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Радиотерапия в лечении раковых заболеваний

Лучевая терапия (радиотерапия) является общепринятым безопасным и эффективным методом лечения злокачественных опухолей.

Уже десятилетия лучевая терапия (ЛТ) широко используется при большинстве онкологических заболеваний. ЛТ в лечении онкологических заболеваний в последнее время все больше конкурирует с хирургическими вмешательствами.

Современная техника позволяет лучу настолько точно сконцентрироваться в очаге поражения, что нагрузка на окружающие здоровые ткани минимальна. В связи с этим можно сравнить рентгеновский луч со скальпелем хирурга.

Radiotherapy in the treatment of cancer

Radio waves. How useful radio waves for the human body?

Many different studies sometimes give opposite results, so there is still no consensus on this matter.

Radio waves are a type of electromagnetic radiation with wavelengths in the electromagnetic spectrum longer than infrared light. Radio waves have frequencies from 300 GHz to as low as 3 kHz.

Radiotherapy is the treatment of cancer with radiation.

Radiotherapy means the use of radiation, usually X-rays, to treat illness. X-rays were discovered in 1895 and since then radiation has been used in medicine for diagnosis and investigation (X-rays) and treatment (radiotherapy).

Cancer cells grow rapidly, and cause tumors in the body. Radiation therapy aims at destroying these cells, which prevents their growth and spread in the body.

For this purpose, various radiation sources, such as, X-Rays, Gamma Rays, and Particle Beams of electrons, protons, or neutrons, are used to destroy the cancerous cells within the body. The radiation therapy is used to treat patients with almost any type of cancer.
Sources of radiation therapy.
In 1951 there was created an appliance with 60Co (it is radioactive isotope of cobalt used as a source of gamma rays in radiotherapy), which began to be used in the treatment centers.

The construction of these systems continuously improved, and now it is created a lot of different types of isotopic systems, which to a great extent can replace the previously used therapeutic equipment.

Advances in the study of nuclear forces helped to create appliance generating intense beams of mesons; now we get the opportunity to accelerate particles to energies more than 30,000 MeV. These appliance are extremely expensive to build and operate; some of them have become valuable in radiotherapy.

Mechanism of Action
Cancer cells can be distinguished from normal cells in the body, as they tend to replicate more quickly and take over tissue with healthy cells. Radiation therapy manipulates this characteristic of cancer cells by attacking the DNA of cells that are in the process of replicating, rendering the cells unable to multiply sufficiently and eventually leading to their death.

Radiation therapy works by damaging the DNA of cancerous cells. This DNA damage is caused by one of two types of energy, photon or charged particle. This damage is either direct or indirect ionization of the atoms which make up the DNA chain. Indirect ionization happens as a result of the ionization of water, forming free radicals, notably hydroxyl radicals, which then damage the DNA.

Types of Radiation Therapy
The radiation needed in therapy can be administered in three different ways.
- External radiation therapy – A linear accelerator is a machine that is used to focus radiation beams from outside the body directly towards the area of the tumor.
- Internal radiation therapy (brachytherapy) – A small radioactive object is placed inside the body inside or next to the tumor and releases radiation to the area over a set period of time.
- Radiopharmaceuticals – Drugs with radioactive properties are administered to the patient orally or via another route such as intravenously or inside a cavity like the vagina or rectum.
Radiotherapy research.
Making radiotherapy more accurate
In recent years doctors and researchers have developed new ways of targeting external radiotherapy more accurately. The new techniques give a higher dose of radiation to the tumour and there is less damage to surrounding tissue. The newer techniques include

- Intensity modulated radiotherapy
- Image guided radiotherapy
- Volumetric modulated arc radiotherapy (VMAT)
- Stereotactic body ablative radiotherapy (SABR)

Intensity modulated radiotherapy (IMRT)
What IMRT is
Intensity modulated radiotherapy (IMRT) is a type of conformal radiotherapy. Conformal radiotherapy shapes the radiation beams to closely fit the area of the cancer.

You can have IMRT on a standard radiotherapy machine, called a linear accelerator (LINAC). The LINAC has a device called a multileaf collimator. The multileaf collimator is made up of thin leaves of lead which can move independently. They can form shapes that fit precisely around the treatment area. The lead leaves can move while the machine moves around the patient. This shapes the beam of radiation to the tumour as the machine rotates. This means that the tumour receives a very high dose and normal healthy cells nearby receive a much lower dose.

Each radiotherapy beam is divided into many small beamlets, which can vary their intensity. This allows different doses of radiation to be given across the tumour.

Which cancers IMRT can treat
Clinical trials have tested IMRT in a number of cancer types, including breast cancer and head and neck cancer. It is a standard form of treatment for some cancer types. But research is always going on, looking into using new treatments for more types of cancer.

Image guided radiotherapy (IGRT)
What image guided radiotherapy is
Image guided radiotherapy (IGRT) is a type of conformal radiotherapy. Conformal radiotherapy can shape the radiotherapy beams around the area of the cancer.
Image guided radiotherapy uses X-rays and scans similar to CT scans before and during radiotherapy treatment. The X-rays and scans show the size, shape and position of the cancer as well as the surrounding tissues and bones.

**Benefits and possible drawbacks of IGRT**

With image guided radiotherapy, doctors can target the radiotherapy treatment very accurately. This can mean that the treatment works better in curing or controlling a cancer. It can also reduce the risk of side effects. The drawback is that planning the treatment may take longer. Each radiotherapy session also takes longer.

**Stereotactic body radiotherapy (SBRT)**

Stereotactic body radiotherapy (SBRT) is also called stereotactic ablative radiotherapy (SABR). It is a way of giving radiotherapy to a tumour from many different directions to target the treatment very accurately.

**What stereotactic radiotherapy is**

Stereotactic radiotherapy gives radiotherapy from many different positions around the body. The beams meet at the tumour. So the tumour receives a high dose of radiation and the tissues around it only receive a low dose. This lowers the risk of side effects. Usually you have between 3 to 8 treatments.

Stereotactic radiotherapy may be used to treat brain tumours and is called cranial stereotactic radiotherapy. We have a page about stereotactic radiotherapy for brain tumours.

The radiation therapy is used to treat patients with almost any type of cancer.

Doctors have a lot of experience using radiotherapy in medicine. About 4 out of 10 people with cancer (40%) have radiotherapy as part of their treatment. It can be given in various ways, including

- From outside the body as external radiotherapy, using X-rays from linear accelerator machines, electrons, and more rarely other particles such as protons
- From within the body as internal radiotherapy, by drinking a liquid that is taken up by cancer cells or by putting radioactive material in, or close to, the tumour
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Электронно-цифровая подпись

В данной статье раскрывается понятие электронно-цифровой подписи. В качестве примера описывается RSA схема построения электронно-цифровой подписи. Приведены причины для применения электронно-цифровой подписи. Отмечены преимущества электронно-цифровой подписи над ручной подписью.

Electronic digital signature

A digital signature of a message is a number dependent on some secret known only to the signer, and, additionally, on the content of the message being signed. Signatures must be verifiable if a dispute arises as to whether a party signed a document, an unbiased third party should be able to resolve