Understanding Cancer

A SERIES OF SIMPLE EDUCATIONAL VIDEOS FOR THE GENERAL PUBLIC

By Dr Hafsa Waseela Abbas

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Part 10: Diagnosis - MRI scan

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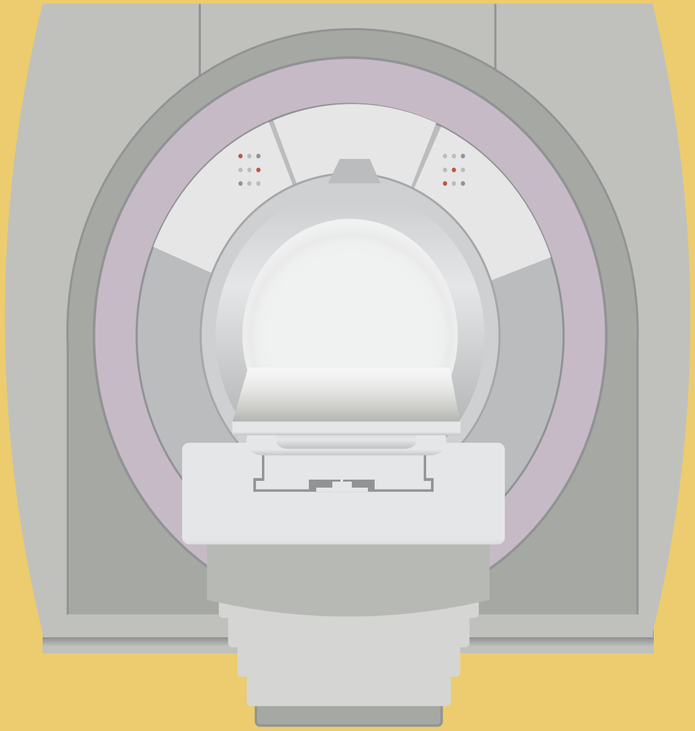
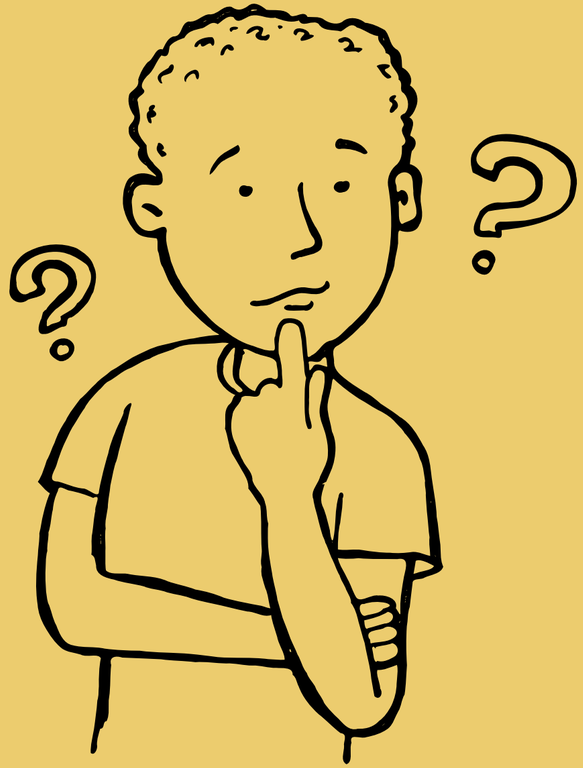
What is an MRI scan?



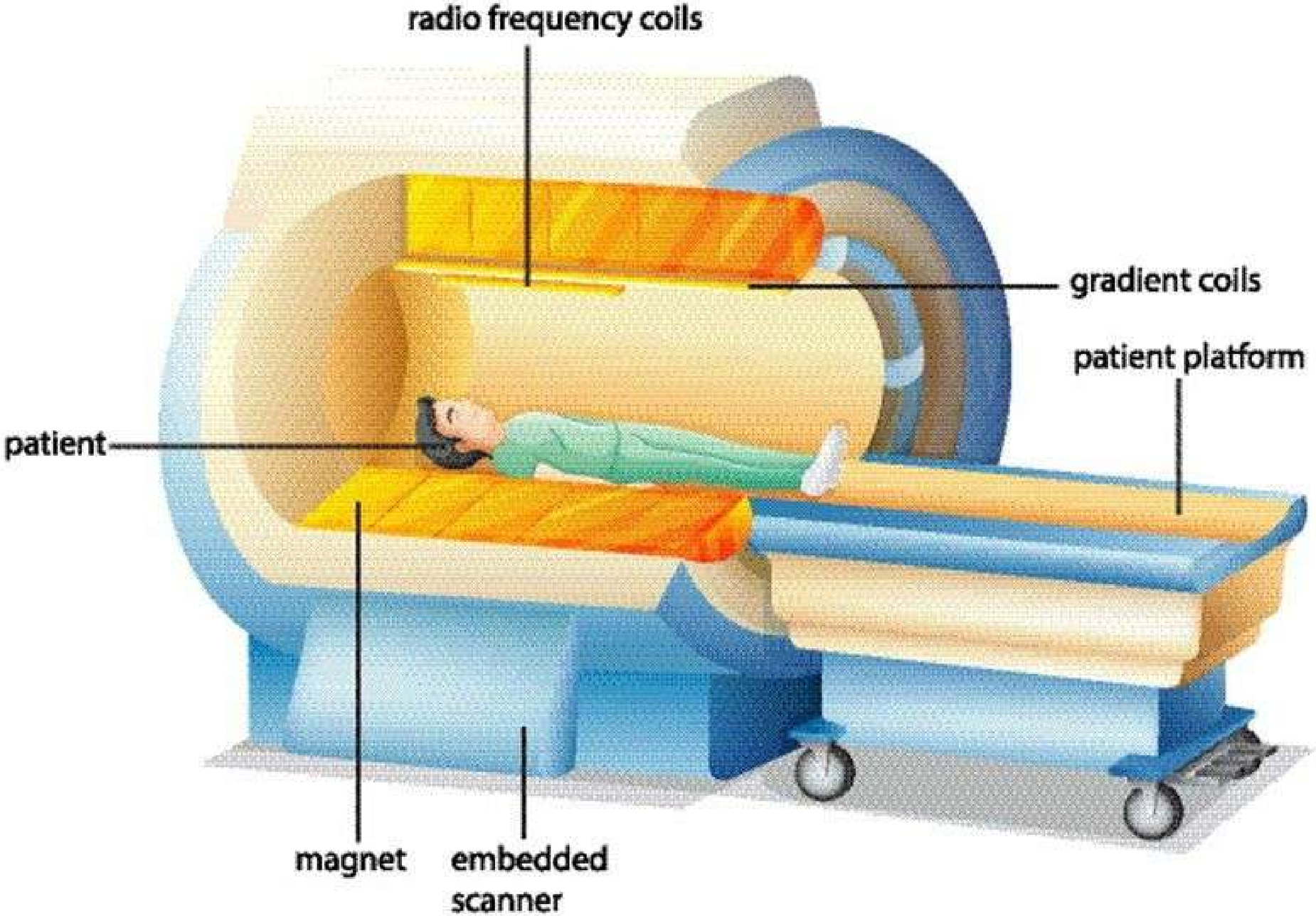


What is an MRI scan?

Magnetic Resonance Imaging

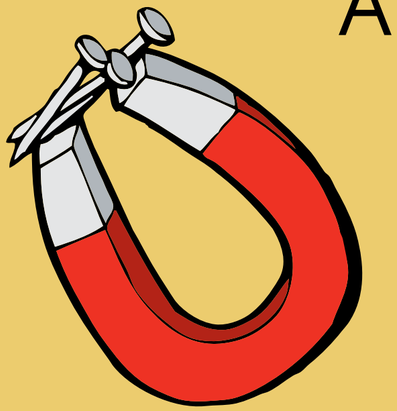
It is a type of scan that produces 3D images of inside the body using STRONG MAGNETS and RADIOWAVES to find out if a patient has the disease and to monitor treatment.

Magnetic Resonance Imaging Machine



MRI scans do not use X-rays.

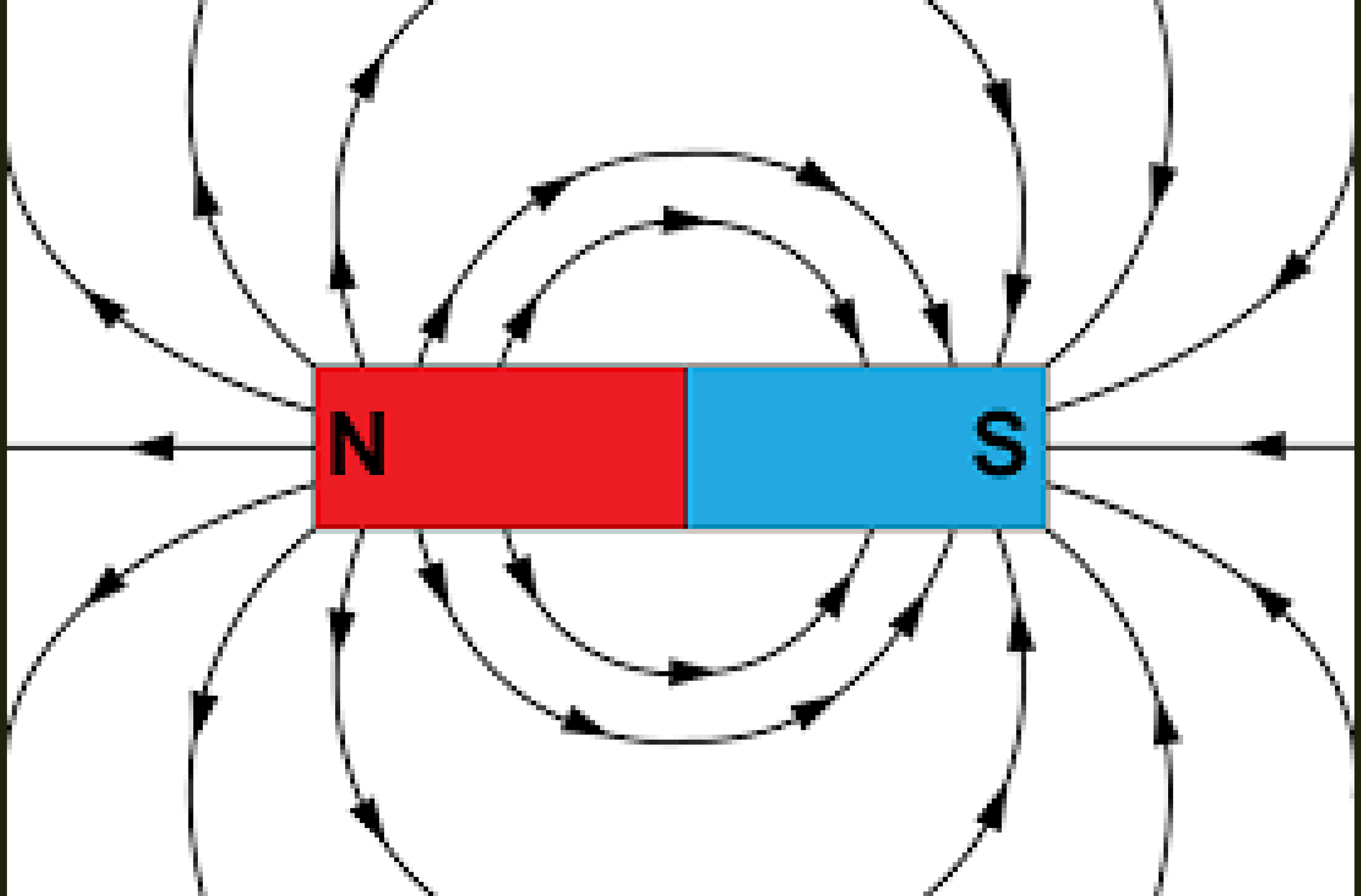
What is a magnet?



A magnet is an object that has a magnetic field.

A magnetic field is how electrically charged particles move in a circular path.

You cannot see it but it can pull on other materials such as iron.


N
S

Who discovered the MRI scan?

Dr Raymond Damadian is a doctor and scientist.

He and a few graduate students made a superconducting magnet and a coil of wires. Many would not volunteer to try it. Dr Damadian tried and it did not work.

Who discovered the MRI scan?

In 1977, the first MRI exam was done. It took almost 5 hours to produce one image.

The machine was called Indomitable and is now owned by the Smithsonian Institution.

It is the best form of scan to see inside the body with cutting it open.

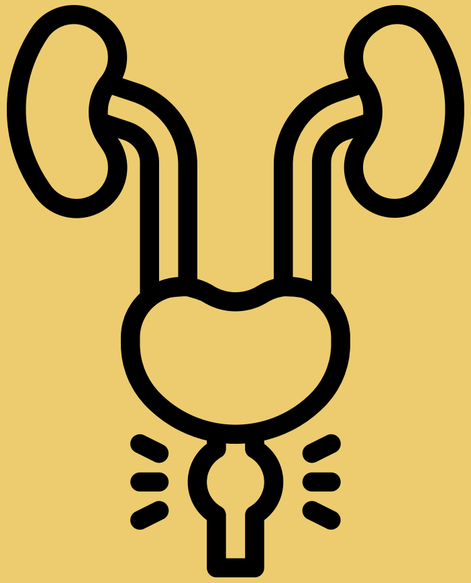
Impact of discovery of scans.

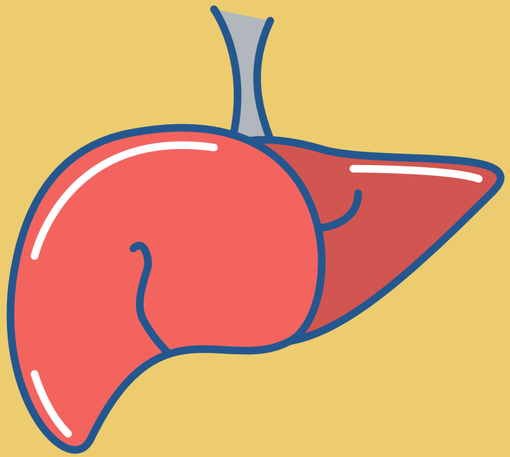
Professor Wilhelm Roentgen discovered X-rays in 1895 accidentally whilst testing whether cathode rays could pass through glass.

The impact of discovering scans such as X-rays and MRI and others have led to development in detecting disease.

What is MRI scans used for?

To view most parts of the body especially soft tissues that are non-bony e.g. brain, muscles, prostate, liver, ligaments and tendons.

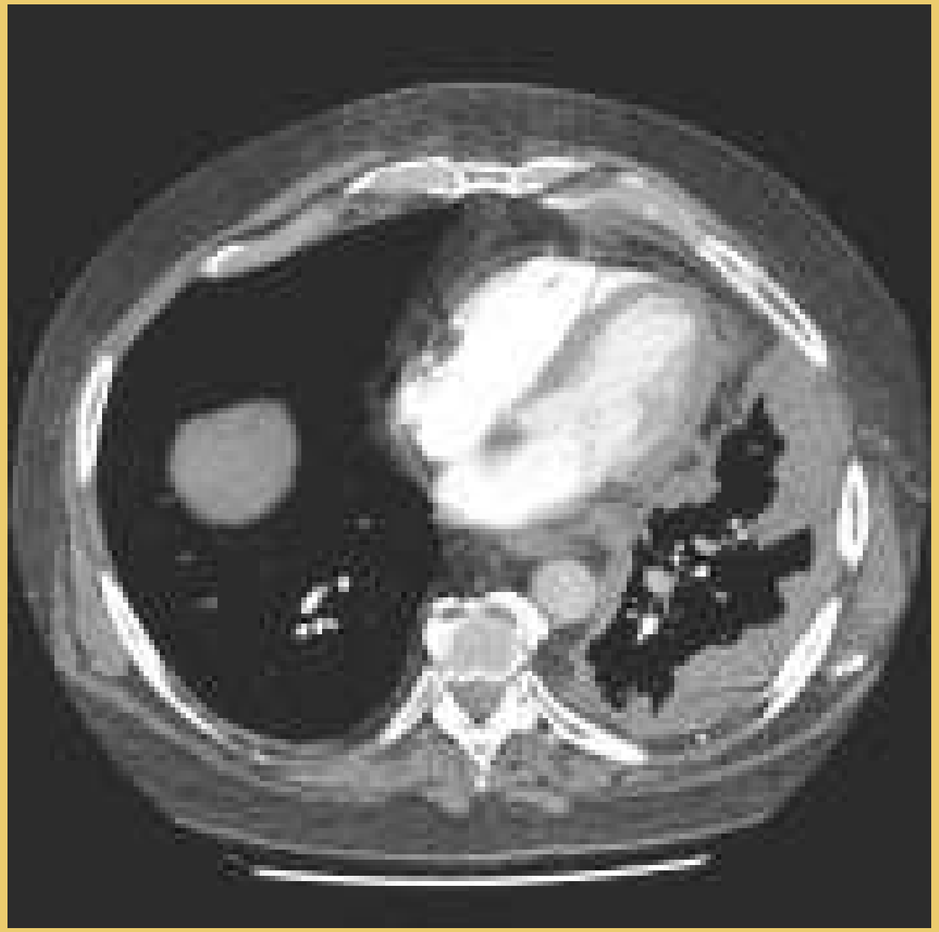




It can help detect tumours.

Mesothelioma

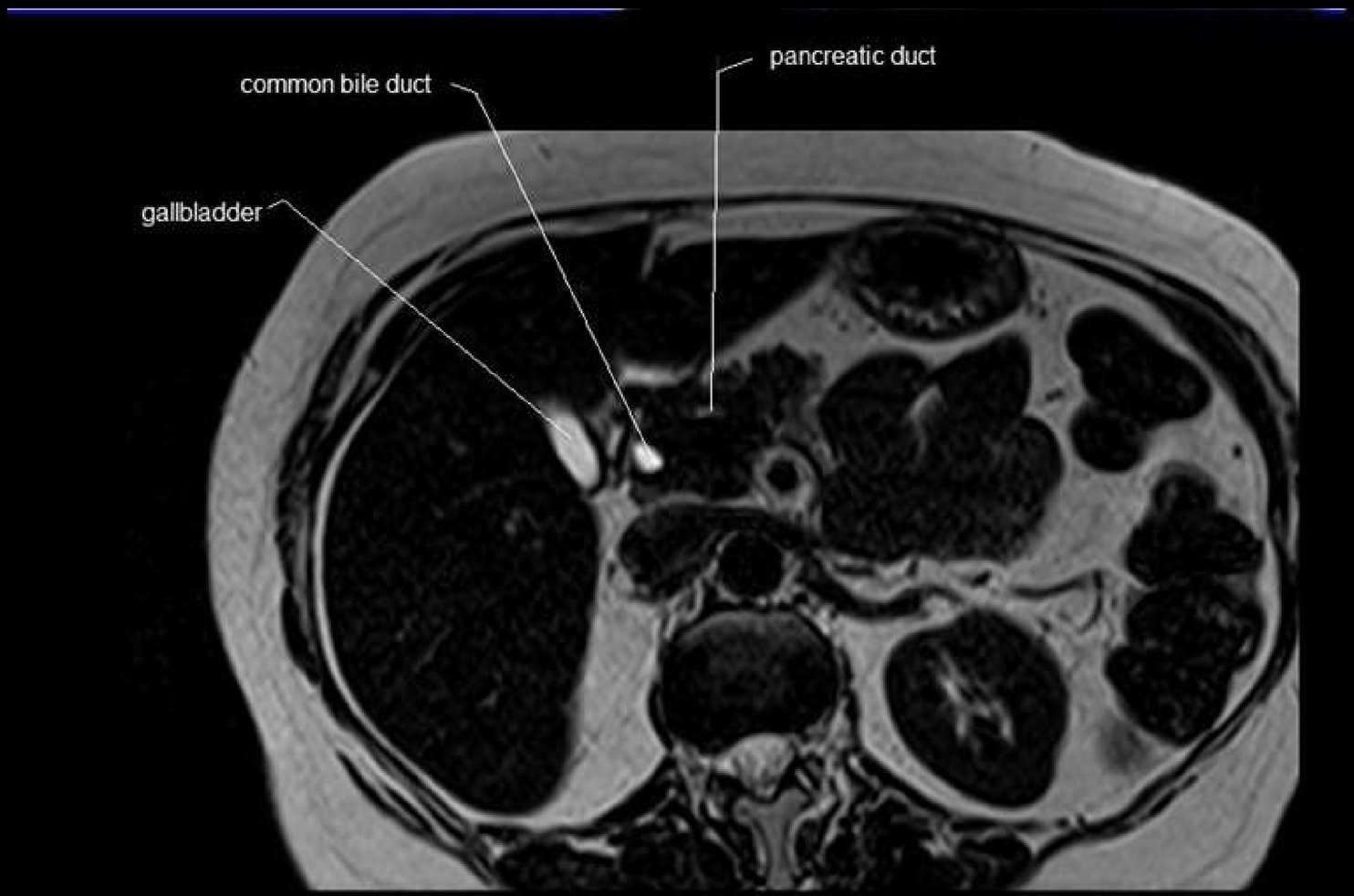
Detect tissue planes.



Source: Radiopaedia

Biliary duct and gall bladder cancer

How far has the cancer spread or invaded other cells and tissue? Has it affected the lymph nodes and vascular structures?



Liver cancer

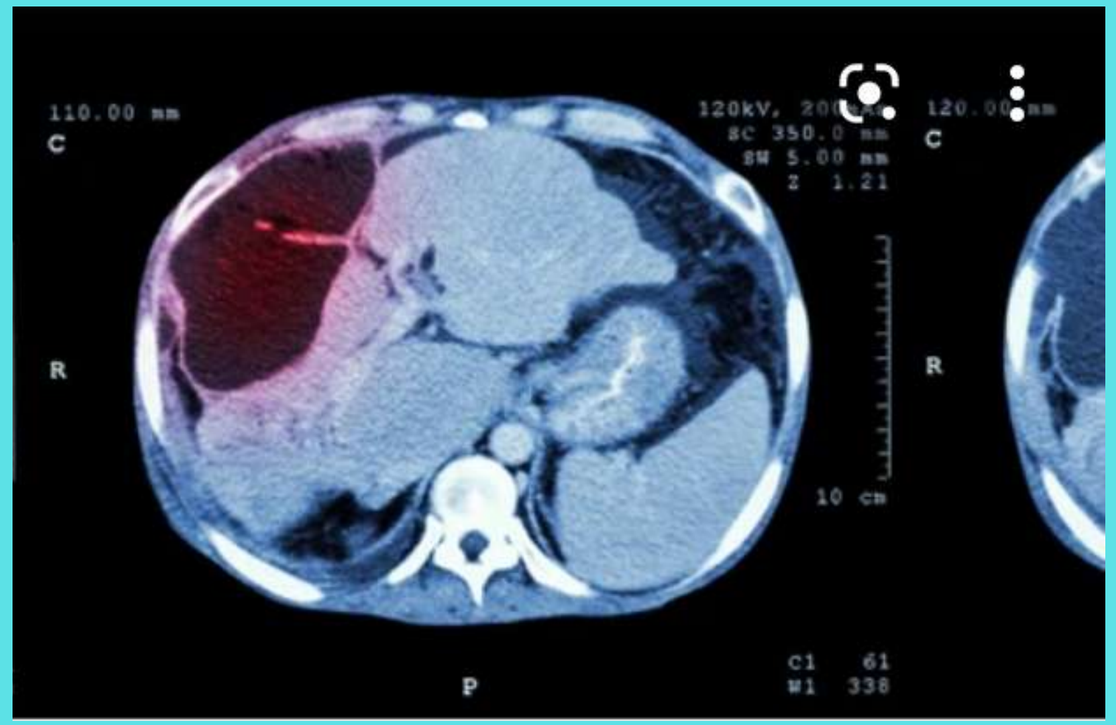
Size?

Shape?

Number?

Location?

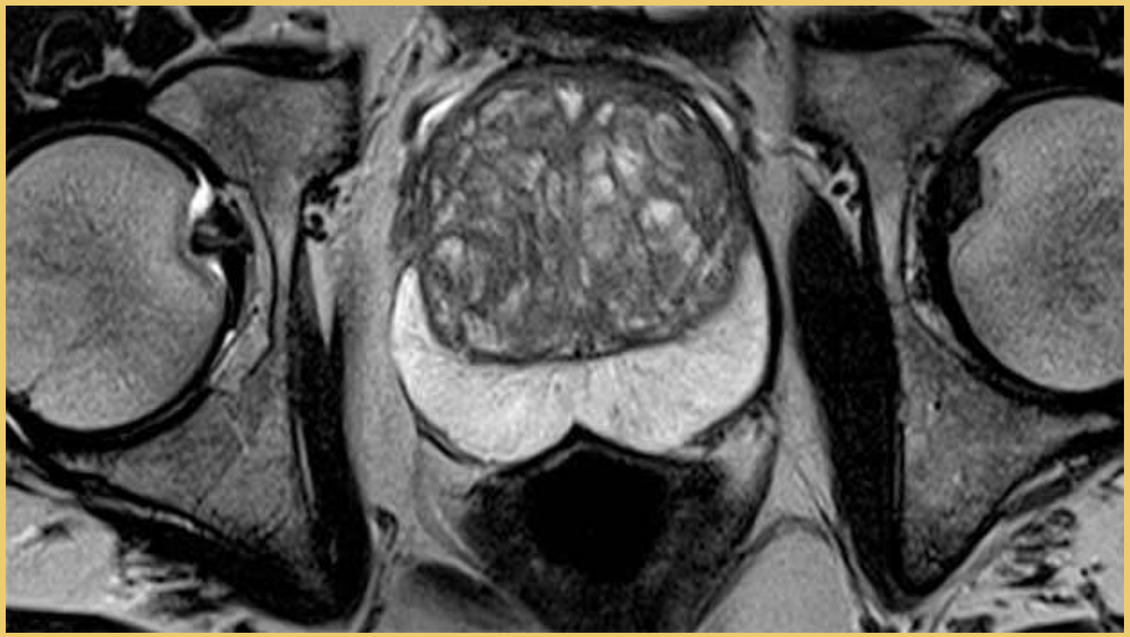
Has it affected the portal vein and vascular structures?



Source: Shutterstock

Prostate cancer

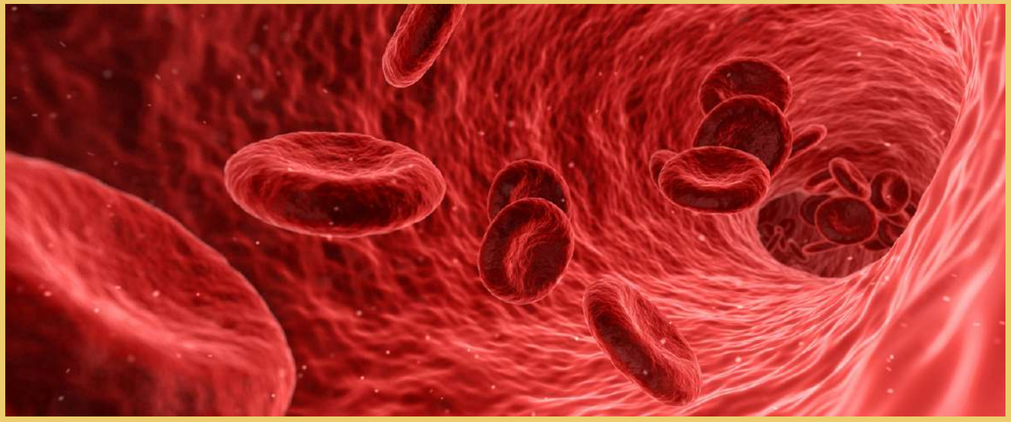
MRI of the prostate and pelvis is an accurate way to see how far the tumour has spread or extended before patients have radiotherapy or surgery.



Source: Cancer Research UK

Functional MRI

This is a special type of MRI that helps to look at structures of the brain for activity (take in more oxygen).



Magnetic Resonance Angiography

This creates images of flowing blood, and blood vessels (arteries and veins) in the body.

How does the MRI scan work?

Our body contains 70% of water.

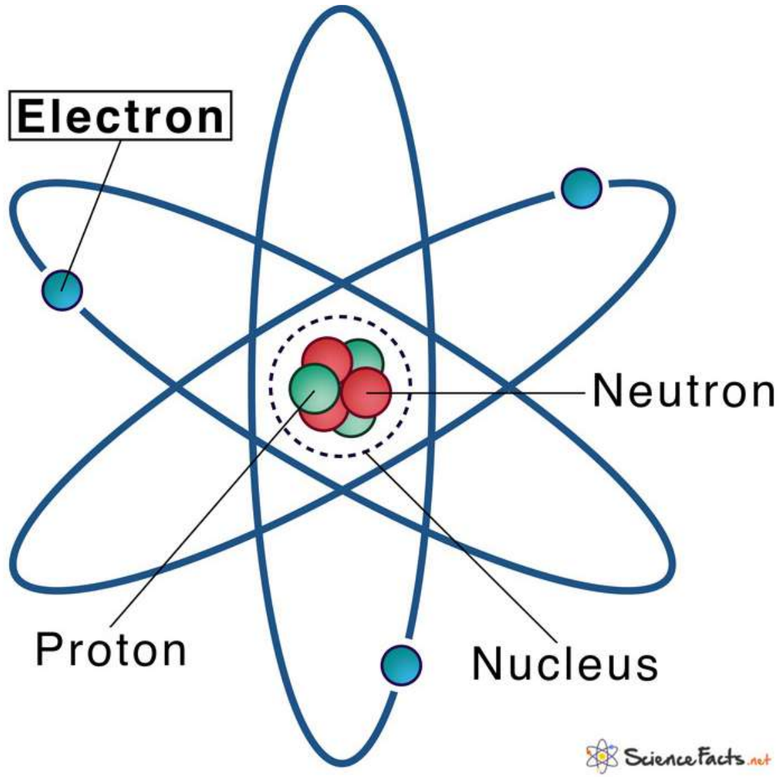
Water is made of oxygen and hydrogen atoms.

How does the MRI scan work?

In the atom, there is a particle called a proton.

It has a positive charge.

Protons are like sensitive little magnets.



How does the MRI scan work?

When laying down in the MRI scanner, the protons line up in the same direction and way.

How does the MRI scan work?

Short radiowaves are sent to certain areas of the body causing the protons to step out of the line format.

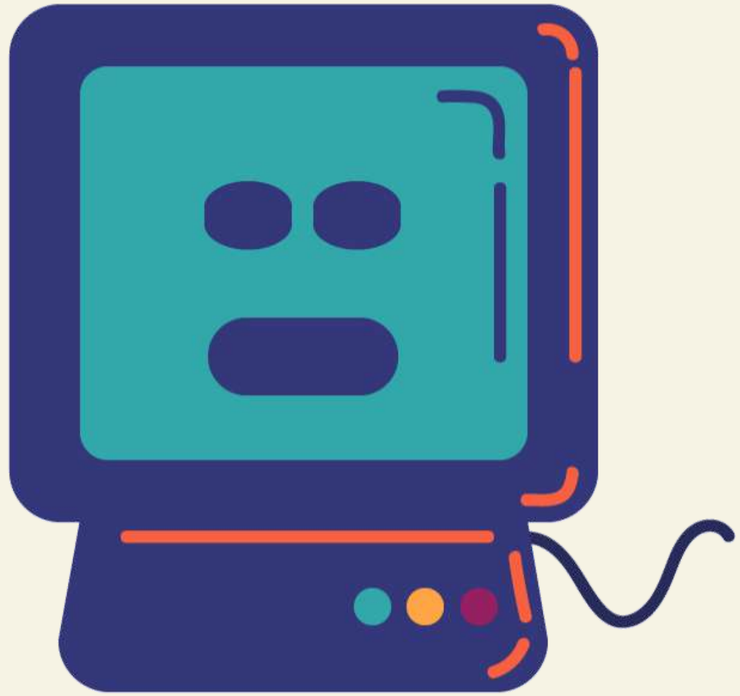
How does the MRI scan work?

The radiowaves are then turned off. The protons form a line again.

The MRI sensors are able to detect the energy released when this happens.

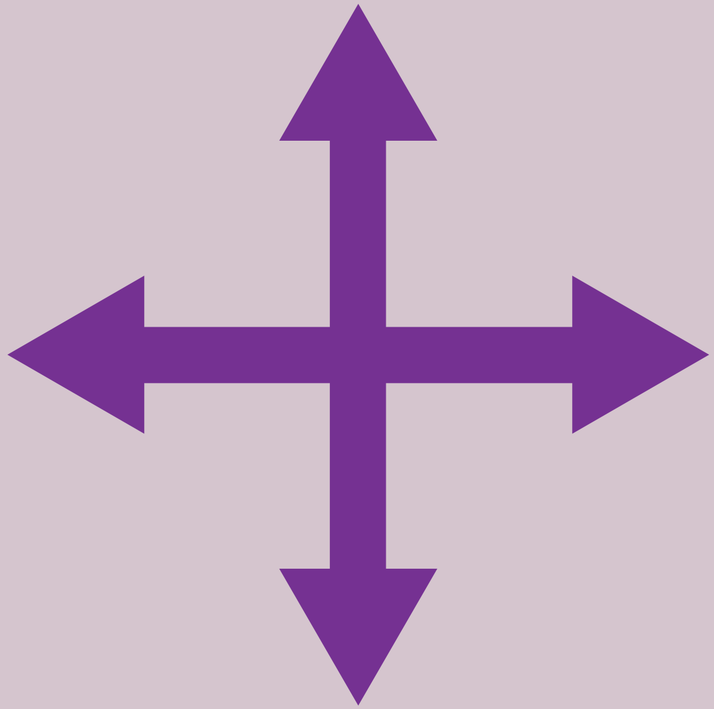
How does the MRI scan work?

This sends out signals or indicator on the location of protons in the body and is picked up by the reciever.



How does the MRI scan work?

Different tissues reform the line of protons at DIFFERENT speed and energy so signals are specific for different tissues.



How does the MRI scan work?

The signals form a detailed image.

How does the MRI scan work?

Contrast agents *E.g. Gadolinium*

It is given before or during MRI scan to increase the speed of protons reforming a line with the magnetic field.

The FASTER this step occurs, the BRIGHTER the image.

How does the MRI scan work?

Contrast agents

This helps see tissues and blood vessels more clearly.

How does the MRI scan work?

Contrast agents

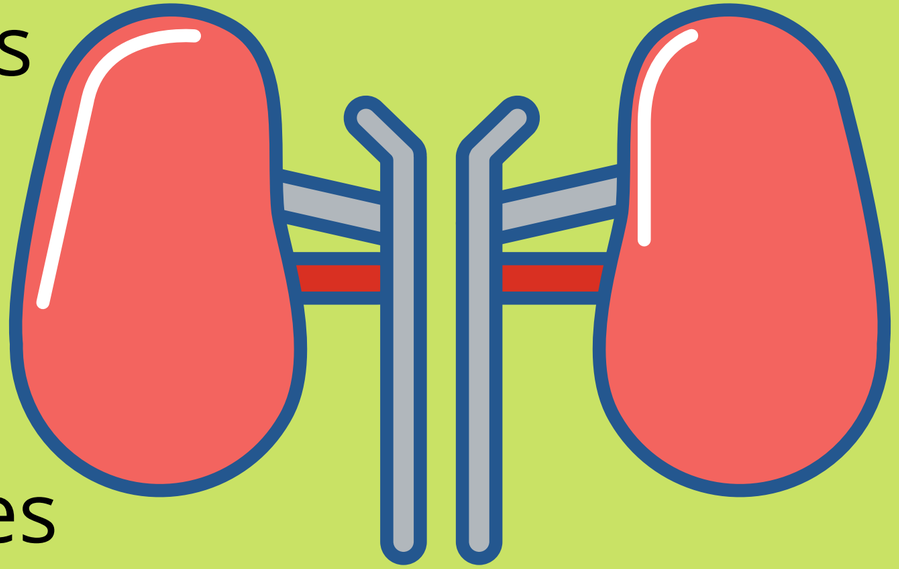
It can cause mild side effects but do not last long:

- Feeling sick
- Headache
- Dizzy
- Skin rash.

How does the MRI scan work?

Contrast agents

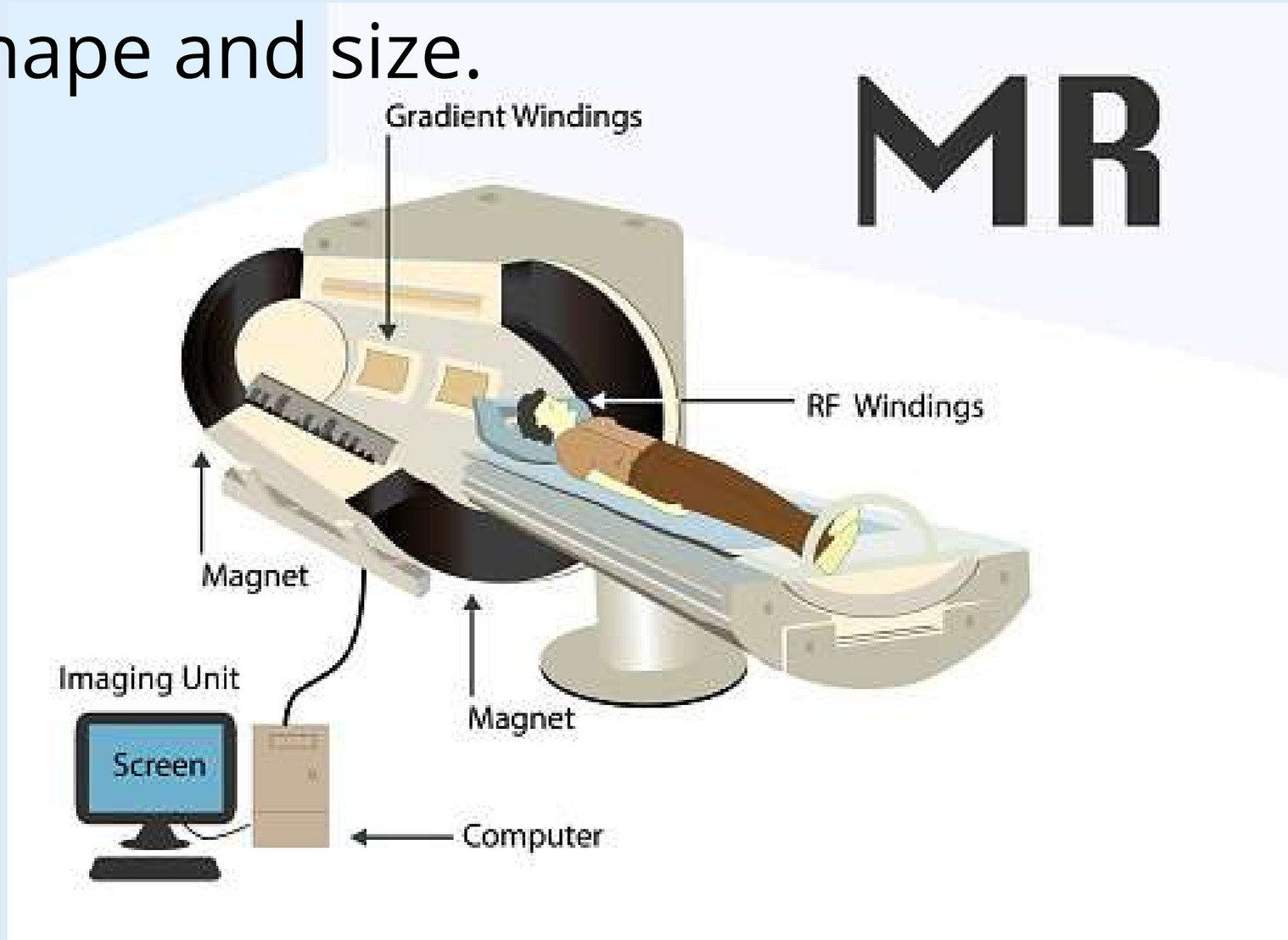
Patients with kidney disease need to have a blood test to see how well their kidneys are working and whether its safe to do the scan.



Contrast dye can cause damage to tissues in patients with kidney disease.

What is inside the MRI scanner?

MRI scanners vary in shape and size.



What is inside the MRI scanner?

Types of magnets

SUPERCONDUCTING MAGNET

It has many coils or circular wires where electricity passes through.

To maintain energy, they are bathed in liquid helium at 269.1 below zero degrees Celsius.

What is inside the MRI scanner?

Types of magnets

THE BORE

It is a horizontal tube where the patient is moved front to back with the magnet.

What is inside the MRI scanner?

Types of magnets

RESISTIVE MAGNETS

They look similar to superconducting magnets but have no liquid helium.

They require alot of electricity to pass through.

What is inside the MRI scanner?

Types of magnets

PERMANENT MAGNETS

They are heavy magnets with a continuous magnetic field.

What is inside the MRI scanner?

Types of magnets

GRADIENT MAGNETS

There are three sets of gradient coils, one for each direction to deliberate changes in the magnetic field.

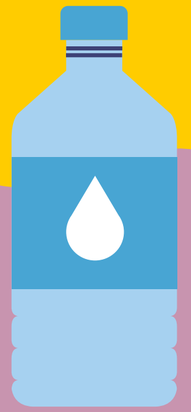
How is the strength of the magnet measured?

1 tesla --> 10,000 gauss

The magnets in MRI systems create a magnetic field of 0.5 to 2 tesla.

This is STRONG as the Earth's magnetic field measures 0.5 gauss!

The process



Preparation of the MRI

The patient can eat, drink and take their medications as normal, unless informed another instruction depending on the scanned area e.g.

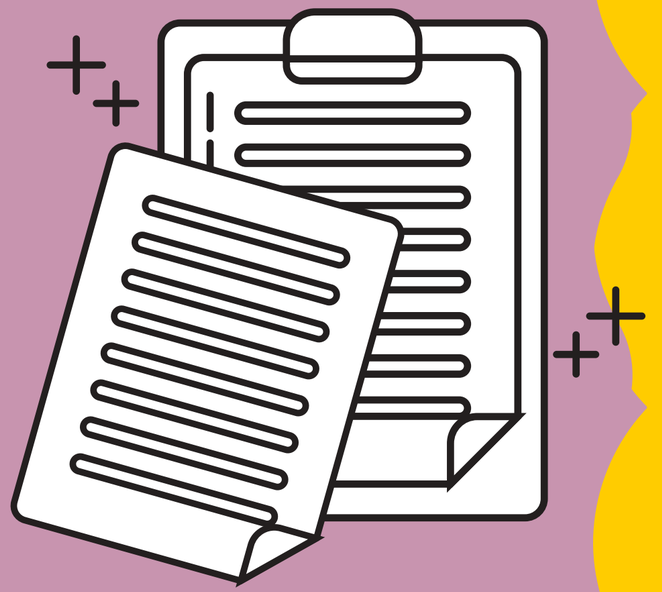
Not to eat or drink for 4 hours before scan.

Drink lots of water.

The process

Preparation of the MRI

A radiographer who is trained in carrying imaging procedures will ask to complete a questionnaire.

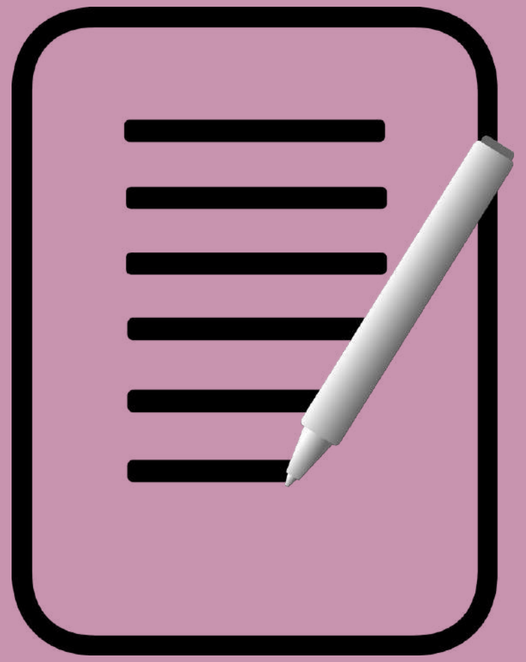


This is a series of questions about the patient's health and medical history.

This helps to ensure the scan runs safely.

The process

Preparation of the MRI



The patient will then be asked to sign a consent form so the scan can take place.

The process

Preparation of the MRI

Removal of any metal objects takes place to not interfere with the magnets: e.g.

- Jewellery and piercing.
- Dentures (false teeth)
- Wigs
- Hearing aid

The process

Preparation of the MRI

The patient may be asked to wear a hospital gown or clothes that has no metal objects e.g.:

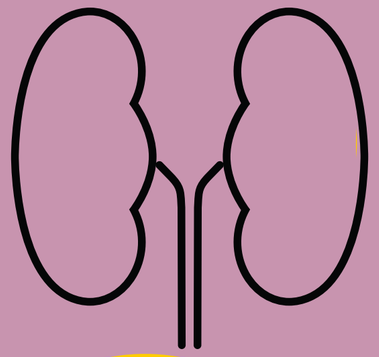
- Buttons
- belts
- wired bras
- Zips

The process

Preparation of the MRI

What do you need to inform the radiographer?

Do you have kidney disease (contrast dye may affect)?
Do you have allergies with anaesthesia?
Do you have blood clotting issues?



The process

Preparation of the MRI

Anaesthesia and Sedatives

It is given to kill pain but it is not normally needed. This must be arranged before the appointment.

If the patient is worried or claustrophobic, it can help keep them relaxed.

The process

Preparation of the MRI

Anaesthesia and Sedatives

If sedation is given, a relative or friend must drive the patient home and the patient cannot drive for another 24 hours nor use machinery.

The process

Preparation of the MRI

Anaesthesia and Sedatives

Babies and young children are given a general anaesthetic to help them stay still.

The process

What happens during the MRI?

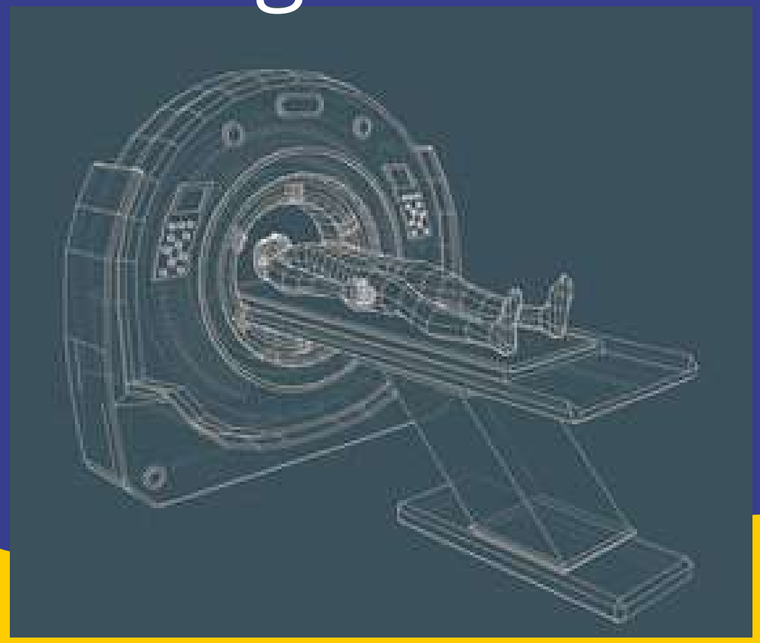
The patient will lie flat on a bed before moved into the cylinder-shaped scanner.

Depending on what is being examined, it may be head first or feet first and the patient must br kept still.

The process

What happens during the MRI?

A frame is sometimes added over the head or chest to pick up signals and give better quality images.



The process

What happens during the MRI?

The radiographer can see the patient via a TV monitor and controls the scanner using a computer in another room to not be affected by the magnetic field.

The process

What happens during the MRI?

The radiographer may ask to hold the breath during short scans.

The process

What happens during the MRI?

A relative can stay with the patient whilst having the scan but must prepare themselves by not having any metal objects and must inform the radiographer beforehand if they have a pacemaker.

The process

What happens during the MRI?

Loud tapping noise is heard and is caused by the electric current in the coils being turned on and off.

Headphone are given to wear.

The process

What happens during the MRI?

A single MRI scan takes a few seconds to a few minutes.

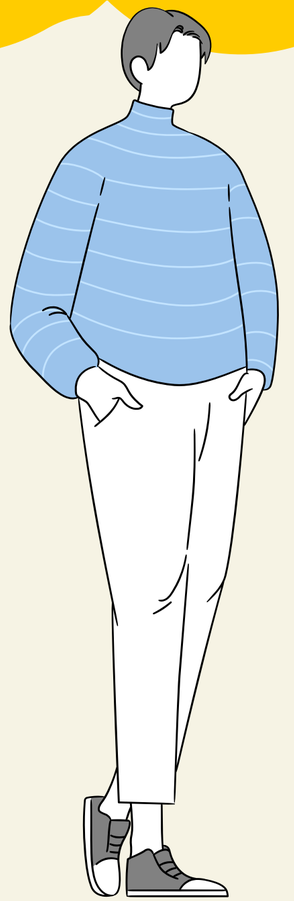
The scan lasts 15 to 90 minutes depending on the area and number of images.

The process

After the scan

Once the scan is done, the patient is moved outside the scanner.

The patient can resume as normal.



The process

After the scan

However, if sedated, a relative or friend must drive the patient home and the patient cannot drive nor use machinery for a further 24 hours.

The process

After the scan

The MRI scan will be examined and reported by a doctor called a radiologist.

New developments

OPEN SCANNERS

They are open on the sides for greater space.
They provide high quality images.

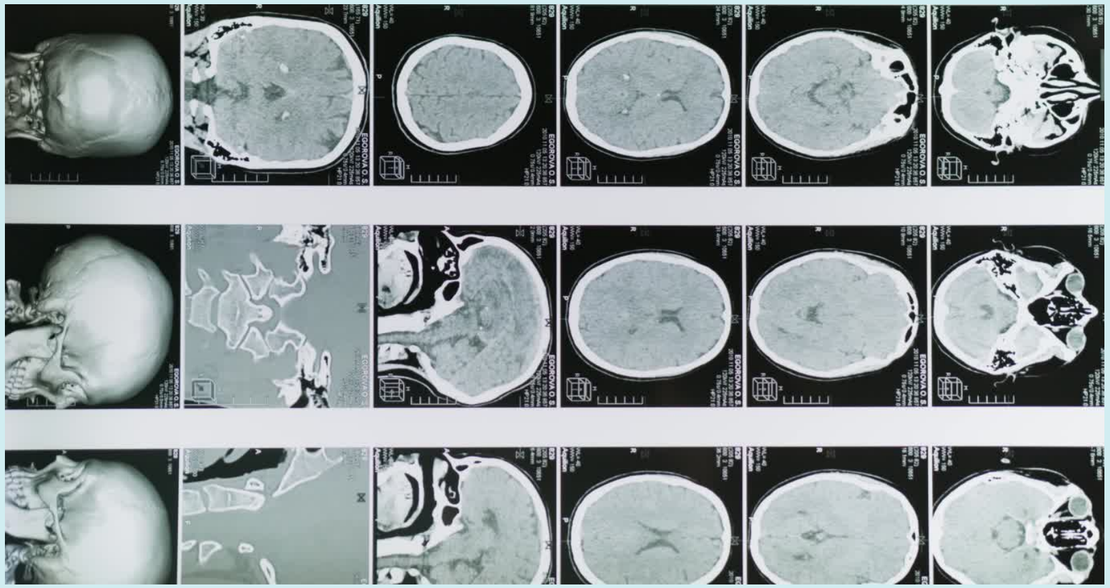
However, they have weaker magnetic fields so can easily miss an abnormal tissue.

Source: Birmingham Fibroid Clinic

New developments

SMALL SCANNERS

They are useful for imaging specific areas.

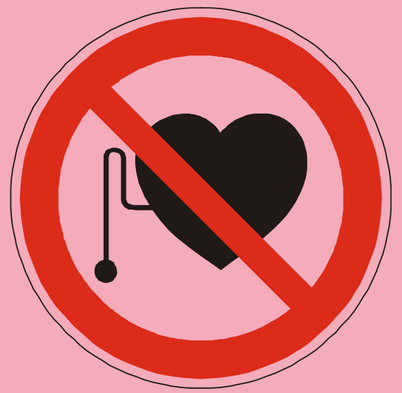


Precautions

- Some patients are claustrophobic or worried despite its a painless process. This can be solved by being familiar with the MRI scanner, sedation and anaesthesia.

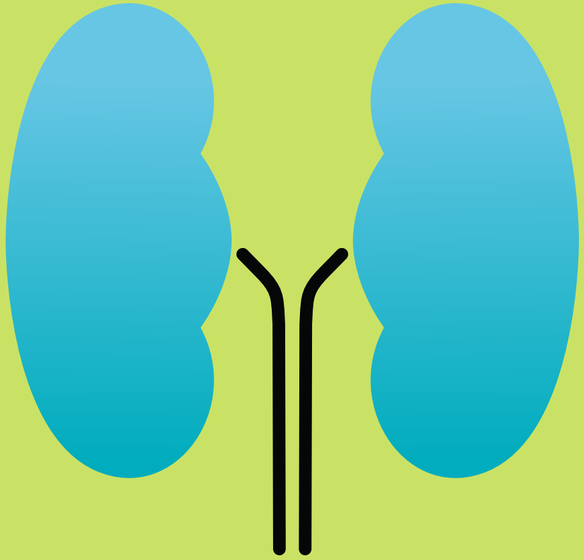
Precautions

- There is no risk of using MRI and is safe but for patients with a pace maker or another metal implant or is pregnant especially the first trimester, MRI is not advised.



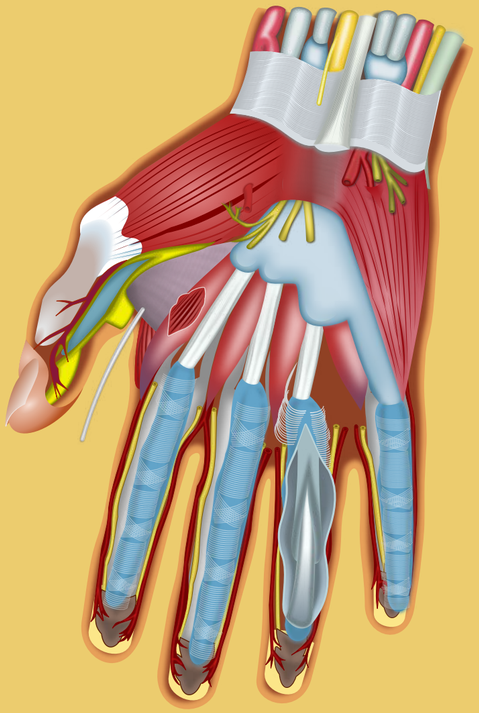
Precautions

- Contrast dye due to link in causing tissue damage in patients with kidney disease.



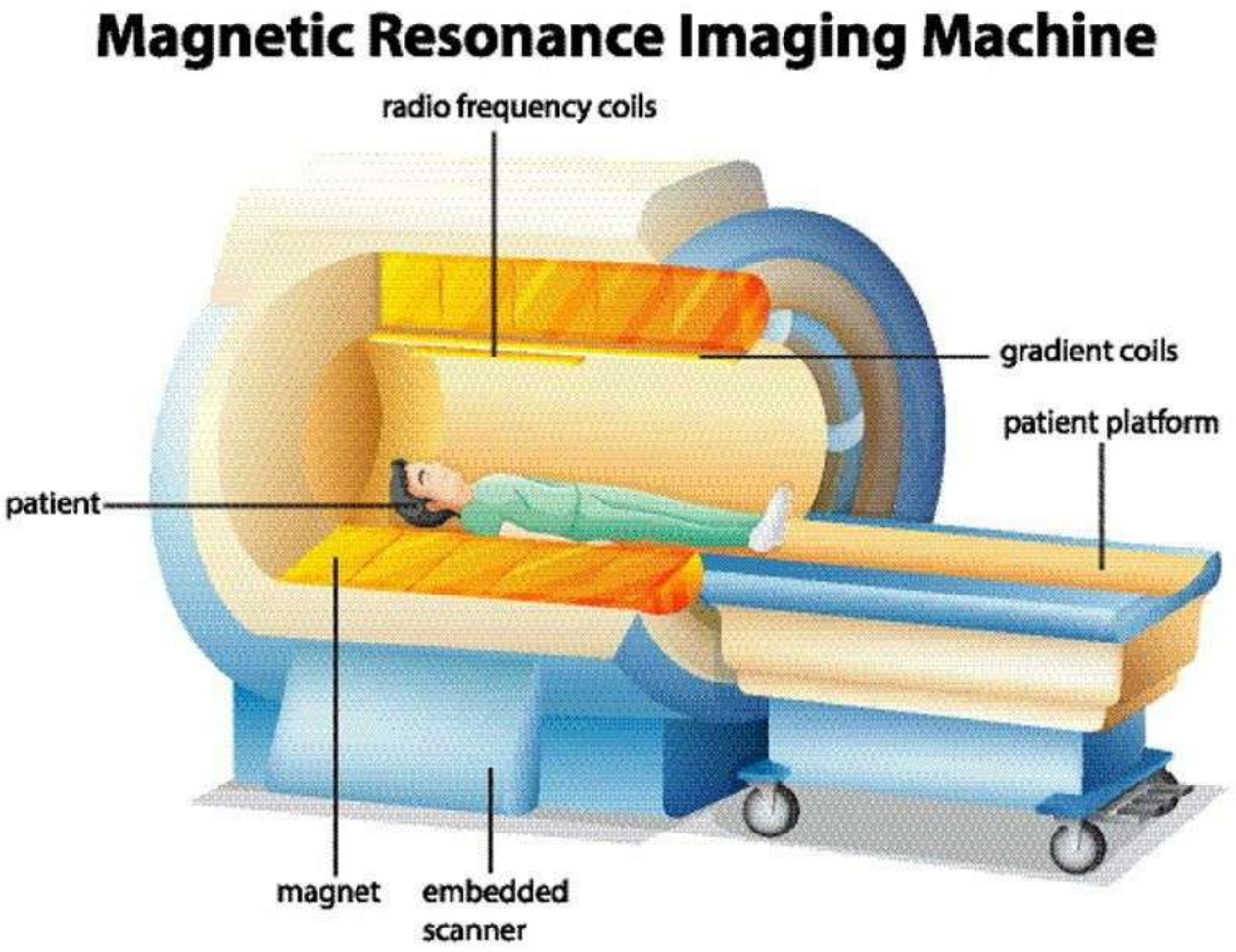
Precautions

- It can cause twitching in the nerves due to the magnetic field.



Overall, MRI scans are painless procedures that create 3D detailed images to help detect disease and monitor treatment.

The benefits outweigh the risks of the procedure.



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Part 11: Diagnosis - CT scan

UPCOMING VIDEO RELEASING SOON!

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Acknowledgements

Oxford Handbook of Oncology
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