X-ray therapy

More detailed topic at the link: Radiotherapy

Introduction

Template:Checked by X-rays transfer their energy to matter when passing through matter - causing ionization of atoms and molecules. In the biological environment, this increase in energy initiates a series of processes leading, according to the amount of absorbed radiation dose, to degenerative processes at different levels of the organism. These properties of ionizing radiation are used to treat oncological (https://cs.wikipedia.org/wiki/Onkologie) patients.

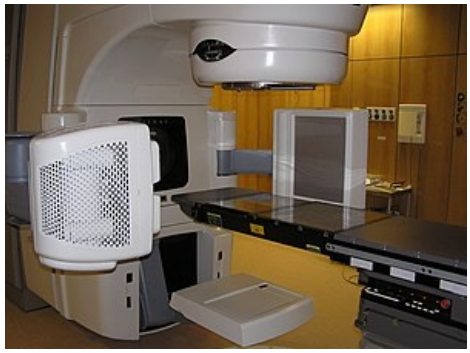
Division

Depending on the localization, volume and radiosensitivity of the tumor, the penetration of the radiation used is chosen.

- Surface radiotherapy – used for tumors on the skin, mucous membranes, works with a voltage of 50-60 kV
- Semi-deep radiotherapy – therapy of tumors just under the skin, all conventional X-ray devices are used with photon energy settings up to 100 keV
- Conventional deep radiotherapy – irradiation of even deeper-seated tumors, X-ray devices with energy photons 200–400 keV
- High-voltage radiotherapy – irradiation of tumours located in depth, energy around 1 MeV

Physical View

Radiation sources



Clinac with two x-rays. FN Motol, Prague, 2006-12-01

Radionuclides

- emitting gamma radiation
  - Cobalt radionuclides (^{60}Co) are used for deep radiotherapy. They are used in Leksell's Gamma Knives.
  - Cesium radionuclides (^{137}Cs) irradiate to a maximum depth of 5 cm.
- therapeutic radionuclides: radionuclides that are introduced into the body and are specifically taken up in certain tissues
  - ^{131}I
  - ^{85}Sr

Particle accelerators

- Ringular: cyclotron, betatron (use in BNCT, proton therapy)
- Linear Accelerator
- Either directly accelerated particles are used, or they are allowed to hit a tungsten target, where they are braked, resulting in high-energy X-ray radiation.

Medical view

File:Biof.png

Profile of transmitted radiation dose to tissues

Radiotherapy is generally divided according to the location of the radiation source into **external (external) radiotherapy (teletherapy, TRT, ERT)'** and **brachyradiotherapy** (brachytherapy, BRT). [1] *In external radiotherapy, the radiation source is outside* the body of the irradiated patient, usually at a distance of 80–100 cm from the patient's body, or from the axis of rotation irradiation device. During brachytherapy, the radiation source is introduced in close proximity to the bearing or directly into an organ or tissue with a tumor, possibly to his bed. Both methods are used separately or in indicated cases they are combined with each other.

Principle of treatment with ionizing radiation

In radiotherapy, the goal is to get the maximum energy of ionizing radiation to the tumor area and at the same time not to damage the surrounding healthy tissue. When X-ray radiation is used, the radiation affects the tissue in front of and behind the tumor. The possible radiation dose is therefore determined by the resistance of the surrounding healthy tissue. The intensity of the biological effect of radiation is influenced by:

- total exposure time, but also time distribution of individual doses during therapy
- spatial distribution of irradiation - the effect increases with the volume of irradiated tissue for the same exposures
- quality of radiation - determined by the so-called half-thickness - indicates the thickness of a certain metal,

which will reduce the intensity of radiation by half (in mm)

Treatment with ionizing radiation is practically only used in oncology (https://cs.wikipedia.org/wiki/Onkologie) patients due to possible negative biological effects.

Mechanism of the biological effect of ionizing radiation

The passage of X-rays through the biological environment causes ionization and excitation of the atoms and molecules of the organism's cells, resulting in chemically highly active substances. X-rays cause indirect ionization. In contrast to the direct effect of ionizing radiation, when radiation energy is absorbed directly in the nucleus, indirect ionization consists in radiolysis of water with the formation of free radicals (H• and OH •). The radicals further react with DNA molecules, causing breaks and thus causing damage. In addition to radicals, molecular products of radiolysis (H_2, O_2, H_2O_2) with a lifetime of only around 10^{-6} s, because they are quickly converted into reaction products.

In the chain of reactions following radiolysis, the presence of oxygen is very important, because it affects the radiosensitivity of cells. Tissues with less oxygen may be more resistant. The presence of oxygen increases the formation of radicals and prevents reparative processes in the cell. Cells with sufficient oxygen supply are 2-3 times more sensitive to radiation.

Links

Related Articles

- Brachytherapy
- Antitumor therapy

References

1. Radiotherapy - textbooks for students 5th year LF MU Brno. Department of Radiation Oncology, MU Faculty of Medicine. Prepared by: MUDr. L. Hynková, M.D. H. Doleželová, Ph.D., prof. MD P. Šlampa, CSc.

External links

- Radiotherapy (Czech Wikipedia)

Source

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