MAYFIELD CLINIC & SPINE INSTITUTE

Positron Emission Tomography (PET) scan
basic level

Overview
A positron emission tomography (PET) scan is a type of nuclear imaging test that shows the metabolic activities (energy usage) of your brain. While X-ray, CT and MRI scans look at the anatomy of your brain, a PET scan can give your doctor information about how your brain is working.

How does a PET scan work?
A PET scan integrates two technologies to view your body: computed tomography (CT) and a radioactive material (tracer). The tracer is what allows doctors to see how your body tissues absorb and use different chemicals in real time.

Before the PET scan a tracer is injected into your bloodstream (similar to a contrast agent in CT/MRI scans). The tracer is radiolabeled, meaning it emits gamma rays that can be detected by the PET scanner.

Once the tracer is absorbed in your body, a ring-shaped scanner is positioned over the body area. The computer collects the information emitted by the tracer and translates it into two-dimensional cross-sections.

What does a PET scan show?
PET scanning allows doctors to measure a range of activity including blood flow, blood volume, oxygen usage, tissue pH (acidity), glucose (sugar) metabolism, and drug activity. PET is very useful in watching the activity of cancerous tumors. Because malignant cells grow at such a fast rate, they metabolize more sugar than normal cells and can give your doctor a glimpse into how aggressive a tumor is or how its growth is slowed by treatment therapies.

Another common use for PET is for pre-surgical evaluation of medically uncontrolled seizures (Figure 1). By detecting metabolic changes in the brain, the surgeon can pinpoint the nonfunctioning area of the brain causing seizures.

How does the tracer work?
The radioisotopes used in PET to label tracers are 11C, 13N, 150, and 18F (carbon, nitrogen, oxygen and 18F used as a substitute for hydrogen). These radioactive forms of natural elements will pass safely through your body and be detected by the scanner. Various drugs and other chemicals can be labeled with these isotopes without changing their properties.

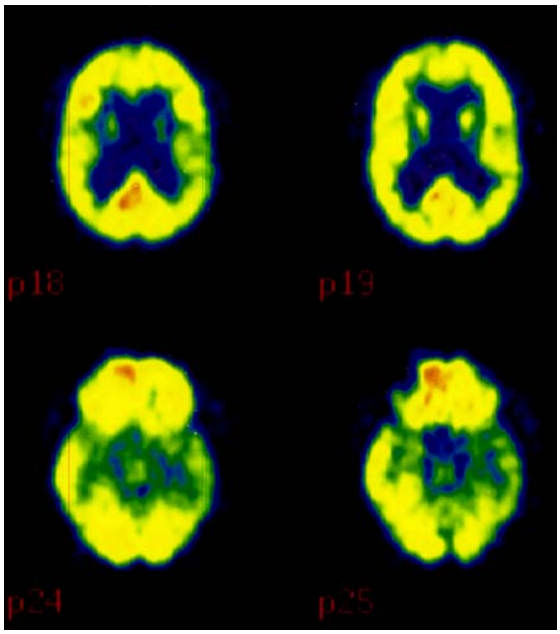

Figure 1. A PET scan of a patient with medically uncontrolled complex partial seizures. The temporal lobe on the left side of the brain metabolizes less sugar than the right, confirming for the surgeon the nonfunctioning area of the brain causing seizures.

The type of tracer used depends on what your doctor wants to measure. For example, if your doctor is looking at a tumor, he might use radiolabeled glucose (FDG) and watch how it is metabolized by the tumor.

Who performs the test?
A specially trained nuclear medicine technologist will perform the test in the Nuclear Medicine department of the hospital, or at an outpatient imaging center. The nuclear medicine doctor will review the images and report the findings.

How should I prepare for the test?

- Do not eat anything for 4–6 hours before the exam
- Wear comfortable clothing
- Be prepared to stay for 2–3 hours

What happens during the test?

First you will receive an injection of a small amount of radioactive tracer. You'll be asked to rest for about 30–45 minutes until the tracer reaches your brain (2 hours to be absorbed by bone). Next you'll lie comfortably on a table that moves slowly through the PET scanner. Be sure to remain as still as possible so that the machine can get accurate pictures. Depending on the information your doctor needs, you may be asked to perform certain tasks like read or speak to activate specific areas of your brain.

Once the scan is complete, you can leave. Be sure to drink plenty of fluids to flush out any tracer left in your body.

What are the risks?

The radiolabeled tracer is radioactive, which means your body is exposed to about the same amount of radiation as in two chest X-rays. The radioactive chemicals have very short half-lives and they won't remain in your system long. There is no need to avoid interacting with people. Women who are pregnant or nursing should not undergo a PET scan.

How do I get results?

The nuclear medicine doctor will promptly review your images and communicate directly with your referring doctor, who in turn will discuss the results with you.

Since PET measures the chemical activity of tissues some diseases such as diabetes or other metabolic disorders may give false results.

Sources & Links

If you have further questions about this diagnostic test, contact the doctor that ordered the test or visit:

www.radiologyinfo.org

www.nlm.nih.gov/medlineplus/diagnosticimaging.html

Glossary

gamma rays: electromagnetic radiation emitted during radioactive decay and having an extremely short wavelength.

glucose: a simple sugar that is a source of energy for the body and the only source of energy for the brain.

positron emission tomography (PET): a nuclear medicine test in which tissue function can be imaged. Damaged tissues have reduced metabolic activity; therefore, gamma radiation from these areas is reduced or absent.

radiolabel: the technique of attaching, or "tagging", a radioactive molecule to another molecule (such as a protein) so that it can be identified in the body. The radiolabeled substance emits positrons that can be picked up by a special scanner.

tomography: the technique of using rotating X-rays to capture an image at a particular depth in the body, bringing those structures into sharp focus while blurring structures at other depths.

tracer: a substance, usually radioactively labeled, which is injected into your body and can be followed to gain information about metabolic processes.

Sources

Society of Nuclear Medicine
www.snm.org/nuclear/whats_nm.html
The PET scan, a window into the brain
www.epub.org.br/cm/n01/pet/pet.htm
Nuclear imaging: SPECT and PET Scans
www.spineuniverse.com/conditions/spectscan.html
What is a PET scan?
www.falange.demon.co.uk/explain-petscan.htm
PET www.nationalpetscan.com/petref.htm

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