An Illuminating Hope, Even in the Darkest Threat

CNTA Scholarship Essay

Every year, cancer claims the lives of approximately 7.6 million people around the world. 4.0 million of those are between 39 and 60 years old and 100,000 are children under the age of 15; yet the majority of Americans find it frighteningly easy to ignore such statistics when they are unaffected themselves. I might have felt the same way had my best friend not been diagnosed with Osteosarcoma in his left knee last September. In a matter of days his life was drastically altered in ways that seemed foreign to us, and our false sense of security disintegrated. However, thanks to advances in medical techniques the tumor is now removed and he will be allowed to return to school next fall. He is only one of millions of people under the threat of cancer, many of whom require extensive medical procedures and nuclear medicine techniques using isotopes to recover. So what would happen to all of these patients if the supply of isotopes was to run dry?

Isotopes, also known as radionuclides, can occur naturally in places like stars or areas in the atmosphere. They are also developed artificially for our use in radionuclide generators, particle accelerators, and nuclear reactors. Molybdenum-99 is an important medical isotope because it is used to derive technetium-99, which is used in 80 percent of all nuclear medicines. The majority of molybdenum-99 is produced in only five countries; reactors in Belgium, Canada, France, South America and the Netherlands produce most of the world's supply. 80 countries draw from this reservoir and the United States alone accounts for half of the global consumption of these radionuclides. Having such a limited number of producers presents serious issues to the global supply of medical isotopes. The reactors have an average age of 45 years old and are often out of commission for extended times of repair and maintenance. Experts predict that Canadian and French reactors will shut down permanently in 2015, and a proposed reactor will not be opened in the Netherlands until 2016. Because the stockpile of medical isotopes is depleting, many medical operations are being delayed. A survey revealed that 70 percent of physicians have delayed procedures by at least a day, and one third of those have prolonged wait times by over a month. The United States, acknowledging the significance of these isotopes and anticipating the problems that may arise, has been searching for possible replacements of sources and has named the University of Missouri as a possible site for production.

For cancer patients, time is of the essence. Early detection of tumors significantly increases the survival rate, and rapid treatment is key to successful cures. Yet as the supply of radionuclides dwindles wait times for treatments grow, and delays in such time sensitive afflictions can prove harmful or even fatal. But why are medical isotopes so crucial to cancer patients? How much effect can they really have, and how would a shortage classify as a national dilemma?

The fact is that tens of millions of nuclear medicine procedures using medical isotopes are performed each year. Technetium-99 and similar radionuclides are at the epicenter of nuclear medical techniques that effectively locate and combat malignant tumors. Isotopes are also effective in the discovery of organ irregularities and other ailments. Because medical isotopes play such a central role in cancer diagnosis and treatment, a shortage is a paramount subject on the global spectrum.

Isotopes are utilized in over 10,000 hospitals worldwide. Of the quantity of isotopes employed, 90 percent are used to diagnose various conditions. In many forms of diagnosis isotopes are used in tracers (short-lived isotopes connected to chemical compounds). These tracers are administered through injections, inhalations, or oral procedures and give off gamma rays from inside a patient's body. The emitted gamma rays can then be observed with a gamma camera. Medical professionals monitor the behaviors and positions of the tracers and use that information to amass detailed information on a patient's bodily functions and identify any irregularities that exist. Positron Emission Tomography (PET) also manipulates tracers, using isotopes formed in cyclotrons. PET is a more precise technique in which a positron-emitting radionuclide is administered, usually through the form of an injection. As these isotopes decay they release positrons that collide with electrons and thus cause two gamma rays to be released in opposite directions. A PET camera reveals the locations of these decaying isotopes with tremendous accuracy. Once these isotopes are pinpointed, excesses and absences in certain areas can reveal abnormalities. Because of its impressive veracity, PET is used in oncology with fluorine-18 as the tracer (fluorine-18 is the most accurate and non-invasive isotope available for the procedure). The process is also exploited in cardiac and brain imaging. PET can also be combined with computed x-ray tomography in PETCT for 30 percent better diagnosis and exclusive data on a wide variety of afflictions, including dementia, cancer, and cardiovascular disease. When a steady cache of medical isotopes is established, these methods can be performed in appropriate time and the prognosis is often much brighter. An insufficient supply will often result in delays that could darken outlooks for patients.

In addition to diagnosis, isotopes possess serviceability in the actual treatment of malignant tumors. Radionuclide therapy is one method that applies isotopes to areas of the body plagued by rapidly-dividing cancer cells as a treatment. These cancerous cells are notably sensitive to damaging radiation, so isotopes are used to irradiate the surrounding areas of some tumors in order to control or even eliminate them. This application of isotopes comes in a plethora of different medical techniques. External irradiation, also known as teletherapy, uses radioactive cobalt-60 to produce a gamma beam; even brain tumors, which require extremely precise and sensitive care, can be treated using a more concentrated gamma beam focused from 201 sources of cobalt-60 isotopes in a miracle-like procedure called gamma knife radiosurgery. Iodine-131 can defeat thyroid cancer and is probably the most successful cancer treatment. A process called Targeted Alpha Therapy (TAT), also dubbed alpha radioimmunotherapy, can control numerous cancer growths that are spread around the body. In this method, a carrier such as a monoclonal antibody carries the isotope Bismuth-213 to the exact location of cancer cells which allows powerful, short range alpha emissions to target cancer cells and minimize damage to nonthreatening cells. Leukemia can be treated by using radiation produced by isotopes to kill infected bone marrow; the bone marrow is then removed, and healthy marrow is implanted in its place. Treatments can also soothe pain resulting from cancer; for example, strontium-89, samarium-153, and rhenium-186 are administered to relieve tumor-induced bone pain. All of these treatments are subdivisions of Radionuclide Therapy and therefore rely chiefly on a supply of isotopes to function, and all of these treatments can provide comfort and even cures for patients suffering from cancer.

For cancer patients and their families, swift and effective detection and therapy is of the foremost urgency, and these treatments work exclusively on the properties of radionuclides. Without these isotopes many cancer treatments would be nonexistent. Therefore, research, development, and supply of medical isotopes must be of the highest priority in the coming years as science advances. For those who believe they are invincible, those who believe that the statistics are distant and insignificant, and those who believe their lives will never be affected by cancer, it may be convenient to ignore the isotope crisis. But for patients, these nuclear medicine scarcities are not just something to read articles about or to apathetically discuss; these isotope shortages and the ensuing procedure delays can be a matter of life or death. For patients, the threatening shadow of cancer can eclipse the joys of life and destroy the spirit alongside the body. For patients, pioneering research and a ready supply of medical isotopes allow illuminating hope even in the midst of that shadow. This is why medical isotopes and their production are so direly important; they allow hope in hopeless situations and provide cures for otherwise incurable afflictions. They provide a bright light that can pierce into the menacing dark shroud of disease and suffering that descends like fog over so much of our world. We have methods of detection that work, we have treatments that work, and we have cures that work. There are millions depending on these isotopes to fight on. Now is the time to focus on these isotopes, to research them and produce them, and to strive forward for those who desperately need us to. So why would we stop now?

Sources

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