Magnetic Resonance Imaging (MRI)

What is magnetic resonance imaging (MRI)?

MRI is a diagnostic procedure that uses a combination of a large magnet, radiofrequencies, and a computer to produce detailed images of organs and structures within the body.

How does an MRI scan work?

The MRI machine is a large, cylindrical (tube-shaped) machine that creates a strong magnetic field around the patient. The magnetic field, along with a radiofrequency, alters the hydrogen atoms' natural alignment in the body. Computers are then used to form a two-dimensional (2D) image of a body structure or organ based on the activity of the hydrogen atoms. Cross-sectional views can be obtained to reveal further details. MRI does not use radiation, as do x-rays or computed tomography (CT scans).

A magnetic field is created and pulses of radio waves are sent from a scanner. The radio waves knock the nuclei of the atoms in your body out of their normal position. As the nuclei realign back into proper position, they send out radio signals. These signals are received by a computer that analyzes and converts them into an image of the part of the body being examined. This image appears on a viewing monitor. Some MRI machines look like narrow tunnels, while others are more open.

Magnetic resonance imaging (MRI) may be used instead of computed tomography (CT) in situations where organs or soft tissue are being studied, because bones do not obscure the images of organs and soft tissues, as they do in CT.

Because radiation is not used, there is no risk of exposure to radiation during an MRI procedure.

Due to the use of the strong magnet, MRI cannot be performed on patients with implanted pacemakers, intracranial aneurysm clips, cochlear implants, certain prosthetic devices, implanted drug infusion pumps, neurostimulators, bone-growth stimulators, certain intrauterine contraceptive devices, or any other type of iron-based metal implants. MRI is also contraindicated in the presence of internal metallic objects such as bullets or shrapnel, as well as surgical clips, pins, plates, screws, metal sutures, or wire mesh.

Newer uses and indications for MRI have contributed to the development of additional magnetic resonance technology. Magnetic resonance angiography (MRA) is a procedure used to evaluate blood flow through arteries in a noninvasive (the skin is not pierced) manner. MRA can also be used to detect aneurysms within the brain and vascular malformations (abnormalities of blood vessels within the brain, spinal cord, or other parts of the body).

Magnetic resonance spectroscopy (MRS) is another noninvasive procedure used to assess chemical abnormalities in body tissues such as the brain. MRS may be used to assess disorders such as HIV infection of the brain, stroke, head injury, coma, Alzheimer's disease, tumors, and multiple sclerosis.

Functional magnetic resonance imaging of the brain (fMRI) is used to determine the specific location of the brain where a certain function, such as speech or memory, occurs. The general areas of the brain in which such functions occur are known, but the exact location may vary from person to person. During functional resonance imaging of the brain, you will be asked to perform a specific task, such as recite the Pledge of Allegiance, while the scan is being done. By pinpointing the exact location of the functional center in the brain, physicians can plan surgery or other treatments for a particular disorder of the brain.

Another advance in MRI technology is the "open" MRI. Standard MRI units have a closed cylinder-shaped tunnel into which the patient is placed for the procedure. Open MRI units do not completely surround the patient, and some units may be open on all sides. Open MRI units are particularly useful for procedures involving:

- children
  Parents or other caregivers may stay with a child during the procedure to provide comfort and security.
- claustrophobia
  Before the development of open MRI units, persons with severe claustrophobia often required a sedative medication prior to the procedure.
- very large or obese persons
  Almost anyone can be accommodated in most open MRI units.

Reminders Before the Examination

Tell the radiologist if you are claustrophobic and think that you will be unable

to lie still while inside the scanning machine; if you have a pacemaker inserted, or have had heart valves replaced; if you have metal plates, pins, metal implants, surgical staples, or aneurysm clips; if you have permanent eye liner; if you are pregnant; if you ever had a bullet wound; or if you have ever worked with metal (i.e., a metal grinder).

How is an MRI performed?

An MRI may be performed on an outpatient basis, or as part of inpatient care. Although each facility may have specific protocols in place, generally, an MRI procedure follows this process:

1. Because of the strong magnetic field, the patient must remove all jewelry and metal objects such as hairpins or barrettes, hearing aids, eyeglasses, and dental pieces.
2. If a contrast medication and/or sedative are to be given by an intravenous line (IV), an IV line will be started in the hand or arm. If the contrast is to be taken by mouth, the patient will be given the contrast to swallow.
3. The patient will lie on a table that slides into a tunnel in the scanner.
4. The MRI staff will be in another room where the scanner controls are located. However, the patient will be in constant sight of the staff through a window. Speakers inside the scanner will enable the staff to communicate with and hear the patient. The patient will have a call bell so that he/she can let the staff know if he/she has any problems during the procedure.
5. During the scanning process, a clicking noise will sound as the magnetic field is created and pulses of radio waves are sent from the scanner. The patient may be given headphones to wear to help block out the noises from the MRI scanner and hear any messages or instructions from the technologist.
6. It is important that the patient remain very still during the examination.
7. At intervals, the patient may be instructed to hold his/her breath, or to not breathe, for a few seconds, depending on the body part being examined. The patient will then be told when he/she can breathe. The patient should not have to hold his/her breath for longer than a few seconds, so this should not be uncomfortable.
8. The technologist will be watching the patient at all times and will be in constant communication.

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