Nuclear Medicine

OBJECTIVE: Develop to Its Highest Potential the Application of Nuclear Science to the Diagnosis and Treatment of Human Disease.

The phenomenon of radiation was considered by early investigators to be an opportunity for improved health care as well as a health risk. What was the basis for their optimism? Simply that a unique tool could be made available in forms convenient for use by the medical profession for diagnosis as well as the treatment of human diseases. Through nuclear medicine, it would be possible to monitor body function, to isolate the causes and extent of disease, and to subject these to a range of treatments never before possible.

Techniques That Aid in Diagnosis

Heart Disease There are two major techniques for diagnosing whether patients with symptoms of coronary artery disease in fact have such disease. One involves the injection of opaque dye into an artery near the heart, after which the motion of the dye is followed by fluoroscopy. This technique, called cardiac catheterization, is painful and expensive and carries risks. The other technique, developed in the nuclear medicine program, involves injection of the radioisotope thallium-201 into the bloodstream and subsequent detection of the uptake of this tracer in cellular tissue. Reduced uptake of thallium-201 in a region indicates either reduced blood flow or damage to cells, or both. Thus the technique can detect damage to the cells of the heart and reduced blood flow to the heart. The technique is relatively inexpensive, less invasive, and low risk. Although it does not exclude the use of cardiac catheterization (which is usually required prior to surgery, once the presence of disease is confirmed), the thallium-201 scan is in wide use as a screening test, often obviating the need for catheterization. For the 370,000 patients who undergo the scan annually and avoid the necessity for more expensive catheterization, this has meant a savings of $78 million per year in medical expenses.

Diagnostic Scanning The need for a versatile scanning technique, adaptive to a range of diagnostic applications, was fulfilled through the use of the radioisotope technetium-99*m* for imaging with the scintillation camera. The "daughter" from the quick decay of this radioisotope was found to produce low-energy electrons just sufficient for satisfactory tissue penetration and detection by the camera. With this approach it is possible to determine the amount and rate of blood flow to an area, whether an organ has normal or impaired functions, and the presence or absence of tumors, particularly in the brain, liver, and bone. At least 6 million technetium-99*m* studies are performed annually, representing approximately 80 percent of all nuclear medicine imaging procedures. Industry is currently producing technetium-99*m* with a sales volume totaling $26 million per year.

Hodgkin's Disease The radioisotope gallium-67 has been used in a number of applications in nuclear medicine because it concentrates in tumors and abscesses and because of the efficient detectability of its gamma-ray emissions. Gallium-67 scanning is particularly useful in the diagnosis of Hodgkin's disease in a procedure that also permits discrimination between the various stages of this disease. The ability to discriminate is valuable because treatment is specific for each stage of the disease. The benefit of the scan to patients who have not yet reached the most severe stage of the disease, in terms of avoiding unnecessary medical expenses and losing productive time alone, is estimated to be $10 million annually. In all applications, more than 250,000 gallium-67 scans are performed annually at a cost of $5 million for the radiopharmaceutical alone.

Instruments That Aid in Diagnosis

The Scintillation Camera The scintillation camera, named the "Anger Camera" for its inventor, was de-