

## Nuclear Medicine

### Consumer Information

#### Contributors:

Dr Timothy Cain

MBBS, FRANZCR, MBA

Ms Ann Revell, Dr Christine Walker, A/Prof Stacy Goergen

### What is Nuclear Medicine?

Nuclear Medicine is a medical specialty that involves the administration of a small amount of a radioactive medication into the patient. This makes the patient weakly radioactive for a short time and the images are made from the ionising radiation given off (emitted) from the patient. The radioactive medication is most commonly injected into the blood stream via a vein, but it may be given to the patient in many different ways including:

- swallowed
- injected directly into the tissue beneath the skin
- injected into a shunt
- injected into a joint, or
- inhaled

Many different organs may be imaged depending on the type of radioactive material administered. The medication given to the patient is called a radiopharmaceutical. Only a very small amount of radiopharmaceutical is given so that the radiation dose is kept to a minimum. For this reason, Nuclear Medicine studies usually take longer to perform than other imaging tests.

Some diseases or conditions can be treated using Nuclear Medicine. In these cases, the amount of radiopharmaceutical given is much greater, and it usually goes mostly to the diseased or abnormal organ. The type of radiopharmaceutical given usually emits ionising radiation that has maximum effect on the organ that is being treated.

### Who are Nuclear Medicine Specialists?

Nuclear Medicine specialists are doctors who have had specialised training in Nuclear Medicine. Some of these specialists are also trained in other medical specialties such as radiology, cardiology (heart specialist), endocrinology (hormone specialist), oncology (cancer specialist), or in the use of diagnostic ultrasound.

A Nuclear Medicine physician is a Nuclear Medicine specialist who has undertaken his or her training through a clinical medical speciality (such as general medicine, cardiology or oncology). Some radiologists undertake training in Nuclear Medicine and may be referred to as nuclear radiologists.

### Who are Nuclear Medicine Technologists?

Nuclear Medicine technologists are health professionals who have been trained in Nuclear Medicine. They have obtained a university degree which among other things allows them to:

- measure and use radiopharmaceuticals
- give injections and take blood samples
- use Nuclear Medicine gamma cameras
- use computers to process and analyse Nuclear Medicine studies
- understand diseases investigated or treated by Nuclear Medicine, and
- deal with patients professionally

A Nuclear Medicine technologist is different to a radiographer.

### What is a radiopharmaceutical?

A radiopharmaceutical is a medication used in Nuclear Medicine which has a *radioactive part* and a *pharmaceutical part*.

The *radioactive part* is an unstable element (radioisotope) which gives off energy as it decays to a different element or energy state. The actual amount of the radioactive substance given for most imaging tests is usually very small; approximately millionths of a gram. The dose of ionising radiation received by a patient having a Nuclear Medicine test can be very low or moderate; the dose varies between different studies in a similar range to that received from CT imaging. This *radioactive part* is sometimes referred to as a radioactive label or a radioactive tracer. The radioactive part is most commonly Technetium 99m, but other radioisotopes such as Iodine 123, Indium 111 and Gallium 67 are also used. Fluorine 18 is an isotope used in PET (positron emission tomography) studies.

The body is not able to detect this ionising radiation and it does not make you "warmer" or "glow in the dark". The dose of ionising radiation received during a Nuclear Medicine test will not be determined by the number of images taken. It is determined from the radioactivity injected in the radiopharmaceutical, the half life of the radioisotope and how quickly this is eliminated from the body in urine, faeces or breath. The half life is the time taken for half of the radioactive atoms to decay or change their energy state. For most radioisotopes used in Nuclear Medicine, this half life is measured in hours so after a day or so there is very little radioactivity remaining.

The *pharmaceutical part* may be a few atoms or a complex molecule which helps take the radioactive label to the part of the body being imaged in the nuclear medicine test. It is mostly the choice of the *pharmaceutical part* which determines where the radiopharmaceutical will go in the body and what body part or organ system will be demonstrated.

Technetium 99m MDP will be used in a [nuclear bone scan](#) but Technetium 99m MAG3 will be used in a nuclear renal scan.

### What is a Gamma Camera?

A gamma camera is a machine which is able to detect very small amounts of ionising radiation and make pictures from the ionising radiation emitted from patients having a Nuclear Medicine study. The Gamma camera usually has a table which the patient lies on; this may be narrow. The pictures or images are taken using the camera "head".

A camera may have one, two or occasionally three heads, with one or more being used to obtain the images. Each camera head is a heavy object with a flat surface that has to be very close to the patient. The camera heads may be supported in a number of different ways using strong metal arms or a gantry. There are no unusual sensations associated with having images taken with a gamma camera and the machine makes no noise.

### How is Nuclear Medicine different from normal X-ray and CT examinations?

When a normal X-ray and CT examination is made, an image is formed from the "shadow" created by the body as it is positioned between the X-ray machine (source of the X-ray beam) and the X-ray detector. The body stops some but not all of the X-rays that are aimed at it; the patient does not become radioactive.

In Nuclear Medicine studies, the radiopharmaceutical administered to the patient makes the patient radioactive (more than normal) for a short time. This emitted ionising radiation (usually a gamma ray) can be detected and measured using a nuclear medicine gamma camera. An X-ray or CT image is therefore formed from ionising radiation (X-rays) that pass through the body but do not arise from the

body, and a Nuclear Medicine image is formed from the ionising radiation (usually Gamma rays) that arise from the body. A gamma ray has properties similar to an X-ray, but it arises from the nucleus of an atom while an X-ray arises from the electron shell.

Another way that Nuclear Medicine is different from X-ray and CT examinations is that an X-ray study demonstrates what something *looks like* and this gives indirect information about how it is *working*: normally, abnormally, diseased, injured, etc. In Nuclear Medicine studies, the radiopharmaceutical usually only gets to the body part or organ system if it has some function. The Nuclear Medicine study therefore shows how something is *working* and from the images the Nuclear Medicine specialist is often also able to gain information about what the body part or organ system *looks like*.

Nuclear Medicine and X-ray tests are therefore often complementary, providing different information that together make a diagnosis more certain.

**Please note:**

This information is of a general nature only and is not intended as a substitute for medical advice. It is designed to support, not replace, the relationship that exists between a patient and his/her doctor. It is recommended that any specific questions regarding your procedure be discussed with your family doctor or medical specialist

The QUDI Program is managed by the Royal Australian and New Zealand College of Radiologists and funded by the Australian Commonwealth Department of Health and Ageing.

**Publication Date:** May 1st 2009

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