MODERN APPROACHES TO POSITRON EMISSION TOMOGRAPHY

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Introduction. Positron emission tomography (PET)[1] is a functional imaging technique that uses radioactive substances known as radiotracers to visualize and measure changes in metabolic processes, and in other physiological activities including blood flow, regional chemical composition, and absorption. Different tracers are used for various imaging purposes, depending on the target process within the body. For example, 18F-FDG is commonly used to detect cancer, NaF18F is widely used for detecting bone formation, and oxygen-15 is sometimes used to measure blood flow.

Relevance. PET scan is an effective way to help identify a variety of conditions, including cancer, heart disease and brain disorders. Your doctor can use this information to help diagnose, monitor or treat your condition.

Purpose of the study. To identify a variety of cancers and disorders of brain and other organs of the body ,it also helps to watch regular blood flow through out the body .

Materials and methods of research . The performance of radiation detectors used in positron-emission tomography (PET) is determined by the intrinsic properties of the scintillators, the geometry and surface treatment of the scintillator crystals and the electrical and optical characteristics of the photosensors. Experimental studies were performed to assess the timing resolution and energy resolution of detectors constructed with samples of different scintillator materials (LaBr3, CeBr3, LFS, LSO, LYSO: Ce, Ca and GAGG) that were fabricated into different shapes with various surface treatments. The saturation correction of SiPMs was applied for tested detectors based on a Tracepro simulation. Overall, we tested 28 pairs of different forms of scintillators to determine the one with the best CTR and light output. Two common high-performance silicon photomultipliers (SiPMs) provided by SensL (J-series, 6 mm) or AdvanSiD (NUV, 6 mm) were used for photodetectors. The PET detector constructed with 6 mm CeBr3 cubes achieved the best CTR with a FWHM of 74 ps. The 4 mm co-doped LYSO: Ce, Ca pyramid crystals achieved 88.1 ps FWHM CTR. The 2 mm, 4 mm and 6 mm 0.2% Ce, 0.1% Ca co-doped LYSO cubes achieved 95.6 ps, 106 ps and 129 ps FWHM CTR, respectively. The scintillator crystals with unpolished surfaces had better timing than those with polished surfaces. The timing resolution was also improved by using certain geometric factors, such as a pyramid shape, to improve light transportation in the scintillator crystals.

A PET (positron emission tomography) scan is an imaging test that uses radioactive material to diagnose a variety of diseases. Doctors use it to find tumours, diagnose heart disease, brain disorders and other conditions. A PET scan provides a picture of the body working, not just a picture of its structure, like some other scans.

If you have a PET scan, you'll be given an injection of a small amount of short-acting radioactive liquid, known as a tracer. The one most commonly used is FDG (fluorodeoxyglucose).

FDG is a simple sugar — it's glucose that has been radiolabelled, and it gives off energy in the body, which can be seen by the scanner.

The rate that the sugar is taken up by the body's tissues provides an indication of how active the tissue is. For example, cancer cells grow quickly, which needs a lot of energy, and hence a lot of sugar. This increased uptake of sugar makes them show up as bright hot spots on the scan.

Healthy tissue also uses more sugar than unhealthy tissue, so an area where there is little tracer may indicate unhealthy tissue or reduced blood flow.

PET scans can be used for many purposes, including:

- finding tumours
- monitoring the spread or recurrence of cancer
- monitoring a tumour's response to treatment
- diagnosing and evaluating heart disease
- in refractory epilepsy — to assess whether a person is suitable for surgery

The scan usually takes about 15 to 20 minutes but you can expect to be in the PET imaging department for between 2 and 3 hours.

Before the scan, you should:

- ask about any food and drink restrictions before your scan
- bring any previous x-ray or radiology images you have
- let staff know if you're breastfeeding, or if you are (or might be) pregnant
- tell them if you have diabetes
- tell them if you are likely to feel anxious about being in a closed space

After arriving at the hospital or radiology centre, you will change into a gown and remove all metal and jewellery items. Staff will insert an intravenous line into a vein on the back of your hand or arm. Your blood sugar levels will be checked and then the radioactive tracer will be injected into your vein through the intravenous line.

You may then need to rest quietly in a bed or chair for 90 minutes. For some scans you may need to drink some contrast material. You will be able to empty your bladder before the scans.

The PET scanner has a flat bed which slides into a round opening. Once in the PET scanner, you will be asked to remain as still as possible, while the scans are being done. You can tell the staff if you get stiff or uncomfortable, or if you are feeling claustrophobic.

The scan usually does not take more than 20 minutes.

After the scanning, staff will check the images. They will remove your intravenous line. After the test you should drink plenty of water to flush out the radioactive tracer. If you are breastfeeding, you will be given specific instructions.

A specialist will examine the scans and write a report for your doctor, who will explain the results to you.

Results . total of 754 patients (mean age, 59.38±9.28 years; age range 31–88 years) were recruited in our study. Among the lung cancer patients diagnosed by PET-CT, pathological diagnosis demonstrated that 705 cases were confirmed with lung cancer, and 49 cases were diagnosed with benignant disease. The false positive rate of PET-CT was 6.50%.

Conclusions. Thus,Based on the current model and given the limitations that have been highlighted in terms of availability of data, the results of the current analysis suggest that the use of PET-CT in the diagnosis of recurrent or persistent lung l cancer is not cost-effective for symptomatic or asymptomatic in mans and womans.