Nuclear medicine provides imaging modalities that can be used to observe physiological processes in the human body. They are different to imaging modalities such as computed tomography (CT), which are predominantly used to assess human anatomy (Sharp et al, 2005). Nuclear medicine is commonly used to assess the bones, heart, lungs, renal system and brain. This article – the first in a five-part series – provides a general guide for nursing staff. It will be followed by four articles on specific nuclear medicine techniques and their uses.

**History**
Radiation was first used for medical investigations in the early 20th century, and was followed by the first therapy for leukaemia in 1936 and the study of sodium dynamics in the body in 1937 (Bit.ly/SNMMITimeline). A popular early application of nuclear medicine was the use of radioactive iodine to diagnose and treat thyroid diseases.

Technetium-99m ($^{99m}$Tc) was discovered in 1938 but did not enter mainstream use until the 1960s (Bit.ly/SNMMITimeline). Today, along with other radioisotopes (defined in Box 1), such as iodine 131 ($^{131}$I) and $^{99m}$Tc is used for hundreds of diagnostic investigations and treatments.

Positron emission tomography (PET) was first approved in the late 1980s as a method to assess blood perfusion in the heart; in 1998, it was used for the first time to assess treatment response to chemotherapy and quantify disease progression (Bit.ly/SNMMITimeline).

**Indications**
Nuclear medicine is used for a variety of diagnostic investigations – the most common one is a bone scan (defined in Box 1). Referrals to nuclear medicine can be made to investigate malignancy, trauma and other pathologies (Leslie and Greenberg, 2003). In addition to its diagnostic uses, nuclear medicine is also used therapeutically – for example, to treat pathologies of the thyroid.

**Technique**
Nuclear medicine works on the principle of radioactive decay (defined in Box 1). A radioactive element is attached to a drug...
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designed to target a specific area of interest, for example:
- An organ system;
- A localised area of the body;
- The whole body.

The drug is usually administered intravenously but, among other methods, can also be inhaled, swallowed or administered intradermally. The radioactive element circulates in the body according to the drug to which it is attached and the body physiology. Radioactive decay is detected and localised, which allows health professionals to build a picture of:
- How the drug interacts with the body;
- Where radiation has accumulated;
- How long it resides in an area.

Observations are made using a gamma camera, which detects the radioactive emissions of the administered drug. As the radioactive drug decays, it releases gamma rays, which interact with a crystal that is located in the head of the camera. This causes a small flash of light, is multiplied and eventually registers as a small point on the image. Millions of points combine to form images that are clinically useful.

Conventional nuclear medicine is often carried out with a gamma camera that also has a CT component, so the physiological data from the nuclear medicine images can be combined with the anatomical data from the CT scans – this is known as single-photon emission CT (SPECT-CT, Box 1).

Protection from radiation

Patients, the public and staff need to be protected from exposure to radiation. To protect patients, the amount of radiation they receive is optimised and they are given advice on how to further reduce their exposure after the procedure.

A common piece of advice is to drink regularly and urinate often: the radioactive drug is eliminated through the bladder, so frequent urination reduces exposure. Use of bottles and bedpans should be avoided immediately after the procedure. To protect other users, patients should be encouraged to use a specific toilet that has restricted access. To avoid contamination from splashes, male patients should be advised to sit down when urinating.

In most cases, patients are radioactive for roughly 24 hours after administration of the radioactive drug. During that time, is generally higher than the dose needed for diagnostic investigations – will often be nursed in a side room;
- Staff should minimise close contact with the patient as much as possible. Pregnant women should avoid contact with the patient altogether.
A medical physicist will regularly visit to assess the patient’s level of radioactivity and, once this is low enough, normal nursing procedures can be resumed.

If contamination is suspected:
- Disposable gloves and aprons should be worn, and shoe coverings if necessary;
- Waste and soiled linen should be sealed away.

For patients who have received a therapeutic dose of radiation, advice from medical physicists may be sought. Sometimes patients will need to be isolated to protect staff and visitors from unnecessary exposure to radiation. This can be a difficult time for patients, as they are often undergoing diagnostic procedures or treatment for a potentially serious condition and, therefore, require psychological support.

Alleviating anxieties

Patients are often anxious when attending the nuclear medicine department; this may be due, in part, to the negative connotations surrounding the word ‘nuclear’ (Vijayakumar et al., 2006). Nurses and technicians in that department, as well as on the wards and in outpatient clinics, play a key role in alleviating these anxieties by offering reassurance and clear information.

From initial contact to imaging procedure and post-procedure advice, nurses and other members of staff will be giving patients information and should also be reassuring them. As nuclear medicine is still a relatively unfamiliar specialty, educating both patients and staff will help to reduce any anxieties.

References


Box 1. Glossary

- Bone scan: a nuclear medicine investigation assessing the amount of bone the body produces over a 2-4-hour period
- Cardiac stress test: a nuclear medicine investigation assessing the perfusion of the cardiac muscle
- Radioactive decay: a process in which an unstable atom loses energy, by emitting radiation in the form of particles or gamma rays
- Radioisotope: a radioactive version of an isotope. An isotope is a nuclide – an individual species of atom with a specific proton and atomic mass number – that has the same proton number but a different atomic mass number
- Single-photon emission computed tomography-computed tomography (SPECT-CT): an imaging method that combines nuclear medicine and CT

QUICK FACT

24 hours

The period patients remain radioactive after a nuclear medicine procedure

Bone scintigraphy is used to diagnose bone diseases or assess their severity.