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Using the Magnetic Resonance Imaging in Medicine

Hiba Mohammed Jabr Kafash
University College of madent Alelema Department of Medical Physics

Zahraa Mazin MOhammed Said, Murtada Saheb Shaker Habib
University of Hilla college of Science, Department of Medical Physics

Rusul Tarkhan Shahd
Almustaqbal University College of sciences Department of Medical physics

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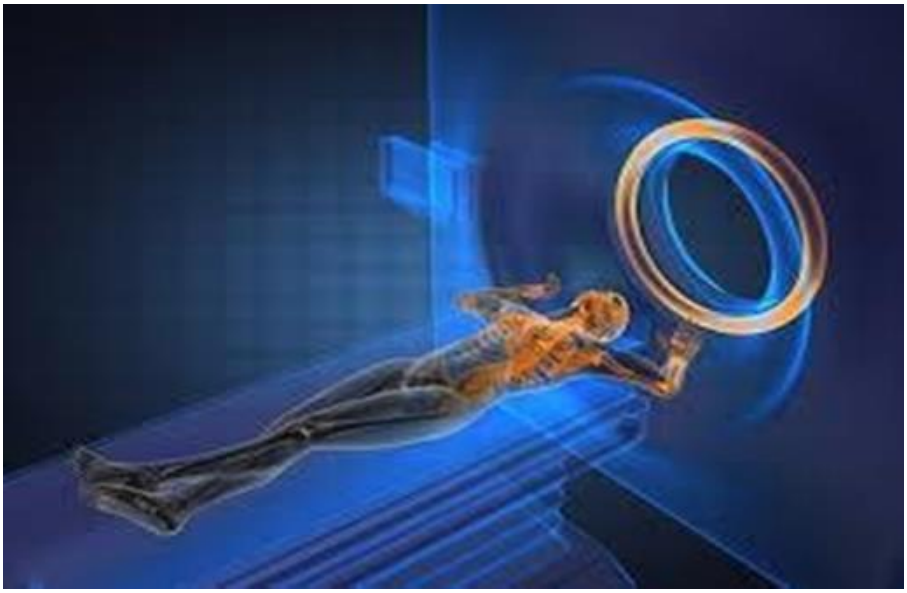
Annotation: This field causes the hydrogen atoms to become magnetized and all of them move toward their northern magnetic side, uniting in one direction. After that, the body is exposed to radio rays that increase the energy of these atoms, and therefore they will change their direction to a certain degree, leaving us with one atom out of every million atoms used in the MRI process. This is a large number of atoms sufficient to produce a clear image of the part to be imaged, and they emit the opposite amount of energy. This reverse energy is received from the device, calculated, and formed in the form of an image. This image shows the intensity of hydrogen in each area of the body, and through this image, doctors are able to detect many diseases.When atoms in the body are excited, the protons move with and against the direction of the main magnetic field. The protons corresponding to the main direction increase by a small amount compared to the antiprotons, but they are very important in obtaining the image later. These protons are especially excited by radio waves and change their position from vertical to horizontal, but they soon become It returns to the equilibrium position, but to return to the equilibrium position Balance There are two important timings.

Introduction

It is a medical imaging method to clarify pathological changes in living tissue. Magnetic resonance has non-medical uses. From a physical standpoint, it relies on magnetic fields or magnetic fields and radio waves. Magnetic resonance imaging is considered an expensive examination and not always available in many hospitals. There are difficulties when performing this type of imaging on patients who feel afraid of closed spaces or patients who complain of excessive obesity .The beginning of the history and birth of the Idea of magnetic resonance was in the year 1945-1946 when the scientist Felix Bloch and Edward Purcell received the Nobel Prize for their discovery of magnetic resonance. It was developed by scientist Erwin Hahn in 1950 and developed for medical use in 1973 by British and American scientists Peter Mansfield and Paul Lauterbur. 1976 The first MRI of a finger section was published. In 1977, he published the first full-body photography. It should be noted that magnetic resonance was initially used only in chemical laboratories. After that, it was updated to enter the medical field. It was initially called nuclear magnetic resonance, but the name was later changed due to the public's fear and sensitivity to the word "nuclear," which meant the nucleus of the atom, not the nuclear rays themselves.The Idea of magnetic resonance depends on stimulating the protons in the atoms of the elements present in the body to emit a signal, and then capturing it, determining its location in the body, and displaying it on a gray scale that indicates the strength of the signal, and the gradient varies according to the tissues present in the body. The most stimulating of these elements is hydrogen, due to its abundant presence in living bodies and the presence of one proton in the atomic nucleus, which gives it greater power than the rest of the elements in issuing the signals used in magnetic resonance. The device consists of a huge spiral electromagnet to form a magnetic field around the patient, producing a 2 Tesla magnetic field, equivalent to… 20000 Gauss.

➢ Magnetic resonance imaging-MRI

A strong magnetic field and high-frequency radio waves are used to produce highly detailed images. An MRI does not use X-rays, and is usually very safe.



➢ Components of an MRI machine

An MRI system consists of four main components: a main magnet consisting of superconducting coils, gradient coils, radio frequency (RF) coils, and computer systems.

➢ Performing an MRI

For an MRI, the person lies on a movable table that is moved into the narrow, large tubular scanner that produces a strong magnetic field. Protons are not positively charged parts of the atom in tissues in any arrangement Usually appointed. But when protons are surrounded by a strong magnetic field, as is the case In an MRI scanner, they match or line up with the magnetic field. The scanner then emits a pulse of radio waves, which disperses the protons Temporarily. As the protons align with the magnetic field again, they release energy called signals). The signal strength varies depending on the tissue. The scanner records the ringing These signals are magnetic. A computer is used to analyze signals and produce images.

➢ MRI machine work?

An MRI examination can take about 20 to 30 minutes, and during this examination the person is placed inside a large, powerful magnet that can reach a magnetic strength 30,000 times higher than the strength of the Earth's field.

Using radio transmission devices placed in the MRI room, the direction of the magnetic field can be changed at a certain point. After that, the examiners stop the transmission, and then the body releases the energy that entered it again in the form of a returning transmission. Through the returning information and using advanced radio wave detectors, Examiners can construct an image that shows the body's anatomy and detects abnormal processes within the body.

➢ Magnetic resonance device (MRI)

Our body consists of a large number of atoms rotating around its axis

When they are excited by a large magnetic field, such as an MRI device, they become organized And pay attention Then when it is exposed to a radio field, it scatters.

These different signals indicate the location of each atom, for example the kidney or the liver These signals are captured by detectors, which then process the signals with computers.

The whole treatment process is called MRI Resonance imaging shows tissues and organs that cannot be seen by x-rays

➢ Magnetic resonance imaging

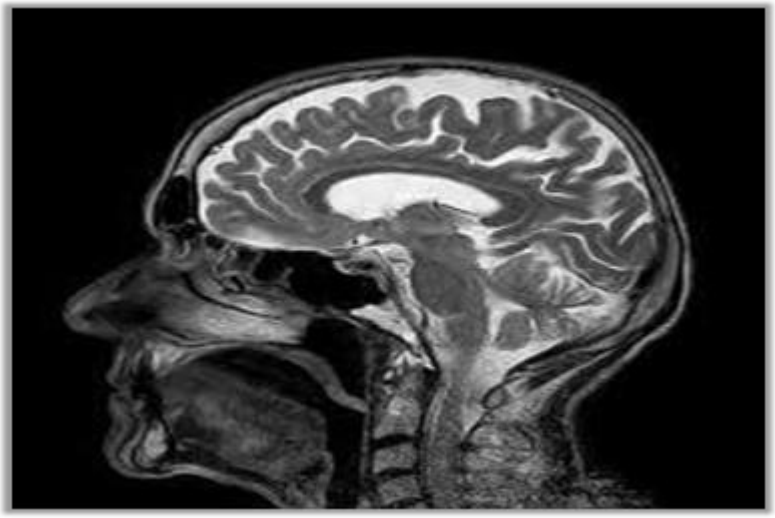
Examiners can change how different tissues appear on scans by changing the pulses Radio waves, strength and direction of the magnetic field, and other factors; For example For example, fatty tissue appears dark on one type of scan, and light on another. These different images provide complementary information, so more is being obtained One (often a contrast agent containing gadolinium may be injected) Magnetized contrast agent (intravenous or joint) Gadolinium agents cause changes The magnetic field in such a way that the images become clearer. Before the test, subjects remove most or all of their clothing and are given a garment in which they are not present Buttons, locks, zippers, or other metal. All objects must also be left behind Metal (such as keys, jewelry, cell phones, and other items that They can be affected by the magnetic field such as credit cards and watches outside a room MRI scanning, patients should also lie still when Pictures are being taken, and they may have to hold their breath sometimes.

Since the The scanner makes a loud noise, people may be given headphones or Earplugs. The examination may take from 20 to 60 minutes. After testing, people can resume their usual activities immediately.

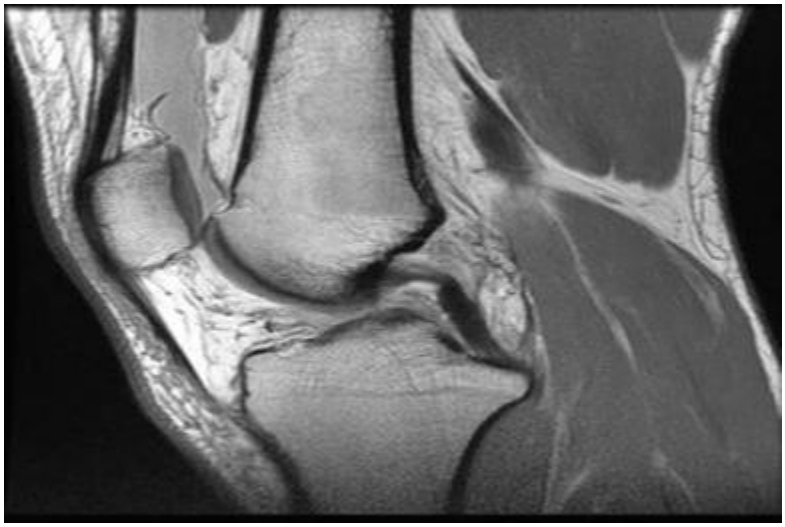
➢ Uses of MRI

MRI is preferred over CT when doctors need more detail about soft tissues, such as imaging abnormalities and anomalies in the brain, spinal cord, muscles, and liver. MRI is particularly useful for identifying tumors in these tissues. MRI is also used to do the following

- ✓ Measurement of certain molecules in the brain, which distinguishes between a brain tumor and a brain abscess.
- ✓ Identifying deformities of the female reproductive organs, fractures of the hip and pelvis.
- ✓ Helping doctors evaluate joint abnormalities (such as tears in the ligaments or cartilage in the knee and sprains).
- ✓ Help doctors evaluate bleeding and infection



◯MRI of the brain



◯Magnetic resonance imaging of the knee

MRI is also used when CT risks are high; For example, an MRI may be preferred For people who have a reaction to iodinated contrast agents used in CT scans and for pregnant women (because radiation can cause problems in the fetus) MRI, which is done after gadolinium contrast agent is injected into a vein, helps doctors evaluate inflammation, tumors, and blood vessels. Injecting this agent into the joint also helps doctors get a clearer picture of joint deformities or abnormalities, especially if they are complex (such as in injuries).

- ➢ **Use of cardiovascular magnetic resonance imaging**

Magnetic resonance imaging is used to detect many cardiovascular problems, the most important of which are the following:

The size of the heart's chambers. Thickness of the heart walls.

Aneurysm.

Damage resulting from heart attacks. Vascular infections.

Vascular blockage.

- **Use of MRI of bones and joints**

Magnetic resonance imaging of bones and joints is used to detect: Joint deformities resulting from injuries such as ligament tears.

Spinal deformities.

Bone infections.

Tumors in the spine and soft tissues.

In addition, MRI can detect breast tumors.

- **Using MRI to detect tumors**

An MRI procedure is used to detect tumors or abnormalities found in:

Kidney. Liver.

Spleen.

The womb.

Pancreas.

Ovaries.

Prostate.

- Types of MRI devices

1- Closed – 2- Open

Closed MRI

Open MRI

- **How to prepare for an MRI**

There are no special preparations before doing an MRI. You can eat and drink normally before doing it. In addition, it will not require you to stop any medications you are taking. The doctor may only ask you to remove your clothes and wear a special examination gown.

The table below shows the difference between closed and open MRI

Axis of differences	Closed MRI machine	Open MRI machine
Picture quality	The closed MRI device is more accurate as it produces images with more details, which reflects the ability of doctors to make a better diagnosis using it, as the strength of the open device's waves reaches (1-3) Tesla.	The strength of the open MRI waves is 0.5 Tesla or less, making its images less accurate
The speed	It takes less time to take images of the body due to the strength of the waves used, which is the difference between an open and a closed MRI machine	It requires taking pictures with this device longer time
The sound	The closed device emits a very loud and annoying sound, so patients may have to use earplugs to reduce hearing the annoying sound if using the closed device.	An open MRI machine is much quieter than a closed type
Technical advantages	The closed MRI device lacks many technical advantages and flexibility in operation, making this difference between the open and closed MRI	This type is characterized by its ability to change the patient's position from lying down to standing at several angles while on the

	device a major one.	bed of the device. This allows him to take more accurate pictures of some spine conditions and back pain
Comforts	This type causes fear and anxiety for some because it is almost completely enclosed, with the need to lie down for a period of time without moving, especially for people who suffer from claustrophobia.	An open MRI machine provides a much more comfortable environment for the examination as it is open and not enclosed
Cost	Cost is one of the most important aspects of the difference between an open and closed MRI device, as the closed MRI device has a higher cost in terms of periodic maintenance, in addition to its need for a larger engineering staff and more extensive management.	Maintaining and monitoring the operation of an open MRI machine costs less.

- **Types of MRI**

Functional magnetic resonance imaging

This technique detects metabolic or metabolic changes that occur when the brain is active. Thus, it can show which brain areas are active when a person performs a specific task, such as reading, writing, remembering, calculating, or moving a limb. Functional magnetic resonance imaging can be used in research and clinical settings, for example, to plan epilepsy brain surgery.

- **Perfusion MRI**

In this technique or method, doctors can estimate blood flow in a specific area. This information can be useful during a stroke to determine if blood flow to parts of the brain is low. It can also be used to identify areas where increased blood flow occurs – for example, in tumors. Diffusion MRI This technique detects changes in water movement in cells that are not functioning normally. It is mainly used to detect stroke early. It is also used to detect certain brain disorders and determine whether tumors have spread to the brain. The use of this technique for imaging areas other than the brain is limited. Diffusion MR imaging is often combined with other techniques to evaluate tumors Especially in the brain.

➢ **Magnetic resonance spectroscopy**

This technique uses radio waves that are emitted almost continuously instead of pulses, as in traditional MRI. Magnetic resonance spectroscopy is used to detect brain disorders, such as seizure disorders, Alzheimer's disease, brain tumors, and cysts. It can distinguish between debris Dead cells inside the abscess, and multiplying cells inside the tumor. This technique is also used to evaluate metabolic disorders in the muscles and nervous system. Magnetic resonance angiography (MRA) Magnetic resonance angiography, like conventional angiography and computed tomography angiography, can provide detailed images. For blood vessels. But it is safer and easier to perform, although it is more expensive. Often, MR angiography can be performed without agent injection Contrast MR angiography can show blood flow through arteries and veins, or blood flow only in one direction, thus showing only the arteries or only the veins. As in CT angiography, a computer is used to delineate all tissues, except blood vessels, from the image. Often, the contrast agent gadolinium is injected into a vein to rejuvenate the edges of the blood vessels. The examiner carefully times the scan so that images are taken when gadolinium is concentrated in the blood vessels being evaluated.

Magnetic resonance angiography is used to evaluate blood vessels in the brain, heart, abdominal organs, arms and legs. It is being used to detect the following

- ✓ Aortic aneurysms
- ✓ Aortic dissection
- ✓ Narrowed arteries in the extremities
- ✓ Blood clots in the veins in the extremities and pelvis
- ✓ Blood flow to tumors
- ✓ Tumors that affect or infect blood vessels

➢ **Magnetic resonance venography**

This term refers specifically to magnetic resonance venography It is often used to detect blood clots in a vein that carries blood away from the brain (cerebral venous thrombosis), and to monitor the effect of treatment in this disorder.

➢ **Echo planar imaging**

This ultra-fast technology produces a series of images in seconds; It can be used to image the brain, heart and abdomen. Since surface ultrasonography is fast, movement by the person being examined does not distort the images much. This technology can also provide Information on how tissue works as well. But it requires special equipment, and is more likely to distort some structures than traditional MRI due to the nature of the technique.

➢ **Disadvantages of MRI**

The time required for an MRI is longer than that for a CT scan. MRI is also usually not immediately available compared to CT. Thus, CT may be better in emergency situations, such as serious injuries and stroke. An MRI is also more expensive than a CT scan. Other disadvantages include:

- ✓ Claustrophobia, and sometimes difficulty fitting into the MRI scanner, because the space is small and enclosed or confined.
- ✓ Effects of magnetic fields on metal devices implanted in the body.
- ✓ Reactions to the contrast agent (contrast agent).

➢ **Problems related to the small enclosed space**

The space in an MRI scanner is small and enclosed, making some people feel a bit like suffocation, even for people without anxiety Around confined spaces, some people are usually obese, so.

They have difficulty fitting into the scanner. Therefore, some MRI scanners called open MRI scanners have an open side and a larger internal space. And in this In cases, people may feel less trapped, and people with obesity may be suitable for this Devices. The images produced in open MRI scanners may be inferior to those produced by closed MRI scanners depending on the strength of the magnet, but can still be used to diagnose people who feel People who are anxious about the MRI may be given anti-anxiety medications, such as alprazolam or lorazepam, 15 to 30 minutes before the scan.

- **Magnetic field effects MRI**

is not usually used if people have

- Some materials such as splinters in specific parts of the body, especially in the eyes.
- Implanted devices that can be affected by strong magnetic fields.

These devices include some pacemakers and defibrillators Cardiac defibrillators, cochlear implants, and magnetic metal clips are used Treatment of aneurysms. The magnetic field used in MRI can cause the implanted device to move, overheat, or malfunction. The device is more vulnerable if it was implanted within 6 weeks because scar tissue, which can help keep the device in place, has not yet formed. These devices can also distort MRI images also.

But some devices, such as common dental implants, artificial hips, or spinal rods, are not affected by MRI. Before having an MRI, people who have any implanted devices should tell their doctor, who can determine whether the imaging is safe.

- **MRI results**

After the examination is performed, the patient is given pictures of the area that was examined, in addition to a report explaining the details of the condition, and it is presented to the treating physician to determine the appropriate treatment for the condition. In the end, we have provided you with all the information you may need to know about MRI.

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