

# Scans: X-ray, CT, PET and MRI

This page is about scans, tests that take detailed pictures of the inside of your body. The results give doctors information about your lymphoma and help them decide how best to treat you. We have separate information on ultrasound scans.

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# Overview of scans

## What is a scan?

Scans give detailed pictures of the organs and lymph nodes (glands) in your body. There are different types of scan that work in different ways.

## What are scans used for?

Depending on the type of scan, the results may help your doctors to:

- diagnose lymphoma
- tell the **type** and **stage** (extent) of the lymphoma
- plan your **treatment**
- see how well you have responded to treatment.

## Why are there different types of scans?

Some scans are better than others at checking different parts of the body. Don't worry if you have different scans from other people you meet at the hospital – your doctors choose the most appropriate investigations for you based on your individual situation.

## What is a contrast agent?

You might be given a contrast agent before your scan. This is a type of dye. It helps to show internal structures (blood vessels, organs and tissues) clearly.

Depending on the part of your body being scanned, you have a contrast agent either as:

- a drink
- an injection into a vein in your arm.

If you have a contrast agent, there is a small risk that you could have an **allergic reaction**. Hospital staff are well-trained in dealing with this.

## Are scans safe?

Scans are generally considered to be safe, although some scans do use **radiation**. Doctors weigh the risks of any scan against the benefits.

Ionising radiation can be harmful to DNA (genetic material in our cells). It is thought that it could very slightly increase your risk of developing cancer in the future. However, the amount of radiation you are exposed to during a scan is carefully controlled to keep it as low as possible. This minimises any risks. You can find more information about radiation from medical scans on the [GOV.UK website](#).

## Who carries out scans?

The scans on this page will be carried out by a **radiographer**, a specialist in using equipment to diagnose and treat people who are unwell.

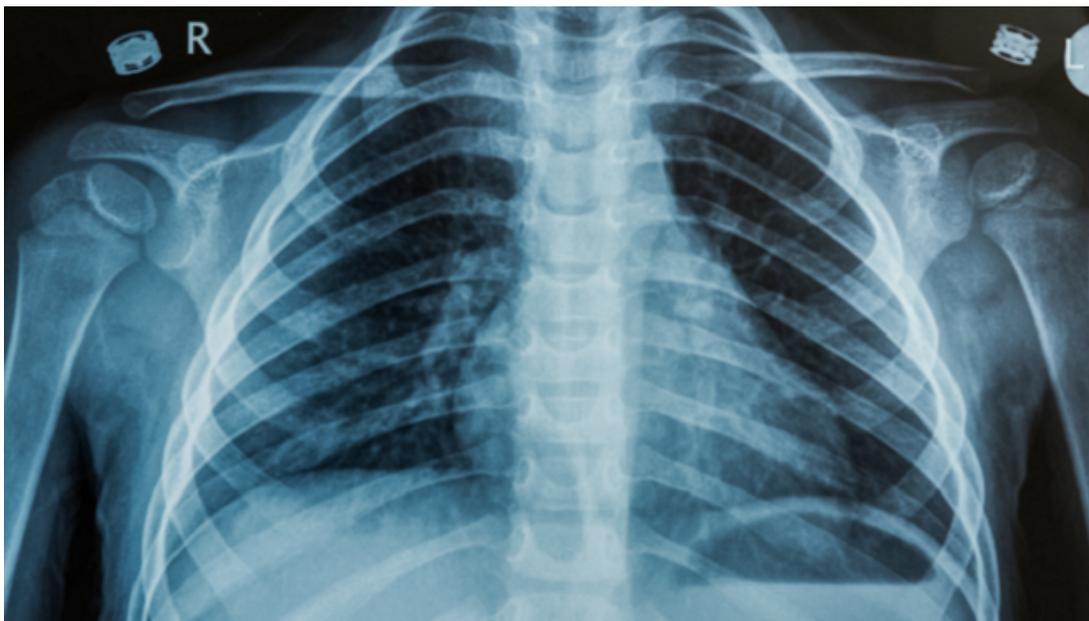
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## What is an X-ray scan?

An X-ray scan, usually just referred to as an X-ray, takes pictures of the inside of your body. X-ray scans use ionising (high-energy) radiation to make pictures from the front to the back of your body.

On the scan image:

- bone and **contrast agent** appears as white
- air (for example in the chest) appears as black
- muscle, fat and fluid appear in shades of grey.



**Figure: A chest X-Ray**

Lymphoma is sometimes first picked up on an X-ray, for example on:

- a chest X-ray done to find out why you are short of breath or have a cough
- an abdominal X-ray if you have pain in your tummy or a change of bowel habit such as diarrhoea.

If you have a **central line** to give you **chemotherapy**, you might have an X-ray to check the position of it.

You may have an X-ray later on, too, for example, to find out if any new symptoms are due to infection or **treatment side effects**.

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## What is the process for having an X-ray scan?

X-ray scans are usually done as an outpatient procedure, which means that you don't have to stay in hospital overnight. You should be able to have your X-ray at your local hospital.

X-ray scans take around 15 minutes for a simple ('plain') X-ray. The scan is not painful.

**Video courtesy of Newcastle upon Tyne Hospitals NHS Foundation Trust**

## How should I prepare?

You should be given information about how to prepare for the scan.

You can eat and drink as normal on the day of your scan. It is safe to continue taking any prescription medication on the day of your appointment.

You are then asked to take off any metal you are wearing (for example, jewellery, a belt, your watch, an underwired bra). If you wear glasses, you might be asked to remove them.

When you attend your appointment, staff in the scanning department ask if you are **pregnant or could be pregnant**.

## What happens during the procedure?

An X-ray machine looks like a tube and has a light bulb at one end. You may have the X-rays taken while you are standing, or while you are sitting or lying down on a couch. You are not closed in during the scan.

The radiographer checks that that you are in the right position. To do this, they might gently press on some parts of your body.

During the scan, the **radiographer** stands behind a screen.

You need to be very still while the pictures are taken. You might be asked to hold your breath for a few seconds during the scan to reduce movement and blurring of the images.

## What happens after the procedure?

You can go straight home after having an X-ray scan. There are no precautions you need to take afterwards.

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## What is a computed tomography (CT) scan?

A computed tomography (CT) scan uses a type of **X-ray**. The scan shows detailed cross-sectional images of the inside of your body. It also shows up areas of disease (such as swollen **lymph nodes**) more clearly than plain X-rays do.

A CT scan takes a number of narrow X-rays, like 'slices' through the body. The images are analysed by a computer and put back together to form a very detailed 3D (three-dimensional) picture of your organs.



**Figure Left: Enlarged lymph nodes (swollen glands) in armpits and abdomen (tummy) on a CT scan at diagnosis**

**Figure Right: Subsequent good quality response to treatment**

CT scans are used to look at the head and neck, spine, chest, abdomen (stomach) and pelvis. They are used:

- to diagnose and **stage** lymphoma
  - to perform CT guided **biopsy** – for example in the abdomen or chest, if needed
  - as part of **radiotherapy planning**
  - to check your response to treatment by comparing scans taken before, during and at the end of a course of **treatment**.
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# What is the process for having a CT scan?

CT scans are usually done as an outpatient procedure, which means that you don't have to stay in hospital overnight. You should be able to have your CT scan at your local hospital.

CT scans take around 45 minutes and are not painful. Due to this length of time, you may be asked to empty your bladder beforehand.

**If you feel anxious about any aspect of having a scan**, speak to your medical team.

## How should I prepare?

You should be given information about how to prepare for the scan.

You might be told not to eat for a couple of hours before your scan.

It is generally safe to continue taking any prescription medication on the day of your appointment. However, you may not be able to take certain types of medication for diabetes on the day. You will be given advice by the CT scanning department about when to take your tablets or insulin.

When you attend your appointment, staff in the scanning department ask if you are **pregnant or could be pregnant**.

You will also be asked if you have asthma or diabetes. If you do, the hospital will carry out a thorough assessment. They will then decide on a course of action that is appropriate to your situation.

Before your scan, you may also be given a **contrast agent** (dye). However, you will first be asked if you have ever had an allergic reaction to a contrast agent.

You are then asked to take off any metal you are wearing (for example, jewellery, a belt, your watch, an underwired bra). If you wear glasses, you might be asked to remove them.

## What happens during the procedure?

The CT scanner is a large cylinder with a couch in the middle of it – it looks a bit like a doughnut. Usually, you lie on your back on the couch, which moves you slowly into the scanner.

You need to lie very still while the scan pictures are taken. You might be asked to hold your breath for approximately 6 seconds during the scan. This reduces your movement and therefore blurring of the scan images.

You are alone in the scanning room during the scan itself. Staff can see you all the time through a glass window and a video camera, and they can talk to you. You can alert them if you feel unwell or distressed – you can ask for help or raise a hand.

Some people worry about feeling claustrophobic (closed in). However, the scanning machine does not surround your whole body at any one time and the scan is also quick (taking under than around 30 seconds), so most people find it OK. **If you feel anxious about having your scan**, speak to a member of hospital staff.

**Video courtesy of Newcastle upon Tyne Hospitals NHS Foundation Trust**

## What happens after the procedure?

You can usually go straight home after your scan.

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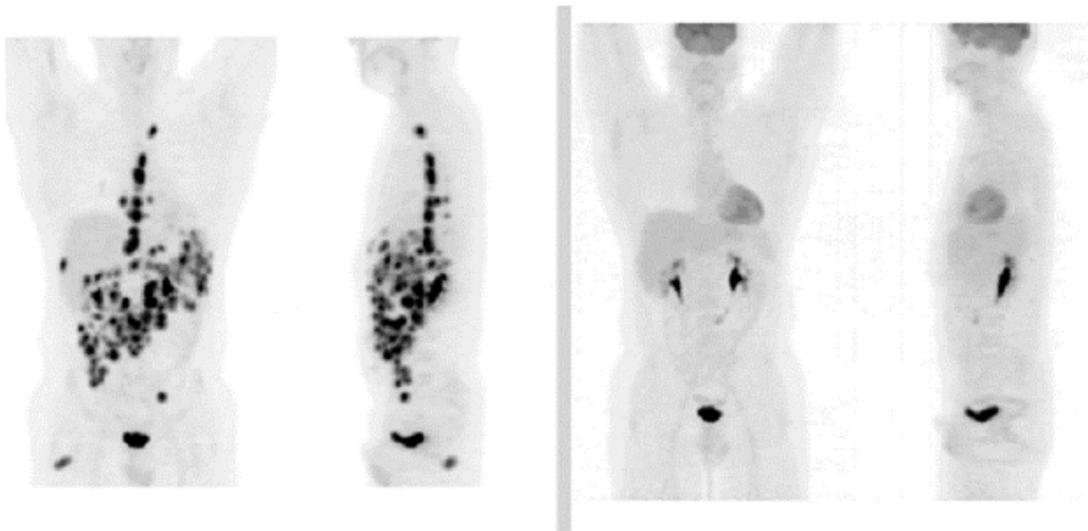
## What is a positron-emission tomography (PET) scan?

PET scans, like **CT scans**, can help doctors work out which parts of your body are involved by lymphoma and which are not.

A positron-emission tomography (PET) scan uses a radiotracer or 'tracer' (radioactive form of sugar) to show up the most active cells in your body. In some types of lymphoma, the cells are very active so show up clearly on a PET scan.

The radiotracer that is usually used is fluoro-deoxy-glucose (FDG). You are given this by injection into a vein before you have the scan. The FDG travels to the cells in the body that use glucose (a sugar) for energy. Cancerous (including lymphoma) cells use up a lot of energy and so need a lot of glucose. The radiotracer is taken up into these cancerous cells and becomes trapped there. These cells then show up as 'hot spots' on the scan.

You may have a CT scan at the same appointment. This is known as a PET/CT scan.



**Figure Left: Non-Hodgkin lymphoma stage IV. Figure Right: Complete response to treatment**

PET scans can be used:

- before treatment to **stage** the lymphoma
- after a few cycles of treatment, to help doctors plan further treatment
- after a course of treatment, to see how well you have responded to it
- to assess your lymphoma if your **medical team** are considering changing your treatment
- to find out if your lymphoma has **relapsed** (come back), if your **symptoms** have returned or new ones begun.

**Note:** if you need a PET scan after a course of **treatment**, you will usually not have one straightaway. There might still be some inflammation (swelling) where the lymphoma was, which could confuse the results. Radiologists usually recommend waiting:

- at least 3–4 weeks after the end of a course of **chemotherapy**.
- approximately 3 months after the end of a course of **radiotherapy**.

PET scans are most useful when the lymphoma cells are very active, which includes:

- **Hodgkin lymphoma**
  - high-grade **non-Hodgkin lymphomas** such as **diffuse large B-cell lymphoma, Burkitt lymphoma, lymphoblastic lymphoma**.
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# What is the process for having a PET scan?

Most of the time, a PET scan is done together with a CT scan. This is known as a PET/CT scan. Combining the images from both scans gives a much clearer picture of exactly which areas of your body are affected by the lymphoma.

PET scans are usually done as an outpatient procedure, which means that you don't have to stay in hospital overnight. Not all hospitals have a PET scanning machine so you might have to travel to a larger centre to have your scan. Otherwise, you may be able to have one at a mobile unit.

PET scans often take around 30–60 minutes. Due to this length of time, you may be asked to empty your bladder beforehand.

The scan is not painful, but you might find it uncomfortable to lie still for a long time. If you think you are likely to find this difficult, ask your doctor for advice about how to cope with the discomfort. You might need to take relief medication beforehand.

The PET scan itself takes less than an hour, but you are usually in the scanning department for around 2–3 hours in total.

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## How should I prepare?

You will be given information about how to prepare for the scan.

It is advisable to wear something that will keep you warm during the scan.

For around 4–6 hours before your scan, you can only drink plain water (although sometimes black coffee or tea is allowed – check with the hospital staff).

It is generally safe to continue taking any prescription medication on the day of your appointment. However, if you are on medication for diabetes, you cannot take medication for diabetes on the day. You will be given advice about when to take your tablets or insulin.

Do not take strenuous exercise in the 6 hours before the scan; this can cause your muscles to take up the glucose radiotracer and could confuse the results.

Before your appointment, let the hospital staff know if you are:

- **pregnant, or could be pregnant**
- **breastfeeding**
- diabetic and how your diabetes is being treated – you should be given advice about eating and about when to take your tablets or insulin before the scan.

Before your scan, you may be given a **contrast agent** (dye).

You are then asked to take off any metal you are wearing (for example jewellery, a belt, your watch, an underwired bra). If you wear glasses, you might be asked to remove them.

You then have your blood sugar levels checked, usually through a finger prick test. A cannula (small tube) is then put into a vein, typically in your arm. The cannula is used to give you the radiotracer injection.

You might be given a contrast agent as a drink.

After you have been given the radiotracer, you have to sit or lie down to relax for at least an hour before you have the scan. This gives enough time for the radiotracer to travel through your body. You may wish to take something to occupy you during this time, such as a book or some music.

Due to the length of time you may have to lie still for, you will usually be asked to empty your bladder before the scan.

## What happens during the procedure?

The PET scanner is a large cylinder with a couch in the middle of it – it looks a bit like a doughnut.

You are asked to keep as still as possible during the scan. Although the scan itself is not painful, you might be uncomfortable, especially if you have to keep your arms above your head.

You are alone in the scanning room during the scan. The hospital staff will be behind a glass screen and can also see you via video camera. You are able to speak to them and they can speak to you via a two-way speaker.

Some people worry about feeling claustrophobic (closed in). However, the scanning machine does not surround your whole body at any one time so most people find it OK. **If you feel anxious about having your scan**, speak to a member of hospital staff.

## What happens after the procedure?

You can usually go straight home after your scan.

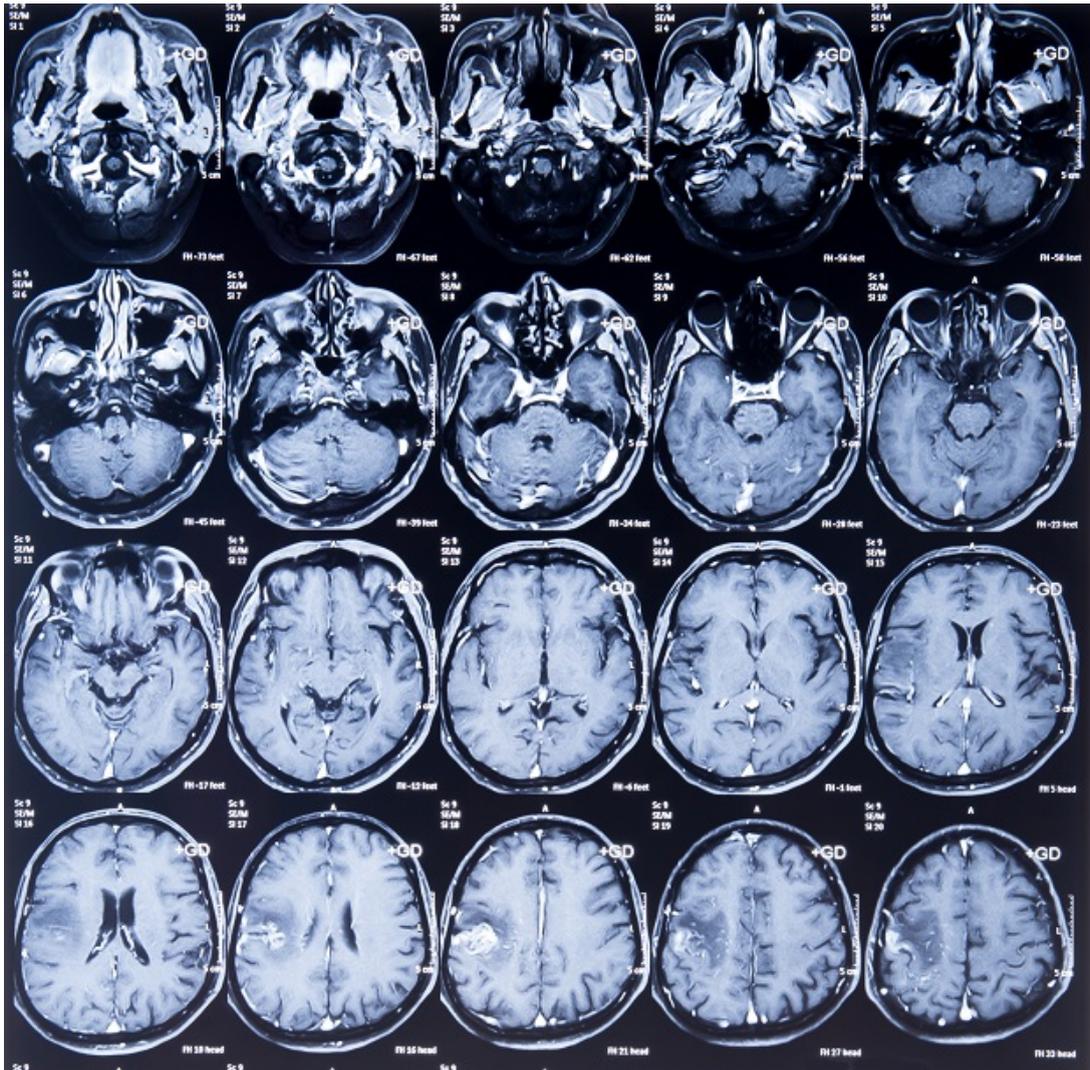
Note: you should avoid close contact with pregnant women, babies and young children for 6 hours after your PET scan. This is because you still have some radioactivity in your body from the radiotracer. It should mostly leave your body after about 6 hours.

Airports often have radiation alarms that you could set off. If you travel by plane within a few days, you could take your scan appointment letter to show that you have recently had a scan.

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## What is a magnetic resonance imaging (MRI) scan?

A magnetic resonance imaging (MRI) scan uses magnets and radio waves to make detailed cross-sectional images of the inside of your body.



**Figure: An MRI scan showing images of the brain**

You might have an MRI scan to:

- diagnose and assess **lymphomas of the central nervous system** (brain and spinal cord) or the head and neck.

You might have an MRI instead of a **CT** or **PET/CT** scan if:

- you are allergic to contrast agents, which are often used in CT and PET/CT scans
  - you are **pregnant**.
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# What is the process for having an MRI scan?

MRI scans are usually done as an outpatient procedure, which means that you don't have to stay in hospital overnight. Not all hospitals have an MRI scanning machine. You might have to travel to a larger hospital to have your scan.

MRI scans can take anywhere from 30 minutes to over an hour. Due to this length of time, you may be asked to empty your bladder beforehand.

The scan is not painful, but you might find it uncomfortable to lie still for a long time.

**Video courtesy of Newcastle NHS Foundation Trust**

## How should I prepare?

You should be given information about how to prepare for the scan.

You can usually eat and drink as normal on the day of your scan. Depending on which part of your body is being scanned, though, you may be advised not to eat or drink for up to 4 hours before your scan. Or you might be told to drink a large amount of water beforehand.

It is generally safe to continue taking any prescription medication on the day of your appointment. If you are on medication for diabetes, you will be given advice about when to take your tablets or insulin.

You must:

- tell the staff if you have any metal in your body, such as staples from previous surgery, metal plates put in after an injury, a hip replacement or a pacemaker
- take off metal (for example, jewellery, a belt, your watch, an underwired bra, glasses).

You may be given a contrast agent (dye).

If you have an MRI scan of your brain, you might be given a **contrast agent**. You should be asked if you have any allergies, kidney problems or problems with blood clotting before you have this contrast agent. This is so that hospital staff can take any necessary precautions.

When you attend your appointment, staff in the scanning department ask if you:

- are pregnant, or could be **pregnant**
- have any implants in your body, especially those containing iron (for example a hip replacement or pacemaker). You will not have an MRI scan if the metal is not compliant with the MRI scanner.
- have ever had an **allergic reaction to a contrast agent**.

## What happens during the procedure?

The MRI scanner is a large cylinder with a couch in the middle of it – it looks a bit like a doughnut. The cylinder measures radio waves as they pass through your body.

The couch moves you into the scanner. You are asked to keep as still as possible during the scan. You might find it uncomfortable to lie still for as long as is needed – if you think you are likely to find this difficult, ask your doctor for advice about how to cope with the discomfort. You might need to take pain relief medication beforehand.

Being in an MRI scanner can feel hot and can be very noisy. You might also feel vibrations and slight movement of the couch during the scan. You should be offered earplugs or you may be able to listen to music during the scan.

You might feel enclosed inside an MRI scanner. Some people feel claustrophobic (closed in). There will be a two-way speaker in the machine so that you can hear and speak to the **radiographers**. You will also have a buzzer to use if you want to let the staff know you feel distressed. **If you feel anxious about having your scan**, speak to a member of hospital staff.

## What happens after the procedure?

You can usually go straight home after your scan, though you shouldn't drive if you have had a sedative or a contrast agent.

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## Frequently asked questions about scans

### Can I have a scan if I am pregnant or breastfeeding?

The advice on scans during pregnancy and while breastfeeding depends on the type of scan you have.

#### X-ray scans

There is a small risk of an unborn baby being exposed to **radiation** during an X-ray scan. This could increase their risk of developing cancer in childhood. However, most X-ray scans use a low dosage of radiation, so the risks are very small.

Doctors carefully assess the risks and benefits of giving people who are pregnant an X-ray scan. If an X-ray scan is considered to be necessary, they will protect your baby using lead shielding during the scan.

Breastfeeding is generally considered to be safe after an **X-ray** scan.

#### CT scans

There is a small risk to an unborn baby from a CT scan, especially during the first trimester of pregnancy. If you are pregnant, you may have a different type of scan to assess the lymphoma, for example an **ultrasound scan** or a **magnetic resonance imaging** (MRI) scan.

Breastfeeding is generally considered to be safe after a CT scan (including if you have had a contrast agent). However, you may be advised not to breastfeed for a day or two afterwards. Follow the advice of your doctors.

## PET scans

PET scans cause a risk to an unborn baby. If you are pregnant, your doctor might advise that you have a different type of scan to assess the lymphoma, for example a magnetic resonance imaging (MRI) scan.

If you are breastfeeding, you might be advised to stop for a while after having the radiotracer injection. Follow the advice of your doctors.

## MRI scans

There is no evidence that MRI scans are unsafe during pregnancy. However, doctors often avoid giving this type of scan during the first trimester when the baby's organs are developing.

The **contrast agent** used in MRI scans enters the breast milk only in extremely small amounts. Breastfeeding therefore does not put your baby at risk.

## Are scans painful?

Scans are not painful but you may find it uncomfortable if you need to still for a long time. Hospitals often have a range of supports to help keep you comfortable.

If you think you are likely to find it difficult to lie still for the time, ask your doctor for advice about how to cope with the discomfort. You might need to take pain relief medication beforehand.

## Do scans use radiation?

Some scans use radiation. This includes X-ray scans, CT scans, PET scans and PET/CT scans. MRI scans do not use radiation.

Radiation is a type of energy. We are exposed to low levels of radiation every day. There are two types of radiation:

- non-ionising (low energy), which comes from natural sources such as soil and water
- ionising (high energy), which is man-made. This is the type of radiation used in some cancer treatments. It works by making breaks in the DNA (genetic material) in cells.

Ionising radiation can cause cancer. However, the levels you are exposed to during medical tests and scans are carefully controlled and kept as low as possible. This means that the risk it poses is very low.

## **Will I be radioactive after a scan?**

Being radioactive means giving off radiation. Whether you are radioactive for a short while after your scan depends on the type of scan you have.

You will not be radioactive after:

- an X-ray scan
- a CT scan
- an MRI scan

After a PET or a PET/CT scan, you will be radioactive for around 6 hours. You should avoid being around women who are pregnant during this time.

## **Are there any side effects of having a contrast agent?**

The contrast agent during a CT scan might make you feel hot all over, but this usually only lasts for a few minutes. Sometimes people feel sick after the contrast agent.

If you have a contrast agent by injection, it can sometimes sting and may make you feel warm or cold where the contrast is injected. With an iodine contrast agent injected into your arm, you may feel a warm sensation travelling down your arms. This tends to pass very quickly.

Other common and short-lasting sensations with an iodine contrast agent injection include:

- a strange taste in your mouth
- feeling as though you are passing urine.

A small number of people have an allergic reaction to the contrast agent. This can cause itchy skin, swollen lumps in the skin. Very rarely, contrast agents cause a more serious allergic reaction, leading to breathing problems

and swelling of the throat. Hospital staff are trained to treat any allergic reactions that develop.

You might be asked to arrive at your appointment an hour early. You will be asked if you have ever had an allergic reaction to a contrast agent before. You'll also be asked other questions about your general health to check that it is safe for you to have the contrast agent. In some departments, you may be asked to stay in the hospital for a short time after a CT scan if you have had intravenous contrast. This allows time for hospital staff to check for any signs of an allergic reaction.

## When will I get the results?

Your doctor usually gets the results from the hospital within a few days and will discuss them with you. Staff in the scanning department won't be able to give you your scan results while you are at the hospital.

## I feel anxious about having the scan - what can I do?

Talk to the staff in scanning department at your hospital if you are worried about any part of having your scan. They can answer any questions you have and may be able to suggest ways of coping with your anxiety.

If you feel very anxious, you may be able to have an anti-anxiety drug before your scan. This is more common with MRI than with other types of scan. If you feel an anti-anxiety drug could help you, talk to the staff in the scanning department about this possibility in advance of your appointment.

Some people find that listening to a CD during the scan helps to take their mind off of the procedure. You could ask your hospital if you are able to take someone with you to your appointment.

For some people, **waiting for test results** can be a particularly anxious time. Although the wait might feel long, it is important that doctors collect all of the information they need in order to plan the best **treatment** for you.

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## References

These are some of the sources we used to prepare this information. The full list of sources is available on request. Please contact us by email at [publications@lymphoma-action.org.uk](mailto:publications@lymphoma-action.org.uk) or phone on **01296 619409** if you would like a copy.

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## Further reading

- Tests, diagnosis and staging
- Waiting for your results
- Radiotherapy
- Glossary

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