

## Nuclear Medicine

### What is it? And how does it work?

**Nuclear medicine** is a branch of **medical** imaging that uses small amounts of radioactive material to diagnose and determine the severity of or treat a variety of diseases, including many types of cancers, heart disease, gastrointestinal, endocrine, neurological disorders and other abnormalities within the body.

Nuclear medicine imaging uses small amounts of radioactive materials called radiotracers that are typically injected into the bloodstream, inhaled or swallowed. The radiotracer travels through the area being examined and gives off energy in the form of gamma rays which are detected by a special camera and a computer to create images of the inside of your body. Nuclear medicine imaging provides unique information that often cannot be obtained using other imaging procedures and offers the potential to identify disease in its earliest stages.

Because nuclear medicine procedures are able to pinpoint molecular activity within the body, they offer the potential to identify disease in its earliest stages as well as a patient's immediate response to therapeutic interventions.

#### Diagnosis

Nuclear medicine imaging procedures are non-invasive and, with the exception of intravenous injections, are usually painless medical tests that help physicians diagnose and evaluate medical conditions.

Depending on the type of nuclear medicine exam, the radiotracer is either injected into the body, swallowed or inhaled as a gas and eventually accumulates in the organ or area of the body being examined. Radioactive emissions from the radiotracer are detected by a special camera or imaging device that produces pictures and provides molecular information.

Nuclear medicine images can be superimposed with computed Tomography (CT) or Magnetic resonance imaging (MRI) to produce special views, a practice known as image fusion or co-registration. These views allow the information from two different exams to be correlated and interpreted on one image, leading to more precise information and accurate diagnoses.

### What are some common uses of the procedure?

Radiologists use radionuclide imaging procedures to visualize the structure and function of an organ, tissue, bone or system within the body.

In adults, nuclear medicine is used to:

#### Heart

- visualize heart blood flow and function (such as a myocardial perfusion scan)
- detect coronary artery disease and the extent of coronary stenosis
- assess damage to the heart following a heart attack
- evaluate treatment options such as bypass heart surgery and angioplasty
- evaluate the results of revascularization procedures
- detect heart transplant rejection

- evaluate heart function before and after chemotherapy

### **Lungs**

- scan lungs for respiratory and blood flow problems
- assess differential lung function for lung reduction or transplant surgery
- detect lung transplant rejection

### **Bones**

- evaluate bones for fractures, infection and arthritis
- evaluate for metastatic bone disease
- evaluate painful prosthetic joints
- evaluate bone tumours
- identify sites for biopsy

Other imaging procedures and offers the potential to identify disease in its earliest stages.

### **Brain**

- investigate abnormalities in the brain in patients with certain symptoms or disorders, such as seizures, memory loss and suspected abnormalities in blood flow
- detect the early onset of neurological disorders such as Alzheimer's disease
- assist in surgical planning and localize seizure foci
- evaluate for abnormalities in a chemical in the brain involved in controlling movement in patients with suspected Parkinson's disease or related movement disorders
- evaluation for suspected brain tumour recurrence, surgical or radiation planning or localization for biopsy

### **Other Systems**

- Identify inflammation or abnormal function of the gallbladder
- Identify bleeding into the bowel.
- assess post-operative complications of gallbladder surgery
- evaluate lymphedema
- evaluate fever of unknown origin
- locate the presence of infection
- measure thyroid function to detect an overactive or underactive thyroid
- help diagnose hyperthyroidism and blood cell disorders
- evaluate for hyperparathyroidism
- evaluate stomach emptying
- evaluate spinal fluid flow and potential spinal fluid leaks

**In adults and children, nuclear medicine is also used to:**

### **Cancer**

- stage cancer by determining the presence or spread of cancer in various parts of the body
- Localize sentinel lymph nodes before surgery in patients with breast cancer or skin and soft tissue tumours.
- plan treatment
- evaluate response to therapy
- detect the recurrence of cancer
- detect rare tumours of the pancreas and adrenal glands

### **Renal**

- analyse native and transplant kidney blood flow and function
- detect urinary tract obstruction
- evaluate for hypertension related to the kidney arteries
- evaluate kidneys for infection versus scar
- detect and follow-up urinary reflux

**In children, nuclear medicine is also used to:**

- investigate abnormalities in the oesophagus such as esophageal reflux or motility disorders
- evaluate the openness of tear ducts
- evaluate the openness of ventricular shunts in the brain
- assess congenital heart disease for shunts and pulmonary blood flow