Modern Uses of Nuclear Technology in Medicine

As the world continues to become a smarter and safer place, one thing remains certain: nuclear technology is the way forward. Nuclear science and technology is being applied in almost all fields and studies, such as agriculture, art, energy, industry, and space exploration (to name a few). The medical field is no exception to the widespread use of this ever-growing applied science. In today's world "about one-third of all procedures used in modern hospitals involve radiation or radioactivity," (ANS, "Nuclear Medicine Applications") and, "more than 10,000 hospitals worldwide use radioisotopes in medicine" (ANS, "Nuclear Medicine Applications"). With constant advances in nuclear sciences and technologies, it's no wonder why there are so many uses for it, such as diagnosing patients and nuclear medicine therapy, in modern medicine around the world.

One of the most common and well-known uses for nuclear technology in modern medicine is diagnosing and scanning patients, which includes X-rays and other scans. X-rays use nuclear technology in order to allow doctors to observe a patient's bones or other body parts that are denser than the skin. When X-rays scans are used, they emit radiation in the form of X-ray waves. These waves are able to pass through skin, but cannot pass through bone or other dense objects. This allows doctors to search a patient's body for cracks and fractures in bones or ruptures and other injuries in organs. X-rays are used in CT (computed tomography) scans as well. CT scanners use X-rays to take pictures of internal organs, showing them with precise shapes and important details. Doctors can then use these scans to, "locate and identify tumors, size anomalies, or other physiological or functional organ problems" (USNRC, "Uses of Radiation"). Doctors also use nuclear technology in PET, or Positron Emission Tomography, and SPECT, or Single Photon Emission Computed Tomography scans, which, along with X-ray and CT scans, fall under a practice known as "nuclear imaging" (ANS, "Nuclear Medicine Applications"). Another way that doctors use nuclear technology in modern diagnosis practices is through diagnostic radiopharmaceuticals. The use of radiopharmaceuticals is based on the fact that different organs in our bodies typically absorb different chemicals in varying amounts. For example, the thyroid, "takes up iodine, whilst the brain consumes quantities of glucose" (WNA, "Radioisotopes in Medicine"). In order to then get detailed scans and images or varying body parts, doctors give patients radioactive (but not harmful) isotopes to consume. The pill or other medium that doctors use contains the radioactive isotope of whatever substance is mostly consumed by whichever organ they want to observe. While in the body, the radioactive isotope is consumed by the predetermined organ and emits gamma rays "sufficient enough to escape from the body" (WNA, "Radioisotopes in Medicine"). As soon as the isotope begins emitting gamma rays, a gamma camera takes pictures of the region of the body that is emitting radiation. Diagnostic radiopharmaceuticals have a wide range of use in today's medicine, which include, "to examine blood flow of the brain, functioning of the liver, lungs, heart, or kidneys, to assess bone growth, and to confirm other diagnostic procedures. Another important use is to predict the effects of surgery and assess changes since treatment" (WNA, "Radioisotopes in Medicine"). While radiopharmaceuticals and radioactive isotopes are extremely important in medicine diagnosis and scanning, they also play an important role in nuclear technology's contribution to nuclear medicine therapy.

Nuclear medicine therapy, or radiation therapy, utilizes radioisotopes in order to deal with cancerous growths and tumors inside of a patient's body. Its effectiveness is such an improvement from previous therapeutic technologies that now over half of people with cancer receive radiation therapy, with it sometimes being the only treatment required. The treatment can either be administered from inside or from outside of the patient's body, and works by targeting a local area of cancerous cells and splitting the DNA within them with gamma waves or other high-energy radiation waves. When the DNA of a cancer cell is split, "These breaks keep cancer cells from growing and dividing and cause them to die" (ACS, "Radiation Therapy Basics"). External radiation therapy, or teletherapy, uses the gamma wave radiation of the unstable cobalt-60 or high-energy X-rays in order to kill cancer cells without making an incision on the body. The radiation used is harnessed "through a series of collimators and jaws which shape the beam as it is directed at the patient" (Teach Nuclear, "Cancer Therapy"). Unfortunately, since the beams are so focused in order to kill the cancer cells, normal somatic cells are typically killed in the process as well. With this small risk in the mix of the surgery, the dosage of radiation and the placement of the beam must be precise. Fortunately for patients of this "gamma knife radiosurgery" (WNA, "Radioisotopes in Medicine"), the concentrated beams and the knowledge of today's nuclear technologies minimizes the number of healthy cells killed, and some of them even recover after treatment is over. Today, there are more than 30,000 patients that are treated with teletherapy. As previously mentioned, radiation therapy can also be completed by inserting radioisotopes into the body. This method, known simply as internal radionuclide therapy, involves inserting a radiation source in the localized target area where the cancerous cells are growing. The radioisotopes that enter the body are inserted into the cancer treatment area by a catheter, where they split up the DNA and kill the cancer cells, just like teletherapy. The most effective type of internal radionuclide therapy is known as brachytherapy, which is short-range radiotherapy that produces very little overall radiation to the body, limiting the death of healthy cells (WNA, "Radioisotopes in Medicine"). Today, one of the most common types to brachytherapy is the use of iodine-131, which is injected into the body in order to treat thyroid cancer and other thyroid-related issues. As more discoveries in nuclear science are made, the uses of brachytherapy have increased to many different cancers and other bodily malfunctions. For example, dysprosium-165 is used relieving arthritis, while iridium-192 uses beta radiation (the emitting of an electron) to help treat prostate cancer (UME, "Nuclear Medicine and Medical Isotopes"). With each passing day, the importance of nuclear science and technology increases in the medical field, to where it has become an important resource in order to treat so many patients with such effectiveness.

Within the past decade, nuclear technology has become such an integral part into so many fields and lines of work that it is hard to find a job field today that does not, in some way, deal with it. Whether it is agriculture, industry, or modern medicine, with its usage of radiation in diagnosis and therapy, nuclear technology is everywhere. The uses and application of the science keeps growing too, with applications and jobs relating to nuclear technology and engineering growing around 4% in the next 7 years (CollegeGrad, "Nuclear Engineers"). With its diverse and growing applications, especially in the medical field, nuclear technology is no doubt an important part of today's and of a future world.

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