes of RF heating injury. Patients should always have separation between their body and the bore wall.

Heating 40 -

What are retained leads for pacemakers or other biostimulation implants, such as deep-brain or Vagus nerve stimulators?

Even if the pulse generator for a particular implant is removed it does not mean that the patient is free of contraindications for MRI. Retained leads can, in some situations, present a greater heating risks than if they were attached to the device.

Heating 50 -

What are burns from skin-to-skin body loops, without the presence of any metal conductor or direct contact with RF surfaces.

Large caliber loops of body tissue (such as bare ankles touching for a patient wearing long pants, or crossed arms) may create an antennae effect for RF deposition and produce focal heating at the point of greatest electrical resistance in the loop. These burns may take many minutes to become apparent after imaging and can be 2nd or 3rd degree.

SCREENING

Screening 10 -

Who is 'EVERYONE'?

Every person should be screened for magnetic field contraindications before being allowed into any area with unrestricted access to a static magnetic field of 5 gauss or greater. This is true for visitors, accompanying family members, even hospital staff and physicians.

Screening 20 -

What is either the American College of Radiology (ACR) or MRIsafety.com?

To facilitate effective and consistent pre-MRI screening, the ACR (at http://www.ACR.org/mr_safety) and MRIsafety.com (at <http://www.MRIsafety.com>) have standardized patient / visitor screening forms, both in English and Spanish. These are available as free downloads from either of these two sites.

Screening 30 -

What is false?

MR is not a 'one size-fits all' exam. There are multiple variables that can make one exam far more dangerous than another for a given patient. Even if the prior exam was completed at a higher field strength, that offers no assurance of safety. Each patient must be thoroughly screened for each MR exam.

Screening 40 -

What is "physical screening"?

Clinical screening is intended to identify medical contraindications, such as implants, thermoregulation concerns, or contrast concerns. Physical screening is intended to identify objects or materials that would be dangerous if brought into the MRI room, including ferromagnetic objects that may become projectiles and electrically-conductive materials that may experience focal heating during the MR exam.

Screening 50 -

What is Nephrogenic Systemic Fibrosis (NSF), formerly known as Nephrogenic Fibrosing Dermopathy (NFD).

In little over 2 years since a link was found between Gadolinium chelate breakdown and the development of NSF in patients with renal impairment, there are no biopsy-confirmed cases of recently-acquired NSF. By reducing dose, using more stable agents, and screening for risk factors, the MRI community has virtually eliminated this disease.