Lec3_ Medical imaging-part2

Positron emission tomography (PET) machine

Positron emission tomography (PET) is one of the important medical imaging devices that reveal important details of the organs and tissues of the body by injecting a safe radioactive chemical called a radioactive substance and the device is called a positron emission tomography (PET) scanner.

This device detects which diseased cells are absorbing large amounts of the radioactive chemical, indicating a potential health problem. In addition, the PET scan has other capabilities such as measuring some vital functions of the body, such as blood flow, oxygen use, and blood sugar (glucose) metabolism. Organs and tissues that are not working properly can be identified using this device. The most common importance of using this HHR device is to detect cancer cells to help measure their spread in the tissues of the body.

A positron emission tomography (PET) scan produces detailed, 3-D images of the inside of the body. The images can clearly show details of the body being examined, including any abnormal areas, and can shed light on how well certain body functions are working.

A PET scan can show how well certain parts of your body are working, rather than simply how they look.

PET scans are particularly useful in investigating confirmed cancers to determine how far the cancer has spread and how well it is responding to treatment.

Also, PET scans are sometimes used to help plan procedures, such as coronary artery bypass grafting or brain surgery to treat epilepsy. The device can also be used to diagnose some conditions that affect the normal functions of the brain, such as dementia.

Some patients have a kind of phobia when they enter enclosed spaces. They must be helped to overcome this barrier by preparing the patient before the day of the examination for the possibility of taking a mild sedative to help him relax. In addition, avoid wearing jewelry and clothing that contain metal parts because they will need to be removed. It is a good idea to wear loose, comfortable clothing. It may be possible to wear it during the examination, although sometimes you may be asked to wear a hospital gown. In addition to avoiding strenuous exercise for 24 hours before your appointment. It is advised not to eat anything for 6 hours in advance, but you can drink water.

But the more important question is are there any risks in getting a PET scan? The amount of radiation in the radioactive tracer is very low. Where it does not remain in the patient's body for a long time. The patient should drink plenty of water after the PET scan to help flush the radioactive drug from his body. In general, PET scans are safe and rarely cause problems. However, PET scans have a number of exceptions. First, women who are pregnant or breastfeeding should not have a PET scan. Radiation may be harmful to an unborn baby and can pass to the infant in breast milk.

Some people may have an allergic reaction to PET radioactive materials or CT contrast dyes. The medical team can give medication to slow and stop this response quickly.

In addition, people with diabetes may not absorb the sugar in the radioactive tracer, which may affect the results of the examination. This can be addressed with work that will provide suggestions for adjusting your diet and medications prior to the test.

Challenges of developing a PET scan

Advances in positron emission tomography (PET) support its continued use as an important clinical tool. PET scans are actively used in a variety of applications including oncology, cardiology, and neuroscience. Quantitative imaging of physiological, biochemical, and pharmacological targets has paved the way for such applications as metabolic assessment of tumors and quantification of tumor processes.

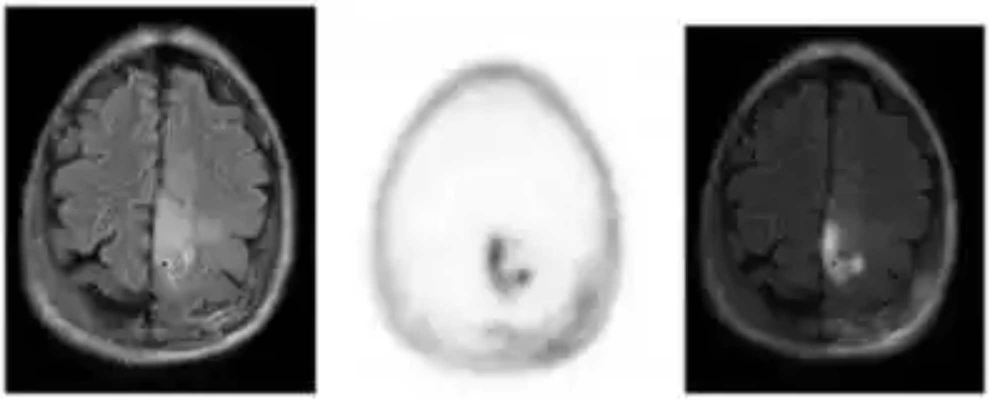
As PET technology continues to evolve, advanced digital detectors and image reconstruction software enable high levels of sensitivity, image quality, and diagnostic insights that inform clinical decisions. Conventional clinical use of the positron emission tomography (PET) technology employs a stable image acquisition technique, in which the imaging is acquired in a single time frame, after the patient is injected with the radioactive intent. New imaging methods are currently used to image the patient using a dynamic whole-body approach to PET imaging.

A PET scan differs from a CT scan or an MRI in some ways. Both X-ray computed tomography and magnetic resonance imaging (MRI) machines produce still images of organs and body structures. While PET scans use a radioactive tracer to show how the organ is working in real time. PET scan images can detect cellular changes in organs and tissues prior to CT and MRI scans.

A new technology has been invented that combines the possibility of a PET scan with a computerized tomography (CT) machine and an MRI machine, that is, performing a PET scan and a CT scan at the same time (PET-CT). This combined test produces 3D images that allow for a more accurate diagnosis. Some hospitals now use a combination PET/MRI scan. This new technology produces high-contrast images and can be used primarily to diagnose and monitor soft tissue cancers (brain, head and neck, liver and pelvis).

A positron emission tomography or magnetic resonance imaging (PET-MRI) scanner is a large imaging machine somewhat similar to a CT or MRI scanner. From start to finish, the scanning and imaging process takes about two hours to complete and does not usually require an overnight hospital stay.

Although the outward appearance is similar between the PET scanner and the magnetic resonance imaging machine, the technique and details of obtaining the image differ. Where the patient is injected with a radioactive substance that has the ability to mass around the cancerous tissue, and this gives her the ability to obtain the details of the cancerous tissue. But PET scans are often combined with CT scans to produce more detailed images. This is known as a .PET-CT scan. See Figure (1-8) [50] and Figure (4).



MRI PET-FECH / CT MRI+PET

Diffusion tensor imaging (DTI)

The diffusion tensor was proposed by Peter Baser, an American citizen, in 1994. Before the advent of the diffusion tensor, magnetic resonance imaging and computed tomography had been advanced in research and use.

The main idea of building an image using a diffusion tensor imaging device is based on understanding the motion and distribution of hydrogen atoms in water molecules within soft tissues. The collision of water molecules leads to diffusion; Diffusion is anisotropic because it is not identical in all directions. With the idea that water molecules spread more freely in the main direction of the axes, and not across them. Maximum scattering is displayed as the image is generated based on divergent scattering, so the image contrast will increase. There are three factors to be considered in the configuration of the diffusion tensor imaging device infrastructure. The first factor is represented by eigenvectors and eigenvalues, which in turn describe the physical properties of materials; For example, the largest Aiken Factor vector indicates the main propagation direction, which corresponds to the direction of the fibers. The second is the apparent diffusion coefficient which shows the direction of the diffusion measurement.

Most of the applications of the diffusion tensor imaging device are in imaging the components of the musculoskeletal system: such as tracking skeletal muscle fibers in three dimensions. This may be useful in monitoring progression in musculoskeletal diseases because it promotes densities of muscle fibers, see Figure (5).

Diffusion tensor imaging technique has been recognized as a tool for neuroimaging. Most studies agreed that preoperative planning with a diffusion tensor device improves postoperative neurological deficits, giving greater resection results and shortening surgery time.

The results also indicate that reassessment of diffusion tensor device images before surgery helps better visualize transformations of the white matter pathways, see Figure (6).

The use of a diffusion tensor device may give essential information on the pathways of the white matter tracts for a better surgical approach, and ultimately reduce the risk of postoperative neurological deficits.