Gamma rays in medicine

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Characteristics of Gamma Rays

Gamma rays are electromagnetic radiation that posses a great amount of energy and are represented by photons emitted by the nuclei of radioactive elements during a process called "Gamma Decay". These photons posses a very high amount of energy, specifically about 10000× more energy than the photons in the visible range in the electromagnetic spectrum. Gamma photons have no mass and no electric charge and they travel at the speed of sound which is 3.108 m.s-1. Due to the very high energy they posses, gamma photons are able penetrate through most materials except lead, and can penetrate through a human's body and cause significant damage at a cellular level.

For more information see: Gamma rays characteristics

Physical Principle of Imaging With Gamma Rays

Imaging with gamma rays is the process of creating diagnostic images by using the penetrative properties of photons of gamma rays that are emitted by nuclei of radioactive elements. This process is widely used in nuclear medicine, and has both preventative and diagnostic elements. Imaging with gamma rays has a wide range of functions including; tumor imaging, infection imaging, bones imaging, thyroid imaging, brain imaging, diagnosis of Alzheimer's, and revealing cardiac functionality. There are two different types of gamma imaging techniques; those create 2D images and those that create 3D images. Examples of utilization of 2D imaging are Whole Body Scans and Parathyroid Scans. Examples of utilization of 3D imaging is the SPECT and PET Scans. Gamma rays imaging is usually achieved by injecting radio-pharmaceuticals that emit radiation. This radiation is then traced by Gamma Cameras that create the 2D or 3D images of the organ that the radio-pharmaceuticals course within.

For more information see: Physical principle of imaging with gamma-rays

Scintigraphy

Scintigraphy is a diagnostic test in which radioisotopes are utilized to create a 2D image, also called a Scintigram, of a body. This Scintigram gives information about the metabolic activities of the part of the body that is examined. Scintigraphy is a branch of nuclear medicine and is used to localize skeletal inflammations, tumors and fractures, as well as to obtain information about the activities of certain organs in the body. It is strictly a diagnostic procedure and and shows the functions rather than the morphology of the organs in the human body. There are several types of Scintigraphy including but not limited to; Skeletal Scintigraphy, Myocardial Scintigraphy, Lung Scintigraphy, Lymphoscintigraphy, Kidney Scintigraphy, and Scintigraphy of the Thyroid Gland. This procedure is achieved of a radio-tracer that is traced by a Gamma Camera that uses a special computer to create 2D images of specific organs in the body.

For more information see: Scintigraphy

Positron Emission Tomography (PET)

Positron Emission Tomography, otherwise known as PET Scan, is an imaging technique in nuclear medicine that produces 3D images of the organ or body part that is investigated. This method shows the morphology and function of the body part investigated. Due to the high quality 3D image they create PET scans are usually used in neuroimaging. When used for structural neuroimaging, PET Scans are used to create a 3D image that reveals anatomical abnormalities that are either congenital or trauma induced. On the other hand when used for functional Neuroimaging, glucose analogue FDG-18 can show which areas of the brain are experiencing variations in glucose metabolism. The procedure for PET scans is very similar to other imaging methods that utilize gamma radiation. A radiotracer is injected into the body and is allowed to spread throughout the body. The scanner then scans and traces this chemical and in turn creates high quality 3D images of the organ examined, which is usually the brain.

For more information see: Positron emission tomography

Radiation Dose to the Patient

The doses of radiation given to a patient vary according to the procedure, patient's medical condition, age, and the part of the body being treated or examined. In clinical medicine, low doses of radiation are given to patients during PET Scans and other diagnostic imaging methods that utilize gamma radiation. Those are usually administered as

radio-tracers or radiopharmaceuticals and are taken either orally or intervenously. High doses of radiation on the other hand are given to a patient during radiation therapy of cancerous and malignant tumors

For more information see: Radiation dose to the patient

Therapeutic use of Gamma Rays

Gamma rays are usually used therapeutically in the branch of medicine called Oncology. They are utilized to treat cancerous and malignant tumors in the human body. Gamma radiation is mostly used when the primary tumor has been surgically removed but the oncologist still believes that clusters of cancerous tumors are still present, and also when the tumor has been detected in an early stage and can be treated using strong gamma radiations. The technique used is called radiotherapy. In radiotherapy, a beam of gamma rays targets cancerous cells and this beam rotates around the targeted area, ionizing the water in the cell into H and OH free radicals that interact with chromosomes therefore destroying the DNA of cancerous cells. Some beams may also directly affect chromosomes without the use of free radicals. Some disadvantages of the therapeutic use of gamma radiation is that sometimes gamma rays can interact with the DNA of healthy cells that are in close proximity with the tumors and therefore alter these cells and cause cancers other than the one being treated.

For more information see: Therapeutic use of gamma-rays

References

- BECKENHAUB, Gianluca – SCHLICHT, Laura, et al. *Therapeutic Use of Gamma Rays* [online]. ©2015. [cit. 2015-12-08]. <Therapeutic_use_of_gamma-rays>.
- Whitley, Helen, and Andreas Lair. "Positron Emission Tomography." Wikilectures.eu. N.p., 7 Dec. 2015. Web. 7 Dec. 2015. Positron emission tomography
- Ekstrom, Johannes, and Nadeem Ahamed. "Gamma Rays Characteristics." - WikiLectures. N.p., 7 Dec. 2015. Web. 07 Dec. 2015. Gamma rays characteristics
- Salih, Sarah, and Anatoli Pozharitskiy. "Physical Principles of Imaging With Gamma Rays."Wikilectures.eu. N.p., 27 Nov. 2015. Web. 7 Dec. 2015. Physical principle of imaging with gamma-rays.
- Teichler, Moritz. "Scintigraphy." *Wikilectures.eu*. N.p., 29 Nov. 2015. Web. 07 Dec. 2015. Scintigraphy.
- Hernes, Elisabet. "Radiation Dose to the Patient." *Wikilectures.eu*. N.p., 7 Dec. 2015. Web. 7 Dec. 2015. Radiation dose to the patient.