Magnetic resonance imaging

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ABSTRACT

MRI machine is a method that uses a magnetic field in addition to radio waves to create detailed images of the various tissues and organs of the body that are to be examined. Some MRI devices consist of a large magnet in the form of a tube. When the patient lies inside the device, the magnetic field works to reorganize the hydrogen atoms in the patient's body. Radio waves emit weak signals, and through it, cross-sectional images are produced, and three-dimensional images can also be issued. In addition to the existence of a type of magnetic resonance imaging known as functional magnetic resonance imaging, this type is used to clarify the anatomy of the brain and also demonstrates metabolic changes in the brain. In addition, it helps in diagnosing damage associated with brain injuries and also diagnosing Alzheimer's disease.

Keywords: MRI machine , various tissues, patient's body

جهاز الرنين المغناطيسي

الملخص

جهاز التصوير بالرنين المغناطيسي يعتبر وسيلة يتم استخدام المجال المغناطيسي بها بالإضافة إلى موجات الراديو لإنشاء صور مفصلة لأنسجة وأعضاء الجسم المختلفة والمراد فحصها. وبعض أجهزة الرنين لمغناطيسي مكونة من مغناطيس كبير على هيئة أنبوب، فعندما يستلقي المريض داخل الجهاز يعمل المجال المغناطيسي بإعادة تنظيم ذرات الهيدروجين في جسم المريض، وتعمل موجات الراديو على إصدار إشارات ضعيفة، ويصدر من خلاله صور مقطعية وأيضاً يمكن إصدار صور ثلاثية الأبعاد. بالإضافة إلى وجود نوع من الرنين المغناطيسي يعرف باسم الرنين المغناطيسي الوظيفي، وهذا النوع يستخدم لتوضيح تشريح الدماغ، وأيضاً يوضح التغيرات الأيضية في الدماغ بالإضافة إلى أنه يساعد في تشخيص الضرر المصاحب لإصابات الدماغ وأيضا تشخيص الإصابة بألزهايمر.

Introduction

Overview-MRI scan

Magnetic resonance imaging (MRI) is a type of scan that uses strong magnetic fields and radio waves to produce detailed images of the inside of the body.

An MRI scanner is a large tube that contains powerful magnets. You lie inside the tube during the scan.

An MRI scan can be used to examine almost any part of the body, including the:

- brain and spinal cord
- bones and joints
- breasts
- heart and blood vessels
- internal organs, such as the liver, womb or prostate gland

The results of an MRI scan can be used to help diagnose conditions, plan treatments and assess how effective previous treatment has been.

What happens during an MRI scan?

During an MRI scan, you lie on a flat bed that's moved into the scanner.

Depending on the part of your body being scanned, you'll be moved into the scanner either head first or feet first.

The MRI scanner is operated by a radiographer, who is trained in carrying out imaging investigations.

They control the scanner using a computer, which is in a different room, to keep it away from the magnetic field generated by the scanner.

You'll be able to talk to the radiographer through an intercom and they'll be able to see you on a television monitor throughout the scan.

At certain times during the scan, the scanner will make loud tapping noises. This is the electric current in the scanner coils being turned on and off.

You'll be given earplugs or headphones to wear.

It's very important to keep as still as possible during your MRI scan.

The scan lasts 15 to 90 minutes, depending on the size of the area being scanned and how many images are taken.

How does an MRI scan work?

Most of the human body is made up of water molecules, which consist of hydrogen and oxygen atoms.

At the centre of each hydrogen atom is an even smaller particle called a proton. Protons are like tiny magnets and are very sensitive to magnetic fields.

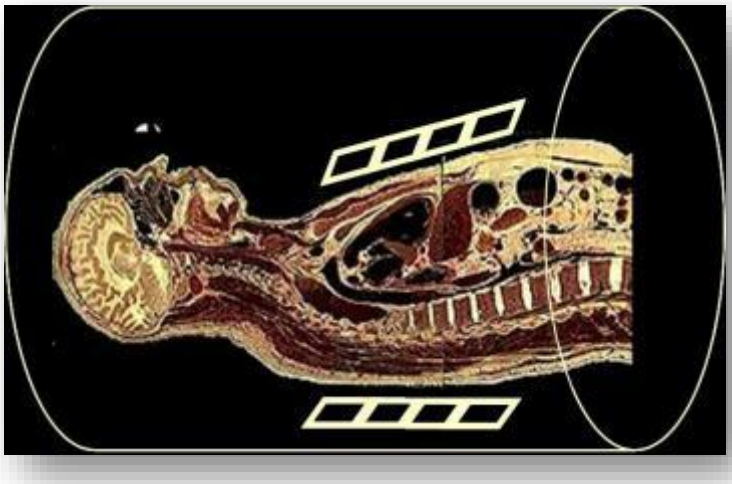
When you lie under the powerful scanner magnets, the protons in your body line up in the same direction, in the same way that a magnet can pull the needle of a compass.

Short bursts of radio waves are then sent to certain areas of the body, knocking the protons out of alignment.

When the radio waves are turned off, the protons realign. This sends out radio signals, which are picked up by receivers.
These signals provide information about the exact location of the protons in the body.
They also help to distinguish between the various types of tissue in the body, because the protons in different types of tissue realign at different speeds and produce distinct signals.
In the same way that millions of pixels on a computer screen can create complex pictures, the signals from the millions of protons in the body are combined to create a detailed image of the inside of the

Are there risks?

Although MRI does not emit the ionizing radiation that is found in x-ray and CT imaging, it does employ a strong magnetic field. The magnetic field extends beyond the machine and exerts very powerful forces on objects of iron, some steels, and other magnetizable objects; it is strong enough to fling a wheelchair across the room. Patients should notify their physicians of any form of medical or implant prior to an MR scan.



When having an MRI scan, the following should be taken into consideration:

•**People with implants, particularly those containing iron,** — pacemakers, vagus nerve stimulators, implantable cardioverter- defibrillators, loop recorders, insulin pumps, cochlear implants, deep brain stimulators, and capsules from capsule endoscopy should not enter an MRI machine.

- **Noise**—loud noise commonly referred to as clicking and beeping, as well as sound intensity up to 120 decibels in certain MR scanners, may require special ear protection.
- **Nerve Stimulation**—a twitching sensation sometimes results from the rapidly switched fields in the MRI.
- **Contrast agents**—patients with severe renal failure who require dialysis may risk a rare but serious illness called nephrogenic systemic fibrosis that may be linked to the use of certain gadolinium-containing agents, such as gadodiamide and others. Although a causal link has not been established, current guidelines in the United States recommend that dialysis patients should only receive gadolinium agents when essential, and that dialysis should be performed as soon as possible after the scan to remove the agent from the body promptly.

- **Pregnancy**—while no effects have been demonstrated on the fetus, it is recommended that MRI scans be avoided as a precaution especially in the first trimester of pregnancy when the fetus' organs are being formed and contrast agents, if used, could enter the fetal bloodstream.
- **Claustrophobia**—people with even mild claustrophobia may find it difficult to tolerate long scan times inside the machine. Familiarization with the machine and process, as well as visualization techniques, sedation, and anesthesia provide patients with mechanisms to overcome their discomfort. Additional coping mechanisms include listening to music or watching a video or movie, closing or covering the eyes, and holding a panic button. The open MRI is a machine that is open on the sides rather than a tube closed at one end, so it does not fully surround the patient. It was developed to accommodate the needs of patients who are uncomfortable with the narrow tunnel and noises of the traditional MRI and for patients whose size or weight make the traditional MRI impractical. Newer open MRI technology provides high quality images for many but not all types of examinations.

Safety

An MRI scan is a painless and safe procedure. You may find it uncomfortable if you have claustrophobia, but most people are able to manage it with support from the radiographer.

Going into the scanner feet first may be easier, although this isn't always possible.

Extensive research has been carried out into whether the magnetic fields and radio waves used during MRI scans could pose a risk to the human body.

No evidence has been found to suggest there's a risk, which means MRI scans are one of the safest medical procedures available.

But MRI scans may not be recommended in certain situations. For example, if you have a metal implant fitted, such as a pacemaker or artificial joint, you may not be able to have an MRI scan.

They're also not usually recommended during pregnancy.

Read more about who can and can't have an MRI scan.

Before the scan

On the day of your MRI scan, you should be able to eat, drink and take any medication as usual, unless you're advised otherwise.

In some cases, you may be asked not to eat or drink anything for up to 4 hours before the scan, and sometimes you may be asked to drink a fairly large amount of water beforehand. This depends on the area being scanned.

When you arrive at the hospital, you'll usually be asked to fill in a questionnaire about your health and medical history. This helps the medical staff to ensure you have the scan safely.

Read more about who can and can't have an MRI scan.

Once you have completed the questionnaire, you'll usually be asked to give your signed consent for the scan to go ahead.

As the MRI scanner produces strong magnetic fields, it's important to remove any metal objects from your body.

These include:

- watches
- jewellery, such as earrings and necklaces
- piercings, such as ear, nipple and nose rings
- dentures (false teeth)

- hearing aids
- wigs (some wigs contain traces of metal)

Any valuables can usually be stored in a secure locker.
Depending on which part of your body is being scanned, you may need to wear a hospital gown during the procedure.
If you don't need to wear a gown, you should wear clothes without metal zips, fasteners, buttons, underwire (bras), belts or buckles.

Contrast dye

Some MRI scans involve having an injection of contrast dye. This makes certain tissues and blood vessels show up more clearly and in greater detail.
Sometimes the contrast dye can cause side effects, such as:

- feeling or being sick
- a skin rash
- a headache
- dizziness

These side effects are usually mild and don't last very long.
It's also possible for contrast dye to cause tissue and organ damage in people with severe kidney disease.
If you have a history of kidney disease, you may be given a blood test to determine how well your kidneys are functioning and whether it's safe to proceed with the scan.
You should let the staff know if you have a history of allergic reactions or any blood clotting problems before having the injection.

Anaesthesia and sedatives

An MRI scan is a painless procedure, so anaesthesia (painkilling medication) isn't usually needed.
If you're claustrophobic, you can ask for a mild sedative to help you relax. You should ask your GP or consultant well in advance of having the scan.
If you decide to have a sedative during the scan, you'll need to arrange for a friend or family member to drive you home afterwards, as you won't be able to drive for 24 hours.
Babies and young children may be given a general anaesthetic before having an MRI scan.
This is because it's very important to stay still during the scan, which babies and young children are often unable to do when they're awake.

During the scan

An MRI scanner is a short cylinder that's open at both ends. You'll lie on a motorised bed that's moved inside the scanner.
You'll enter the scanner either head first or feet first, depending on the part of your body being scanned.
In some cases, a frame may be placed over the body part being scanned, such as the head or chest.
This frame contains receivers that pick up the signals sent out by your body during the scan and it can help to create a better-quality image.
A computer is used to operate the MRI scanner, which is located in a different room to keep it away from the magnetic field generated by the scanner.
The radiographer operates the computer, so they'll also be in a separate room to you.
But you'll be able to talk to them, usually through an intercom, and they'll be able to see you at all times on a television monitor.
A friend or family member may be allowed to stay with you while you're having your scan. Children can usually have a parent with them.
Anyone who stays with you will be asked if they have a pacemaker or any other metal objects in their body.
They'll also have to follow the same guidelines regarding clothing and the removal of metallic objects.

To avoid the images being blurred, it's very important to keep the part of your body being scanned still throughout the whole of the scan until the radiographer tells you to relax.
A single scan may take from a few seconds to 3 or 4 minutes. You may be asked to hold your breath during short scans.
Depending on the size of the area being scanned and how many images are taken, the whole procedure will take 15 to 90 minutes.
The MRI scanner will make loud tapping noises at certain times during the procedure. This is the electric current in the scanner coils being turned on and off. You'll be given earplugs or headphones to wear.
You're usually able to listen to music through headphones during the scan if you want to, and in some cases you can bring your own CD.
You'll be moved out of the scanner when your scan is over.

After the scan

An MRI scan is usually carried out as an outpatient procedure. This means you won't need to stay in hospital overnight.
After the scan, you can resume normal activities immediately. But if you have had a sedative, a friend or relative will need to take you home and stay with you for the first 24 hours.
It's not safe to drive, operate heavy machinery or drink alcohol for 24 hours after having a sedative.
Your MRI scan needs to be studied by a radiologist (a doctor trained in interpreting scans and X-rays) and possibly discussed with other specialists.
This means it's unlikely you'll get the results of your scan immediately.
The radiologist will send a report to the doctor who arranged the scan, who will discuss the results with you.
It usually takes a week or two for the results of an MRI scan to come through, unless they're needed urgently.

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