How the Field of Medicine Benefits from Nuclear Technology

The Application of Nuclear Science and Technology in Modern Medicine

Why would an athlete care about nuclear technology? A fall on the court or a slip on the field could cause them to need extensive testing to isolate the injury and make an accurate diagnosis as quickly as possible. It is not uncommon for athletes to need an array of imaging including, but not limited to, x-rays, CAT scans, PET scans, and bone scans. There are those who assume that advancements in nuclear science will have no effect on them. This is a common misconception. Continuous advancements in this specific field are what makes imaging for everyone quicker and much less expensive than it previously was. Today, most people take for granted the use of nuclear technologies in their routine medical care.

The history of nuclear technologies began when Ernest Lawrence invented the cyclotron. It wasn't until his brother, John Lawrence, realized how the field of nuclear science might apply to medicine. He had been a medical doctor and was intrigued by the idea of using radioisotopes to treat cancer. His suggestion of injecting radioactive sodium chloride near a tumor impacted medicine forever. Because of his pioneering efforts, he is often referred to as the father of nuclear medicine.

A radiopharmaceutical is a radioisotope that has bond to an organic molecule. The radiation from the radioisotopes escapes the body and from this, cameras can create an image. In a normal case, radioactive decay and normal loss of fluid from the body cause the radiation to vanish within nearly one day.

A radiopharmaceutical is given to the patient and an imaging device detects the radiation that can show chemical changes in the body.

Radiopharmaceuticals are injected, inhaled, or taken orally and then will be seen internally. These radioactive tracers are spotted on high-tech cameras that doctors use to track the path of these tracer. They can either be radionuclides found on their own, such as Iodine-131, or can be combined with a carrier molecule. For example, glucose is used as a radionuclide carrier in PET scans since it has a tendency to collect in target areas.

Nearly all endocrine disorders are caused by functional problems. Radionuclide imaging allows the doctors to get a new perspective of an issue. One example in the field of nuclear medicine is that it can be used to treat a malignant thyroid, but it can also be used as a diagnostic tool with healthy thyroids. Countless thyroid disorders can be diagnosed and treated with nuclear technology.

Nuclear imaging is often used in oncology when inspecting cancerous areas to see if the cancer has spread in the body. These nuclear scans show the body's chemistry rather than the physical shape. In some instances, like cancer, more of the radioactive tracer is absorbed into the body. The helpful pictures created from these cameras show the path the tracer took and where the tracer collects. When cancer is present, the tracer collects and becomes a "hot spot". On some scans, the tracer doesn't collect in cancerous areas and becomes a "cold spot".

Coronary artery disease occurs when vasoconstriction happens and the blood vessels that are supposed to supply the heart get built-up with fatty deposits. This is commonly known as atherosclerosis. On some occasions, the buildup becomes so intense that the blood is not able to flow and the risk for a heart attack increases tremendously.

Nuclear medicine in the field of cardiology means that doctors can evaluate blood flow to the heart, the way the heart pumps, and create an image of what a particular heart attack may look like. As part of this diagnostic procedure, myocardial perfusion imaging is the most commonly used.

Experts use myocardial perfusion imaging alongside physical activity to see how effectively the blood is flowing to the heart. Usually this means exercising by walking or riding a bike while being monitored closely. A chemical stress test is done for those who are not able to exercise. The images taken while performing these tests show whether the blood is flowing efficiently. It is important that these tests are performed to help identify when a patient is at an increased risk of a heart attack.

Nuclear science has grown to be so popular in the medical field because of the significant changes it is making. Instead of poking, prodding, or performing exploratory surgery, as was commonly done in the early twentieth century, doctors are using nuclear technologies for diagnosis and imaging. Bone scans, Positron Emission Tomography (PET), Single Photon Emission Computed Tomography (SPECT), and cardiovascular imaging have drastically improved patient care.

Some radionuclides need to be artificially produced by irradiating certain metals or elements to produce new short-lived elements used in nuclear medicine. Two of the most common radionuclides used today are Tc-99m and Iodine-131. Tc-99m is used in roughly 80% of nuclear diagnostic and imaging processes, according to the U.S. Department of Energy. Iodine-131, on the other hand, is mostly used as an agent in therapeutic procedures.

Currently, there are very few sources of Tc-99 and they are all located outside of the United States. The National Research Universal reactor at the Chalk River Laboratories has produced a majority of the world's supply of isotopes used for nuclear imaging. Because the Chalk River facility is to be shut down within the next decade, a new source of Tc-99 must be found or a different radioisotope must be used.

Mo-99 has been identified as a replacement isotope for the previously popular Tc-99. Additionally, Mo-99 has been approved for production in the United States, effectively eliminating the United States' reliance upon foreign sources of medical radioisotopes.

To summarize, nuclear technology has been well-integrated into modern medicine over the past several decades. The medical field improved significantly when Tc-99m was implemented into patient care. While our other sources of radionuclides are continuing to change, the non-stop research in this field will continue to lead us to innovations in medicine. These advancements will help to ensure that medical practitioners can continue to provide accurate, cost effective medical care to their patients.

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