GETTING A CLEAR PICTURE ON MEDICAL IMAGING

Diseases take on all shapes and forms, and some are easier to detect than others. Obvious outward growths like rashes and warts are quick to spot, but for some diseases and conditions more information is needed. Fortunately, nuclear medicine doctors today can use a wide range of modern imaging and diagnosis techniques and technologies to identify a variety of health conditions.

SPECT, PET, MRI, CT, ECHO, fluoroscopy — the list of diagnosis techniques go on, but do you know what they actually are?

Imaging techniques can be broken down into two basic categories: those that simply show the anatomy, known as radiology, and those that look at the physiology, on how the body functions, which is known as functional imaging. This article presents a breakdown of the two imaging disciplines and how some of the most common techniques work.

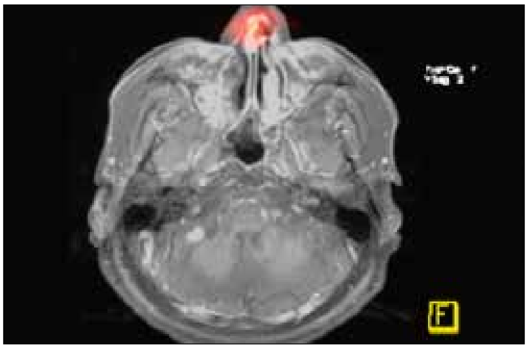
Radiology

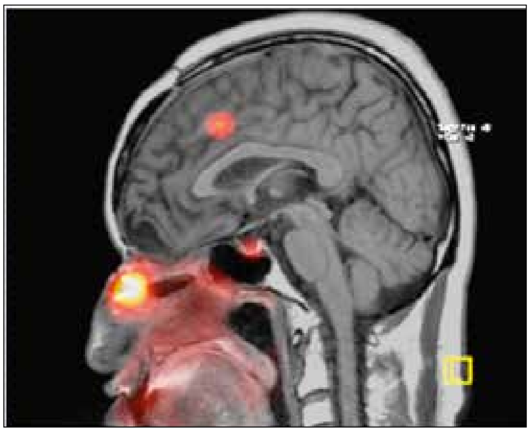
X-ray radiography

This is probably the imaging technology most people are familiar with. It works in a similar manner to casting a shadow; a patient's body part (a broken arm, for example) is placed in front of an X-ray detector and illuminated by an X-ray generator. As X-rays pass through the patient, the rays are absorbed depending on the density and composition of the body part. Bones and flesh do not absorb X-rays at the same efficiency. Some of the rays go through to the X-ray detector and help create an image. The imaging technique in which X-rays produce real-time images and video is called fluoroscopy.

MRI

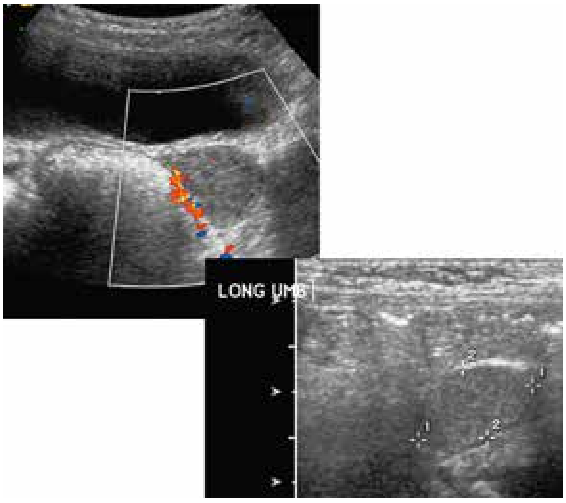
Magnetic resonance imaging produces an image by using a very powerful magnet. The magnet creates a magnetic pulse that aligns water molecules in the patient's body. When the pulse stops, the molecules relax and revert back to their previous state, which in turn produces a signal that is detected without ionizing radiation. Highly-sensitive instruments detect the signal and the resulting information can be translated into an image. Changing the strength and angle of the magnetic fields shows differences between tissue types, allowing doctors to visualize tissues normally too soft to detect through other means.





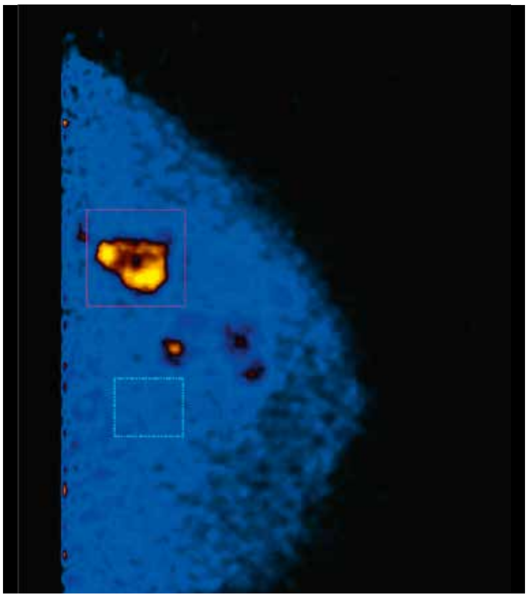
ECHO

An echocardiogram is a sonogram or ultrasound image of a heart and involves no ionizing radiation. An ultrasound signal (a sound wave with a frequency above the upper limits of human hearing) is directed to the heart and as it bounces back after encountering tissue or bone, it is picked up by a sensor. Depending on the frequency of the sound and the time it takes to return, it is possible to create an image of the patient's heart.



PET

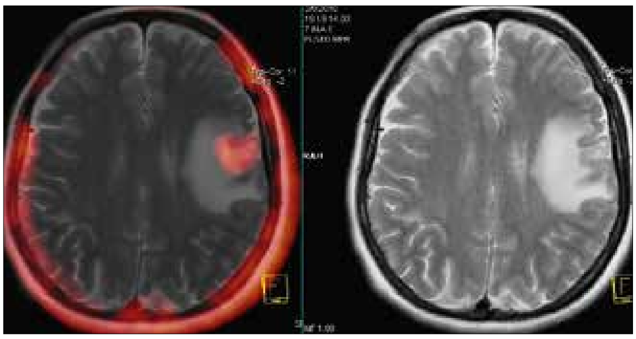
Positron emission tomography works in the same way as SPECT, but uses radioisotopes that decay even faster and produce two gamma rays that move in opposite directions. This allows views from multiple angles, making it possible to produce a three-dimensional visualization of the target area or organ.



Functional Imaging

SPECT

Single photon emission computed tomography is an imaging technique which uses a rotating camera to detect gamma rays released by a gamma emitting radioisotope that is injected into the patient's veins. Different radioisotopes localize in specific organs or areas in the body and reveal the shape or function of the target area to the camera, which is then reconstructed into an image by a computer. The radioisotopes used have short half-lives and so they do not stay in the body for long.



CT

X-ray computed tomography creates an image by rotating an X-ray emitting source and an opposing sensor around a patient. As the X-rays pass through the patient they are deflected and changed. These minute changes are detected by the sensor and translated into an image. The resulting images are cross-sectional 'slices' of a patient, allowing doctors to create three-dimensional reconstructions of patients and their insides.

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(Images: E. Estrada Lobato/IAEA)