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Cobalt therapy

Cobalt therapy is the medical use of gamma rays from the radioisotope cobalt-60 to treat conditions such as cancer. Beginning in the 1950s, cobalt-60 was widely used in external beam radiotherapy (teletherapy) machines, which produced a beam of gamma rays which was directed into the patient's body to kill tumor tissue. Because these "cobalt machines" were expensive and required specialist support, they were often housed in *cobalt units*. Cobalt therapy was a revolutionary advance in radiotherapy in the post-World War II period but is now being replaced by other technologies such as linear accelerators.

Cobalt therapy

Other names	Cobalt-60 therapy
Specialty	oncology

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History

Before the development of medical linear accelerators in the 1970s, the only artificial radiation source used for teletherapy was the x-ray tube. Researchers found ordinary x-ray tubes, which used voltages of 50-150 keV, could treat superficial tumors, but did not have the energy to reach tumors deep in the body. To have the penetrating ability to reach deep-seated tumors without subjecting healthy tissue to dangerous radiation doses required rays with energy around a million electron volts (MeV), called "megavoltage" radiation. To produce a significant amount of MeV x-rays required potentials on the tube of 3-5 million volts (3-5 megavolts), necessitating huge, expensive x-ray machines. By the late 1930s these were being built, but they were available at only a few hospitals.

Radioisotopes produced gamma rays in the megavolt range, but prior to World War II virtually the only radioisotope available for radiotherapy was naturally occurring radium (producing 1-2 MeV gamma rays), which was extremely expensive due to its low occurrence in ores. In 1937 the price of radium was one million dollars per gram in 2005 dollars, and the total worldwide supply of radium available for beam radiotherapy (teletherapy) was 50 grams.

The invention of the nuclear reactor in the Manhattan Project during the World War II made possible the creation of artificial radioisotopes for radiotherapy. Cobalt-60, produced by neutron irradiation of ordinary cobalt metal in a reactor, is a high activity gamma ray emitter, emitting 1.17 and 1.33 MeV gamma rays with an activity of 44 TBq/g (about 1100 Ci/g). The main reason for its wide use in radiotherapy is that it has a longer half-life, 5.27 years, than many other gamma emitters. However this half life still requires cobalt sources to be replaced about every 5 years.

The first cobalt machine in Italy, installed in Borgo Valsugana in 1953.

In 1949, Dr. Harold E. Johns of the University of Saskatchewan sent a request to the National Research Council (NRC) of Canada asking it to produce cobalt-60 isotopes for use in a cobalt therapy unit prototype. Two cobalt-60 apparatuses were then built, one in Saskatoon in the cancer wing of the University of Saskatchewan and the other in London, Ontario. Dr. Johns collected depth-dose data at the University of Saskatchewan which would later become the world standard.[1] The first patient to be treated with cobalt-60 radiation was treated on October 27, 1951, at the War Memorial Children's Hospital in London, Ontario.[2][3] In 1961 cobalt therapy was expected to replace X-ray radiotherapy.[4]. In 1966, Walt Disney's lung cancer was treated with this procedure, but could not prevent his death.

Current use

The role of the cobalt unit has partly been replaced by the linear accelerator, which can generate higher-energy radiation, and does not produce the radioactive waste that radioisotopes do with their attendant disposal problems. Cobalt treatment still has a useful role to play in certain applications and is still in widespread use worldwide, since the machinery is relatively reliable and simple to maintain compared to the modern linear accelerator.

Isotope

As used in radiotherapy, cobalt units produce stable, dichromatic beams of 1.17 and 1.33 MeV, resulting in an average beam energy of 1.25 MeV. The cobalt-60 isotope has a half-life of 5.3 years so the cobalt-60 needs to be replaced occasionally.

See also

- Gamma knife

References

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2. "Cultural Heritage Assessment: Buildings in the South Street Hospital Complex, London, Ontario" (https://www.london.ca/business/Planning-Development/secondary-plans/Documents/Old%20Victoria%20Hospital/Cultural-Heritage-Asssessment-South-Street-Hospital-Buildings.pdf#page=46) (PDF). p. 46. Archived (https://web.archive.org/web/20200504041250/https://www.london.ca/business/Planning-Development/secondary-plans/Documents/Old%20Victoria%20Hospital/Cultural-Heritage-Asssessment-South-Street-Hospital-Buildings.pdf#page=46) (PDF) from the original on 2020-05-04. Retrieved 2020-05-03. "It is perhaps fitting, given the symbolic emphasis that the War Memorial Children's Hospital placed on turning the spoils of war to the benefits of peace, that this facility became the first place in the world to use the Cobalt-60 Beam Therapy Unit (the Cobalt Bomb) in the treatment of a Cancer patient, on October 27, 1951."
3. "Celebrating the 60th anniversary of the world's first cancer treatment with Cobalt-60 radiation" (http://www.lhsc.on.ca/About_Us/LHSC/Publications/Features/Cobalt-60.htm). *Lhsc.on.ca*. 2011-10-27. Archived (https://web.archive.org/web/20161216034624/http://www.lhsc.on.ca/About_Us/LHSC/Publications/Features/Cobalt-60.htm) from the original on 2016-12-16. Retrieved 2016-12-08.
4. "'New Era' in Cobalt Treatment of Cancer" (https://web.archive.org/web/20151024130132/https://news.google.com/newspapers?nid=1301&dat=19611101&id=DIgVAAAAIBAJ&sjid=RuYDAAAAIBAJ&pg=790,7885261). *Sydney Morning Herald*. 1961-11-01. Archived from the original (https://news.google.com/newspapers?nid=1301&dat=19611101&id=DIgVAAAAIBAJ&sjid=RuYDAAAAIBAJ&pg=790,7885261) on 2015-10-24. Retrieved 2015-06-16.

External links

- public domain image of cobalt machine (http://visualsonline.cancer.gov/details.cfm?imageid=1819)