Medical Uses of Radioactivity

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Since the discovery of radiation, people have benefited from the use of radiation in medicine, agriculture and industry. Physicians use X-rays in more than half of all medical diagnoses to determine the extent of disease or physical injury. The radioactive isotope cobalt-60 helps to stop the body's immune reaction to transplanted human organs. Also, tests using nuclear materials in hospital laboratories can detect thyroid underactivity in newborn babies. This makes prompt treatment possible, saving many children from mental retardation.

The discovery of X-rays in 1895 was a major turning point in diagnosing diseases because physicians finally had an easy way to "see" inside the body without having to operate. Newer X-ray technologies such as CT (computerized tomography) scans have revolutionized the diagnosis and treatment of diseases affecting almost every part of the body. Other sophisticated techniques have provided physicians with low-risk ways to diagnose heart disease. For example, doctors can now pinpoint cholesterol deposits that are narrowing or blocking coronary arteries, information essential for bypassing or unclogging them.

Every major hospital in the United States has a nuclear medicine department. Radionuclides are used safely and effectively to diagnose and treat a wide variety of diseases more effectively and safely by "seeing" how the disease process alters the normal function of an organ. To obtain this information a patient swallows, inhales, or receives an injection of a tiny amount of a radionuclide. Special cameras reveal where the radioactivity accumulates briefly in the body, providing, for example, an image of the heart that shows normal and malfunctioning tissue.

Radionuclides are also used in laboratory tests to measure important substances in the body, such as thyroid hormone. Radionuclides are used to effectively treat patients with thyroid diseases, including Graves disease, one of the most common forms of hyperthyroidism, and thyroid cancer.

The use of ionizing radiation has led to major improvements in the diagnosis and treatment of patients with cancer. These innovations have resulted in increased survival rates and improved quality of life. Mammography can detect breast cancer at an early stage when it may be curable. Needle biopsies are more safe, accurate, and informative when guided by X-ray or other imaging techniques. Radiation is used in monitoring the response of tumors to treatment and in distinguishing malignant tumors from benign ones. Bone and liver scans can detect cancers that have spread to these organs.

Half of all people with cancer are treated with radiation, and the number of those who have been cured continues to rise. There are now tens of thousands of individuals alive and cured from various cancers as a result of radiotherapy. In addition, there are many patients who have entered remission as a result of radiotherapy. Radionuclides are also being used to decrease or eliminate the pain associated with cancer, such as that of the prostate or breast cancer that has spread to the bone.

Radionuclides are a technological backbone for much of the biomedical research being done today. They are used in identifying and learning how genes work. Much of the research on AIDS is dependent upon the use of radionuclides. Scientists are also "arming" monoclonal antibodies, antibodies that are produced in the laboratory and engineered to bind to a specific protein on a patient's tumor cells, with radionuclides. When such "armed" antibodies are injected into a patient, they bind to the tumor cells, which are then killed by the attached radioactivity, but the nearby normal cells are spared. So far, this approach has produced encouraging success in treating patients with leukemia.

Another clinical and research tool, PET scanning (positron emission tomography), involves injecting radioactive material into a person to "see" the metabolic activity and circulation in a living brain. PET studies have enabled scientists to pinpoint the site of brain tumors or the source of epileptic activity, and to better understand many neurological diseases. For example, researchers were able to learn how dopamine, the chemical messenger (neurotransmitter) that is involved in Parkinson's disease, is used by the brain.

Applications for X-Rays

- Radiography
- Fluoroscopy
- Digital Subtraction Angiography
- Computed Radiography
- Computerized Axial Tomography
- Mammography
- Radiation Therapy

Applications for Gamma Rays

- Nuclear Medicine
- SPECT (Single Photon Emission Computed Tomography)
- PET (Positron Emission Tomography)
- Radiation Therapy

Sources

ISU Radiation Information Network, http://www.physics.isu.edu/radinf/qanda.htm#use

Links to external resources are provided as a public service and do not imply endorsement by the Washington State Department of Health.