

Positron emission tomography (pet)

[Business](#), [Decision Making](#)



1. ABSTRACT : This study is an effort to highlight the contributions of PET scans in the field of oncology. POSITRON EMISSION TOMOGRAPHY (PET) allows noninvasive, quantitative studies of biological processes in the tumor tissues. Investigators can use PET, to study the Pharmacokinetics of anticancer drugs, Furthermore; PET provides various markers to access tumor response early in the course of therapy. PET is used as a sensitive test to assess the activity of new cytotoxic agents in phase 2 studies and early identification of non-responding tumors through PET scans provides the opportunity to adjust treatment regimes according to individual Chemosensitivity of the tumor tissues.

REF: 1 Key words: Pharmacokinetics, Chemosensitivity 2. INTRODUCTION :“ POSITRON EMISSION TOMOGRAPHY” is based on the phenomenon of spontaneous emission by the nuclei of some unstable ultra-short radionuclide (USLRs) in which the number of protons exceeds that of neutron. The positron annihilates with an electron releasing two gamma photons having same amount of energy (511KEV) in opposite direction at almost 180°. PET scan is widely used for the diagnosis and staging of cancer’s as cancer have high glycolytic activity. Nowadays PET as a combined modality with Computed Tomography is used for diagnosis of cancer and other diseases such as Alzheimer’s disease, Stroke, Epilepsy and provides physiological information about the human body, anatomical information can also be entertained to enlighter the diagnosis with strong evidences.

REF: 2 and 3 3. BENEFITS GAINED FROM POSITRON EMISSION TOMOGRAPHY: Positron emission tomography(PET) is now in routine use in oncology,
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through the success of metabolic imaging mainly with fluorodeoxy glucose clear benefits is obtained with FDG-PET in the assessment of patients with recurrent or residual diseases, especially colorectal cancer and lymphomaREF: 4. To address the role of PET using FDG to monitor primary (neo adjuvant) chemotherapy in patients with locally advanced breast cancer, whole body PET with F-18 FDG has a higher rate of detection of mediastinal lymph-node metastases as well as of extrathoracic metastasesREF: 5. It has also proved effective in the management of non-small-cell lung cancerREF: 6, 7, 8. The present study of PET of regional Cerebral blood flow in normal adults, using the oxygen bolus technique, studies of brain damaged patients, existence of a selective impairments of face processing, Prosopagnosia, resulting from lesions at different loci in the occipital and temporal lobeREF: 9. PET has also contributed in monitoring primary Chemotherapy in Breast cancer, detection of recurrent Prostate cancer. 4.

CLINICAL APPLICATIONS OF PET IN ONCOLOGY: For the diagnosis of unknown primary tumours and detection of metastasis, whole body PET scans are commonly used which demonstrate an overview of radioactivity in the body which can be possible after a consecutive scans and combine all these scans in a 3-dimensional volume hence used in the oncological studiesREF : 10. Pet using F-18 fluorodeoxyglucose (FDG) as tracer has been shown to be clinical benefit by improving the staging of some cancers thereby allowing more appropriate treatment decisions and sometimes avoiding the inappropriate use of radical surgery and radiotherapy. REF: 11 The cancerous cells have abnormal rate of glycolysis in the presence of

oxygen, so FDG is an ideal agent to detect these changes in the metabolism of glucose, greater the accumulation of FDG, greater the glucose uptake and metabolic activity of the tissue examined, therefore it can easily recognize that the regions of increased concentrations of FDG means hypermetabolic regions refers the chances of malignant tumours REF: 12. INITIAL

DIAGNOSIS PET scan is still beneficial in that it may prevent futile attempts at cure , such as sparing the patient's physiological reserves and enhancing the patient's quality of life , So the early diagnosis may effect and helpful in finalising the treatment strategies. REF: 13

MONITORING RESPONSE TO THERAPY Pet can be as predictive of the patient's response to treatment and patient outcome, it can be performed as early as seven days before any chemotherapy or radiotherapy treatments and also eliminates the ineffective treatment which may diminish the patient's physiological reserves and compromise quality of life REF : 14. ASSESSING RECURRENCE Pet is also used

in determining the cancer recurrence which is clinically important and can improve the prognosis and survival of patient's with cancer REF: 15

PATIENT MANAGEMENT Pet imaging provides both the doctor and the patient with more detailed information than other diagnostic tools by certain above key points it provide accurate information regarding the current status of the patient hence improving the decision making which impact on the clinical management of cancer patients. REF : 16

RECOMMENDATION : Your doctor may advised, a PET scan due to the following reasons, With the use of PET for disease staging, follow-up and therapy monitoring in a number of oncological indications there is growing interest in the use of PET for radiation treatment planning.

PET scan is used to detect various types of benign and malignant cancers. PET is also used to diagnose and monitor some stages of cancers with great accuracies at very early stage. PET is used to identify an appropriate site from which a biopsy would yield adequate representative tissue for diagnosis. PET scan helps the doctor to decide whether the best treatment of cancers is for the patient as well as show the working of cancer therapies and treatments. REF: 17 The tracers ^{99m}Tc (technecium) , ^{111}In (indium), ^{132}I (iodine) can be used to highlighted the living subject , so your doctor easily inspect the metabolic functioning of living subject it may be help the doctor to differentiate between normal and abnormal anatomical prospective of the living subject.

PET scan can also show how well a cancer drug is working inside the living body. (^{18}F) fluoro-3-hydroxymethyl butyl) guanine (FHBG), tracer that is useful for the imaging of herpes simplex virus type 1 thymidine kinase reporter-gene expression. REF: 18 FDG PET is a whole- body scanning technique that has greater sensitivity and specificity for nodal staging then CT or MRI in many tumor types sometime PET scan is used to find out the lymph nodes cancer, in the center of chest.

Sometimes your doctor may recommended you to a PET scan rather than a CT because when a patient have had treated with a CT scan that results would still show the remaining signs of cancer cells in living subject, that might be just scar tissues with no activity that has been killed by the treatment, and PET scan easily determined the active and non-active cancer cells, it may be used to evaluate the exact measurement of the cancer cells

area and determines whether it has spread to other parts of the body or not. It is also used in the differentiation between a lump and a cancer. A PET scan may be recommended by a doctor to not only detect cancer but also useful in heart problems like coronary artery disease (CEAD) and damage caused by heart attack and myocardia and expecting to be beneficial in angioplasty and stenting coronary artery bypass surgery (CABG). In a survey of people, 400 brain cancer cases has been seen with asymptomatic patient because the brain cancer symptoms are vary person to person so PET would be commonly advised for this. There may be a series of tracers already exist which are used in PET to imaging at the cellular level and show the complex systemic diseases like brain tumor. PET scan is recently gained advancement in the imaging monitoring of various cancers including breast cancer(The use of PET scanning has been reported by several studies to detect extra-axial nodal disease in 7% to 25% of cases and distant metastases in 10% to 21% in routine studies.

), lung cancer, colorectal, melanoma, lymphoma, head and neck, thyroid cancer, Esophageal cancer, cervical cancer, Renal cell cancer (RCC), Urinary bladder cancer, Gastrointestinal and hepatobiliary cancers, Pancreatic cancer, Ovarian cancer, Thymic tumors, Testicular cancer, Anal cancer. REF: 19 International Atomic Energy Agency (IAEA) expert panel concluded that FDG-PET is recommended for the diagnosis of lung cancer as well as loco-regional and distant staging of nonsmall-cell lung cancer (NSCLC) and pulmonary nodules, for which it is significantly more accurate than computed tomography (CT) in the distinction between benign and malignant lesions as small as 1 cm. An overall sensitivity of 96% (range, 83-100%), specificity of

79% (range, 52-100%), and accuracy of 91% (range, 86-100%) can be expected.

PET is a superior imaging technique for mediastinal lymph node staging in potentially operable NSCLC. To examine the biological behavior of lung cancer in more detail than FDG, with promising findings with the thymidine analogue 3'-deoxy-3'-¹⁸fluorothymidine (FLT), a more stable proliferation marker. PET is more sensitive than CT in measuring the biological effects of anticancer therapy, and it can be used for additional early response assessment in clinical trials. PET will have an advantage in terms of its greater sensitivity at all depths, however it will probably be part of a multimodality imaging approach. REF: 20

Keywords: Cancer, ¹⁸Fluorine-2-fluoro-2-deoxy-d-glucose, guidelines for PET/CT, oncology, positron emission tomography.

6. LIMITATIONS : Despite of its remarkable achievements in Oncology PET scans have certain limitations which compromise its functional efficiency. A relatively new medical procedure, PET imaging is expensive with an average cost ranging between \$900 to \$1400. The resolution of body structures depicted by PET/CT may not be as high as with other imaging techniques such as CT or MRI. PET scan can be time consuming.

It can take several hours to days for the radiotracer to accumulate in the anatomy of interest and imaging may take several hours to reach completion. Furthermore test results of diabetic patients or patients who have eaten within few hours prior to the examination can be adversely affected due to altered blood sugar levels. REF: 21

The radiotracer used for
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imaging takes 30 to 60 minutes to localize in the body and the scanning process takes between 45 to 60 minutes. Patients with limited mobility or difficulty remaining still for long periods of time may find PET scan process uncomfortable or impossible to prefer. Moreover, the limits on the amount of tracer that can be safely administered, makes it difficult to clearly render the body tissues. This means certain abnormalities can be missed or false positive results can be obtained.

The tracer used in PET imaging is very short lived and is efficient for only short period of time this time management is a pre requisite for PET imaging. PET scans risks caused by the radioactive radiotracer used during this procedure. Although the radioactive tracer used in PET imaging are short lived, the radioactive substance e may not be suitable for patients who are pregnant or are at breast feeding.

The exposure in PET imaging systems means that there is only a limited amount of times a patient can undergo this procedure. PET imaging requires cyclotron, an expensive machine that creates the radio isotopes that are used in the radioactive tracers required for PET imaging. PET scans are not offered in the majority of medical centers in the world. Consequently, it is a difficult treatment to acquire. REF: 227. CONCLUSION : The above discussion concluded that Positron emission tomography works on the principle of annihilation using ultra-short radionuclide having high energy which emits in the form of gamma rays and detected by the detectors. It provides the information about cancerous tumours, lymphomas and different types of metastasis in the body by administering F-18 fluorodeoxyglucose which

provide the initial diagnosis of the high metabolite cells which are mainly cancerous cells and then provide appropriate information about further therapies and monitoring of the disease.

The radiotracers of Pet are very short lived and is efficient for only short period of time thus time management is very important along with the scan of diabetic patients who have eaten with in few hours prior to the scan can be adversely affected due to altered blood sugar levels also it can be more cost effective and expensive exam, these all contributed into minor

drawbacks of Pet. 8. REFERENCES : 1) [Http//doi org/101200/JCO 2006066068](http://doi.org/10.1200/JCO.2006.06.6068). 2) A. M. J. Paans, department of nuclear medicine & Molecular Imaging , University Medical Center Groiningen, the Netherlands.

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