What is Radiation Dosimetry?

SNMMI SOCIETY OF NUCLEAR MEDICINE AND MOLECULAR IMAGING

What is Radiation Dosimetry and Why is it Important in Nuclear Medicine Therapy?

Radiopharmaceutical therapy (also known as molecular radiotherapy or "targeted" radionuclide therapy) involves treating a patient with a radioactive material, called a radiopharmaceutical, that targets cancer or other abnormal, diseased cells. This treatment is called "targeted" radionuclide therapy, because the radiopharmaceutical selectively irradiates and damages cancer cells while limiting radiation exposure of healthy tissue. Radiopharmaceuticals typically comprise a radioactive atom (also known as a radionuclide) combined with a targeting molecule that specifically seeks and binds to, in, or near cancer cells. Some radionuclides have the ability to target specific cells without requiring a targeting molecule. For example, thyroid and thyroid cancer tissues assimilate radioactive iodine naturally, and therefore physicians have used radioiodine effectively for many years to safely treat hyperthyroidism (overactive thyroid gland) as well as certain forms of thyroid cancer. Targeted radionuclide therapy holds promise for personalized treatment of many types of cancer because therapy can be tailored to match the molecular properties of a patient's specific tumor. Moreover, because the radiopharmaceutical is carried by the circulatory system, it can treat tumors throughout the body, including cancer that spreads as metastatic disease. Surgery and external-beam radiation therapy (also known as teletherapy), on the other hand, can only eliminate tumors at the treatment site but not elsewhere in the body.

What is radiation dosimetry?

"*Dosimetry*" refers to the science by which radiation dose is determined by measurement, calculation, or a combination of measurement and calculation. The technical name for radiation dose is "*absorbed dose*"; it is the amount of radiation energy that is deposited in tissue divided by the mass of the tissue. The absorbed dose is the most important physical factor that influences the response of tumors and the rest of the body to radiation.

Why is radiation dosimetry important?

Absorbed dose determines the extent to which tumors and normal tissues are affected by radiation. The higher the absorbed dose to tumors, the more cells will be killed by radiation and the greater the likelihood of a cure. However, the higher the absorbed dose to normal tissues, the more likely and severe may be the undesirable toxic side-effects of the radiation. An important advantage of radiopharmaceutical therapy is its ability to irradiate and effectively treat tumors *throughout the body*; at the same time, some irradiation of normal organs is unavoidable. Therefore, the role of radiation dosimetry in targeted radionuclide therapy is to determine specifically, for each patient, the administered amount of the radiopharmaceutical that will most effectively treat the patient's disease while avoiding absorbed doses that damage normal tissues. Individualized radiation dosimetry is critical for planning the most effective and safest targeted radionuclide therapy for each patient.

How is radiation dosimetry performed?

Medical physicists having special expertise in methods for determining absorbed dose collaborate with the treating physician and the nuclear medicine technologist. If a patient undergoes a dosimetry study prior to radiopharmaceutical therapy, the patient may receive a small "dosimetry" amount of the therapeutic radiopharmaceutical prior to actual treatment. The nuclear medicine technologist will then collect three or more nuclear medicine images at different times after the dosimetry administration. In some cases, only one image will be collected. The treatment team may collect blood, urine, and stool samples. The medical physicist then uses the dosimetry measurements to calculate an appropriate treatment for the therapy, based on the patient's unique biodistribution and clearance patterns from the body. In this way, dosimetry ensures that the patient receives a personalized, safe, and effective treatment.

What does the future hold?

Physicians and scientists continue to make rapid and important advances in radiopharmaceutical therapy of cancer. New targeted therapies hold promise for even safer and more effective methods for treating a variety of cancers. Realization of the full potential of these therapies will require personalized dosimetry - a collaboration between physicians and medical physicists - to optimize radiopharmaceutical therapy for each patient. As these collaborations become more commonplace, dosimetry will play an increasingly important role in the care and treatment of cancer patients.

About SNMMI

The Society of Nuclear Medicine (SNMMI) is an international and medical organization dedicated to raising public awareness about nuclear and molecular imaging and therapy and how they can help provide patients with the best health care possible. With more than 18,000 members, SNMMI has been a leader in unifying and optimizing nuclear medicine and molecular imaging since 1954.

The material presented in this pamphlet is for information only and is not intended as a substitute for discussions between you and your physician. Be sure to consult with your physician or the nuclear medicine department where the treatment will be performed if you want more information about this or other nuclear medicine procedures.

Society of Nuclear Medicine and Molecular Imaging
1850 Samuel Morse Drive
Reston, VA 20190
www.SNMMI.org
www.discovermi.org