

Magnetic Resonance Imaging

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What is magnetic resonance imaging (MRI)?

MRI, or magnetic resonance imaging, is a means of "seeing" inside of the body in order for doctors to find certain diseases or abnormal conditions. MRI does not rely on the type of radiation (i.e., ionizing radiation) used for an x-ray or computed tomography (CT) scan. The MRI examination requires specialized equipment that uses a powerful, constant magnetic field, rapidly changing local magnetic fields, radiofrequency energy, and dedicated equipment including a powerful computer to create very clear pictures of internal body structures.

During the MRI examination, the patient is placed within the MR system or "scanner". The powerful, constant magnetic field aligns a tiny fraction of subatomic particles called protons that are present in most of the body's tissues. Radiofrequency energy is applied to cause these protons to produce signals that are picked up by a receiver within the scanner. The signals are specially characterized using the rapidly changing, local magnetic field and computer-processed to produce images of the body part of interest.

What is MRI used for?

MRI has become the preferred procedure for diagnosing a large number of potential problems in many different parts of the body. In general, MRI creates pictures that can show differences between healthy and unhealthy tissue. Doctors use MRI to examine the brain, spine, joints (e.g., knee, shoulder, wrist, and ankle), abdomen, pelvic region, breast, blood vessels, heart and other body parts.

Is MRI safe?

To date, over 150 million patients have had MRI examinations. Every year, approximately 10 million patients undergo MRI procedures. MRI has been shown to be extremely safe as long as proper safety precautions are taken. In general, the MRI procedure produces no pain and causes no known short-term or long-term tissue damage of any kind.

The powerful magnetic field of the scanner can attract certain metallic objects known as "ferromagnetic" objects, causing them to move suddenly and with great force towards the center of the MR system. This may pose a risk to the patient or anyone in the way of the object. Therefore, great care is taken to prevent ferromagnetic objects from entering the MR system room. It is vital that you remove metallic objects in advance of an MRI exam, including watches, jewelry, and items of clothing that have metallic threads or fasteners.

MRI facilities have screening procedures that, when carefully followed, will ensure that the MRI technologist and radiologist knows about the presence of metallic implants and materials so that special precautions can be taken (see below). In some unusual cases the examination may be

canceled because of concern related to a particular implant or device. For example, if an MRI is ordered, it may be cancelled if the patient has a ferromagnetic aneurysm clip because of the risk dislodging the clip from the blood vessel. Also, the magnetic field of the scanner can damage an external hearing aid or cause a heart pacemaker to malfunction. If you have a bullet or other metallic fragment in your body there is a potential risk that it could change position, possibly causing injury.

How to prepare for the MRI examination.

There's no special preparation necessary for the MRI examination. Unless your doctor specifically requests that you not eat or drink anything before the exam, there are no food or drink restrictions. Continue to take any medication prescribed by your doctor unless otherwise directed.

You won't be allowed to wear anything metallic during the MRI examination, so it would be best to leave watches, jewelry or anything made from metal at home. Even some cosmetics contain small amounts of metals, so it is best to not wear make-up.

In order to prevent metallic objects from being attracted by the powerful magnet of the MR system, you will typically receive a gown to wear during your examination. Items that need to be removed by patients before entering the MR system room include:

- Purse, wallet, money clip, credit cards, cards with magnetic strips
- Electronic devices such as beepers or cell phones
- Hearing aids
- Metal jewelry, watches
- Pens, paper clips, keys, coins
- Hair barrettes, hairpins
- Any article of clothing that has a metal zipper, buttons, snaps, hooks, underwires, or metal threads
- Shoes, belt buckles, safety pins

Before the MRI procedure, you will be asked to fill out a screening form asking about anything that might create a health risk or interfere with imaging. You will also undergo an interview by a member of the MRI facility to ensure that you understand the questions on the form. Even if you have undergone an MRI procedure before at this or another facility, you will still be asked to complete an MRI screening form.

Examples of items or things that may create a health hazard or other problem during an MRI exam include:

- Pacemaker
- Implantable cardioverter defibrillator (ICD)
- Neurostimulator
- Aneurysm clip
- Metal implant
- Implanted drug infusion device
- Foreign metal objects, especially if in or near the eye
- Shrapnel or bullet wounds
- Permanent cosmetics or tattoos
- Dentures/teeth with magnetic keepers
- Other implants that involve magnets
- Medication patch (i.e., transdermal patch) that contains metal foil

Check with the MRI technologist or radiologist at the MRI center if you have questions or concerns about any implanted object or health condition that could impact the MRI procedure. This is particularly important if you have undergone surgery involving the brain, ear, eye, heart, or blood vessels.

Important Note: If you are pregnant or think that you could be pregnant, you must notify your physician and the radiologist or the MRI technologist at the MRI center prior to the MRI procedure.

What is the MRI examination like?

The MRI examination is performed in a special room that houses the MR system or "scanner". You will be escorted into the room by a staff member of the MRI facility and asked to lie down on a comfortably padded table that gently glides you into the scanner.

In general, in preparation for the MRI examination, you may be required to wear earplugs or headphones to protect your hearing because, when certain scanners operate, they may produce loud noises. These loud noises are normal and should not worry you.

For some MRI studies, a contrast agent called "gadolinium" may be injected into a vein to help obtain a clearer picture of the area being examined. At some point during the examination, a nurse or technologist will slide the table out of the scanner in order to inject the contrast agent. This is typically done through a small needle connected to an intravenous line that is placed in an arm or hand vein. A saline solution will drip through the intravenous line to prevent clotting until the contrast material is injected at some point during the exam. Unlike contrast agents used in x-ray studies, MRI contrast agents do not contain iodine and, therefore, rarely cause allergic reactions or other problems.

The most important thing for the patient to do is to relax and lie still. Most MRI exams take between 15 to 45 minutes to complete depending on the body part imaged and how many images are needed, although some may take as long as 60-minutes or longer. You'll be told ahead of time just how long your scan is expected to take. You will be asked to remain perfectly still during the time the imaging takes place, but between sequences some minor movement may be allowed. The MRI Technologist will advise you, accordingly.

When MRI procedure begins, you may breathe normally, however, for certain examinations it may be necessary for you to hold your breath for a short period of time.

During your MRI examination, the MR system operator will be able to speak to you, hear you, and observe you at all times. Consult the scanner operator if you have any questions or feel anything unusual.

When the MRI procedure is over, you may be asked to wait until the images are examined to determine if more images are needed. After the scan, you have no restrictions and can go about your normal activities.

Once the entire MRI examination is completed, the pictures will be looked at by a radiologist, a specially-trained physician who is able to interpret the scans for your doctor. The radiologist will send your doctor a report. You should contact your doctor to go over your results and discuss your next step.

DISCLAIMER

This information is provided for the sole purpose of educating you as to the basics of the MRI examination. You should rely on your physician or MRI technologist for specific information about your own examination.

*Developed in Conjunction with the Safety Committee of the International Society for Magnetic Resonance in Medicine

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