

# Radiotherapy

## Introduction

Radiotherapy is a treatment that involves the use of high-energy radiation. It is commonly used to treat cancer.

Almost half of all people with cancer have radiotherapy as part of their treatment plan.

Radiotherapy is also sometimes used to treat benign (non-cancerous) tumours and other conditions – such as thyroid disease and some blood disorders.

This information focuses mainly on the use of radiotherapy as a treatment for cancer.

## Why it is used

Radiotherapy can be used, alone or in combination with chemotherapy (chemoradiotherapy), to try to cure cancers.

For people with incurable cancers, radiotherapy is a very effective method of controlling symptoms.

Radiotherapy can also be used before surgery to shrink a tumour so it's easier to remove (known as neoadjuvant treatment), or after surgery to destroy small amounts of tumour that may be left (known as adjuvant treatment).

## How it is carried out

Radiotherapy can be given in two different ways – from outside the body (external radiotherapy) or inside the body (internal radiotherapy).

External radiotherapy usually involves using a machine called a linear accelerator, which focuses high-energy radiation beams onto the area requiring treatment. External beam radiotherapy is completely painless.

External beam radiotherapy usually involves a series of daily treatments over a number of days or weeks.

Internal radiotherapy can involve placing a small piece of radioactive material temporarily inside the body near the cancerous cells (known as brachytherapy), or the use of a radioactive liquid that's swallowed or injected. The radiation emitted by internal radiotherapy is painless, though the procedure to insert the source can sometimes cause mild discomfort

The type of radiotherapy you have – and the length of the course of treatment – will depend on the size and type of cancer and where it is in the body.

Read more about how radiotherapy is performed.

### How it works

The high-energy radiation used during radiotherapy permanently damages the DNA of cancer cells, causing them to die.

Nearby healthy tissues also suffer temporary cell damage from radiation but these cells are usually able to repair the DNA damage and continue growing normally.

### Side effects

The temporary DNA damage to normal tissues causes side effects, most of which are short-lived.

Common side effects include sore skin, tiredness and hair loss. These tend to get better within a few days or weeks of treatment finishing.

In rare cases, radiotherapy can cause significant long-term effects. For example, treatment to the genitals or pelvic region can cause permanent infertility.

Read more about the side effects of radiotherapy.

### Results

Despite the side effects, radiotherapy can be a highly effective treatment for cancer. Four out of every 10 cancer cures include radiotherapy as part of the treatment plan.

However, radiotherapy does not cause cancerous tumours to shrink immediately and it can take some time for the beneficial effects to become apparent. These effects will depend on the type of cancer you have, other treatments that may be given alongside (such as chemotherapy or surgery) and how advanced the tumour is when treatment begins.

### How radiotherapy is performed

Radiotherapy can be administered in a number of ways. Treatment recommended for you will depend on your individual circumstances.

If radiotherapy is recommended, you will be referred to a specialist radiotherapy department for treatment.

Your treatment team will discuss possible side effects of radiotherapy with you and you will be asked to sign a consent form to confirm you agree to the treatment and understand any risks involved.

### Planning your treatment

Your treatment will be carefully planned to ensure the highest possible dose is delivered to the tumour (to maximise the effectiveness of the treatment) whilst minimising the dose to surrounding healthy tissues.

Your treatment plan will depend on:

where the cancer is in your body

the type and size of the cancer

your general state of health

In planning your treatment, your doctor (a radiotherapy specialist or clinical oncologist) will use all the information gathered during your diagnosis. They may also carry out some additional tests to find more about the size and site of the cancer and get a clearer understanding of the area of your body to be treated. Once your oncologist has all the relevant information, they will calculate the total dose of radiotherapy that you need and the number of individual doses required.

### Positioning

If you are having external radiotherapy (see below), a simulator machine may be used as part of your treatment planning. The simulator moves in the same way as the machine that will be used for your treatment. It uses X-rays to take pictures so your treatment team knows how to position your body when you have your treatment.

Most patients will have a computerised tomography (CT) scan to help the oncologist target the tumour accurately. After this CT scan has been performed the radiographer may put small but permanent ink marks on your skin to ensure the treatment area is targeted accurately each time.

If you are having external radiotherapy to your head or neck, or if it is difficult for you to keep the part of your body having treatment still, a plastic mould will be made for you to wear during treatment. In this case, the ink markings will be made on the mould rather than on your skin.

You can read more about planning external radiotherapy on the Cancer Research UK website.

### Courses of treatment

Radiotherapy is usually given as a number of individual treatments delivering a small dose of radiation daily over several weeks.

Most people have five treatments a week (one treatment a day from Monday to Friday), with a break at the weekend. However, in some cases treatment may be given more than once a day or over the weekend.

The course of treatment usually lasts between one and seven weeks.

The individual radiotherapy doses are often called "fractions". However, the term "attendances" may be used to indicate how many hospital visits will be needed during treatment. This term is sometimes preferred because it's possible to have several treatment fractions during one hospital visit.

The number of fractions or attendances required will depend on the type of cancer being treated and the aim of treatment. If radiotherapy is used to relieve symptoms, rather than cure the cancer, fewer sessions are usually needed.

#### External beam radiotherapy

External beam radiotherapy can be delivered using a variety of techniques.

##### Conventional external beam radiotherapy

Most people receiving radiotherapy will have external radiotherapy delivered by a source of radiation outside the body.

External radiotherapy is usually carried out as an outpatient procedure, so you will not have to stay in hospital overnight. However, you may need to stay in hospital if you are having chemotherapy in combination with radiotherapy (chemoradiotherapy), or if you are unwell.

During the procedure, you will be positioned on a treatment table and a radiotherapy machine (usually a machine called a linear accelerator) will direct high-energy radiation at the area being treated.

You will need to keep as still as possible throughout the treatment, although you can breathe normally. The procedure only takes a few minutes each day and is completely painless.

While you are having treatment, you will be left alone in the treatment room. A radiographer will operate the machine from outside the room and will watch you through a window or on closed circuit television. If necessary, you will be able to talk to the radiographer during the procedure using an intercom.

##### Intensity-modulated radiation therapy (IMRT)

Intensity-modulated radiation therapy (IMRT) is an advanced type of radiation therapy used to treat cancer and noncancerous tumours. IMRT uses computer

technology to manipulate multiple small radiation beams of varying intensities to precisely conform to the shape of a tumour. The radiation intensity of each beam is controlled, and the beam shape changes throughout each treatment.

The goal of IMRT is to distribute the radiation dose to maximize the dose delivered to the tumour whilst avoiding or minimising exposure of healthy tissue to limit the side effects of treatment.

**Image-guided radiation therapy (IGRT)**

Image-guided radiation therapy (IGRT) uses a variety of advanced imaging techniques throughout the course of radiotherapy to accurately identify, pinpoint and monitor your tumour for changes. IGRT allows your oncologist to modify the treatment beams during treatment and therefore increases the chances of the treatment being effective.

**Stereotactic radiosurgery (SRS)**

Stereotactic radiosurgery (SRS), sometimes known as Gamma Knife radiosurgery, is a highly precise radiation therapy used to treat tumours and other abnormalities in the brain.

Specialised equipment focuses up to 200 tiny beams of radiation to deliver a high dose to the treatment area, usually in one treatment in a single day. During the procedure, your head is placed in a frame to keep it still. The accuracy of SRS results in minimal damage to healthy tissues.

**Stereotactic body radiation therapy (SBRT)**

Stereotactic body radiation therapy (SBRT) can be delivered on some modern linear accelerators or with a CyberKnife machine.

CyberKnife treatment involves using a small linear accelerator mounted on a mobile arm. This allows multiple radiation beams to be directed at any part of the body from any direction to deliver a high radiation dose to the tumour and, at the same time, limit damage to healthy tissue.

**Internal radiotherapy**

Sometimes a source of radiation inside the body is used to deliver internal radiotherapy.

Internal radiotherapy can involve a radioactive implant, drink or injection. Depending on the type of treatment being used, you may need to stay in hospital for a short period of time. Radiation emitted by internal radiotherapy is painless, though the procedure to insert the source can sometimes cause mild discomfort.

**Radioactive implants**

The use of radioactive implants (known as brachytherapy) usually involves the insertion of metal wires, seeds or tubes near the cancerous cells.

These implants are often used to treat areas of the body where an implant can be placed inside the body without surgery. For example, a radioactive implant can be placed in the vagina to treat cervical cancer. In some cases, surgery is used to place an implant near the cancerous cells.

The length of time the radioactive implant is left inside your body will depend on the type and nature of your cancer. It could be a few minutes or a few days. In some cases, tiny radioactive implants may be left inside the body permanently.

If you are having a radioactive implant, you may need to stay in hospital for a few days until the radioactive source is removed. After the implant has been removed, you are not a risk to others.

Permanent implants do not present a risk to others because they produce a very small amount of radiation that gradually decreases over time.

#### Liquid radiotherapy

Liquid radiotherapy involves the use of radioactive liquids, usually to treat thyroid cancer. These can be given either as a drink, an injection into a vein, or an injection directly into the area affected by cancer.

After having liquid radiotherapy, you may be radioactive for a few days. This will not cause any long-term harm to your body, but you will probably have to stay in hospital as a precautionary measure until the radioactivity decreases.

The radiation dose will be carefully monitored and you will be able to leave hospital after the radiation has fallen to a safe level. Your treatment team may give you some safety advice to follow for a few days when you get home.

If there is anything about your treatment that you do not understand, or if there is anything you are unsure about, you should ask a member of your treatment team to explain it to you in more detail.

#### Follow-up appointments

After your course of radiotherapy has finished, you will have an appointment with your oncologist to check on your progress. The first appointment is often between four and six weeks after treatment finishes.

You may need follow-up appointments for several years, but they will usually become less frequent as time passes.

Your DOCTOR will be sent a report about your treatment. You will also be able to contact a member of your treatment team if you have any questions after your course of radiotherapy has finished.

### Side effects of radiotherapy

Following radiotherapy, it is likely you will have some side effects. Side effects occur because radiotherapy temporarily damages some healthy cells as well as destroying cancerous ones.

Side effects will depend on:

the part of your body being treated

the dose of radiotherapy

how quickly the healthy cells are able to repair the damage

Radiotherapy affects different people in different ways and it is difficult to know exactly how you will react to the treatment. For some patients side effects are mild, while others experience more severe effects.

Some side effects begin during treatment whereas others can appear weeks or months afterwards.

Most side effects of radiotherapy only last for a few days or weeks after treatment has finished. However, some, such as tiredness or hair loss, can last a few months.

Before starting treatment, you should discuss the risks with your treatment team.

### Common side effects

Most common side effects of radiotherapy are relatively mild and short-lived. Some are described below.

#### Sore skin

Your skin may become red and sore in the area being treated a few days or weeks into a course of radiotherapy, or for up to a couple of weeks afterwards.

Some people's skin may peel (rather like sunburn). This usually heals within a couple of weeks.

Your treatment team will advise about the best way of caring for your skin during treatment. If your skin becomes sore, you should try not to irritate it further.

Avoid shaving and using perfumed soap in the affected area. Protect your skin from cold winds and wear a high-factor sunscreen (SPF 15 or above) to protect your skin from the sun.

#### Tiredness

You may feel tired both during and after radiotherapy. If you feel tired, make sure you give yourself time to rest and take naps if necessary.

Tiredness is particularly common towards the end of a course of radiotherapy and can last for some time afterwards. Doctors believe it occurs as a result of the body repairing damage to healthy cells.

A shortage of red blood cells (anaemia) can also contribute to tiredness during radiotherapy. Therefore, blood tests may be required during radiotherapy for some cancers to ensure you are not becoming anaemic. If you have anaemia, you may need a blood transfusion (where you receive blood removed from another person, known as a donor).

#### Feeling sick (nausea)

Most people are not sick during radiotherapy. However, some people feel sick during, or for a short time after, their treatment. If you experience nausea, your doctor may be able to prescribe medication to help control it.

Radiotherapy to your abdomen (tummy area) or pelvic area may make you sick. This can last a few days after your treatment stops. Anti-sickness medication is available to help this.

#### Loss of appetite

The combination of feeling sick and tired during radiotherapy can make you lose your appetite.

If you have difficulty eating, you may find it easier to eat several small meals throughout the day. You can also speak to your radiotherapist who may refer you to a dietitian (nutritional specialist).

#### Diarrhoea

Diarrhoea is a common side effect of radiotherapy to the abdomen or pelvic area. It usually starts a few days after treatment begins and gradually gets worse as treatment continues. Medication is available.

After your treatment has finished, diarrhoea should disappear within a few weeks. You should tell your doctor if your symptoms have not improved after a few weeks or if you notice any blood in your stools (faeces).

#### Hair loss

Hair loss is a common side effect of radiotherapy to your head or neck. Unlike chemotherapy, radiotherapy will only cause hair loss in the area being treated.

Many people find losing their hair distressing and difficult to cope with. Talk to your family and friends about how you are feeling so they can support you. Your treatment team may also be able to offer advice.



After a few weeks of finishing treatment, your hair should start to grow back. In some cases, the hair grows back a different colour or texture to how it was before.

Read more about cancer and hair loss.

Discomfort on swallowing

Radiotherapy to the chest can cause the tube through which food passes (the oesophagus) to become temporarily inflamed, which may cause temporary discomfort when swallowing. If required, your doctor will be able to prescribe medication to help soothe this.

You should avoid eating hot or spicy food and drinking acidic drinks or spirits during this time because they can aggravate the problem.

Effects on sex and fertility in women

Having radiotherapy may cause you to temporarily lose interest in sex, particularly if you have other side effects, such as tiredness or nausea, or if you are anxious about your condition or treatment.

Radiotherapy to the vaginal area may cause your vagina to become sore and narrower. Your radiotherapist will tell you how you can treat this using a vaginal dilator, which is a device inserted into your vagina to help prevent it narrowing. Having sex regularly after your treatment can also help prevent your vagina narrowing.

If you experience vaginal dryness or pain when having sex, you can use lubricants or ask your DOCTOR or radiotherapist to prescribe appropriate medication.

If you have radiotherapy to the pelvic area there is also a risk of infertility (see below).

Read more about the effects on female sex and fertility on the Cancer Research UK website.

Effects on sex and fertility in men

In men, temporary erectile dysfunction (the inability to get and maintain an erection) and loss of interest in sex are common side effects of pelvic radiotherapy.

Stiff joints and muscles

Radiotherapy can sometimes cause your muscles to tighten up and your joints to become stiff in the area being treated. You may also experience uncomfortable swelling in the affected area.

Exercising regularly can help prevent stiffness. If you have stiff joints and muscles, your doctor or radiotherapist may refer you to a physiotherapist, who will recommend suitable exercises.

## Long-term side effects

It is rare to develop severe, long-term side effects as a result of radiotherapy. Your doctor will discuss the likelihood that you will experience side effects before you consent to treatment.

Some possible long-term side effects are described below.

### Infertility and early menopause in women

In women, radiotherapy to the pelvic area exposes the ovaries to radiation. In pre-menopausal women, this may cause early menopause (where a woman's monthly periods stop) and infertility (the inability to get pregnant). This is often very upsetting, particularly for younger women who want to have a family.

Before having treatment, your doctor will discuss all the options and available support with you. For example, it may be possible for some of your eggs to be surgically removed, frozen and stored until you are ready to have a baby.

### Infertility in men

Radiotherapy to the pelvic area or testicles can cause infertility in men, which may be temporary or permanent.

If there is a risk that you could become infertile following radiotherapy, your doctor will discuss this with you before your treatment. It may be possible to store your sperm until you decide to have a baby, although this is not always available on the NHS.

### Changes to the skin

Long-term changes to the skin can occur after having radiotherapy. Some people notice their skin is thicker, a slightly darker colour and, occasionally, dimpled (like the peel of an orange). These changes usually improve over time.

### Bowel incontinence

Bowel incontinence, sometimes known as faecal incontinence, is a rare side effect of radiotherapy to the pelvis. It is the inability to control your bowel movements which can result in faeces (stools) leaking from your rectum (back passage).

Bowel incontinence can be treated with dietary changes, medicines or a number of different surgical procedures. Read more about treating bowel incontinence.

## Lymphoedema

Radiotherapy can damage your body's network of channels and glands that make up the lymphatic system. One of the functions of the lymphatic system is to drain excess fluid from your tissues.

If the lymphatic system is damaged, fluid can build up and cause swelling and pain. This is known as lymphoedema

Lymphoedema often occurs in the arms or legs, although it can also affect other areas, such as the chest. Arm lymphoedema is sometimes seen in women who have had armpit surgery or radiotherapy for breast cancer.

It may be possible to prevent lymphoedema occurring using appropriate skincare techniques and exercise. If lymphoedema does develop, it can be controlled with early treatment in a specialised lymphoedema clinic.

## Second cancer

Radiotherapy is sometimes associated with a slightly increased risk of developing certain types of cancer many years after treatment (a 'second cancer').