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Review Article

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ADVANCEMENT OF PET/CT SCAN IN DETECTING EARLY STAGE OF CANCER

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ABSTRACT

Cancer is a disease caused when cells divide uncontrollably. Cancer is caused by changes to DNA. Most cancer-causing DNA changes occur in sections of DNA called genes. A PET-CT scan combines a CT scan and a PET scan. It gives detailed information about your cancer. You usually have a PET-CT scan in the radiology department as an outpatient. A radiographer operates the scanner. A CECT is a diagnostic procedure in which a contrast material is injected and rotating beams of X-rays are used. This test is usually done to determine the cause of symptoms like cough, shortness of breath, chest pain or to detect the presence of any tumors, injury to the internal organs. The aim of the work is to evaluate the accuracy of PET/CT vs CECT in the assessment of response to therapy in cancer patients, assessment of both early and late therapeutic response and to explore the diagnostic value of the cross-modality fusion images provided by positron emission tomography/computed tomography (PET/CT) and contrast-enhanced CT (CECT).

KEYWORDS: PET/CT, CECT, Cancer.

CANCER

Cancer is the uncontrolled growth of abnormal cells anywhere in the body. These abnormal cells are termed cancer cells, malignant cells, or tumor cells. These cells can infiltrate normal body tissues. Many cancers and the abnormal cells that compose the cancer tissue are further identified by the name of the tissue that the abnormal cells originated from (for example, breast cancer, lung cancer, and colorectal cancer). When damaged or unrepaired cells do not die and become cancer cells and show uncontrolled division and growth - a mass of cancer cells develops. Frequently, cancer cells can break away from this original mass of cells, travel through the blood and lymph systems, and lodge in other organs where they can again repeat the uncontrolled growth cycle. This process of cancer cells leaving an area and growing in another body area is termed metastatic spread or metastasis. For example, if breast cancer cells spread to a bone, it means that the individual has metastatic breast cancer to bone.

Risk Factor – Anything that may cause a normal body cell to develop abnormally potentially can cause cancer.

Some cancer causes remain unknown while other cancers have environmental or lifestyle triggers or may develop from more than one known cause. Some may be developmentally influenced by a person's genetic makeup. Many patients develop cancer due to a combination of these factors.

Factor-

1. Heredity
2. Ionizing radiation
3. Chemical substances
4. Dietary factors – Meat, energy balance, fat, protein, alcohol, nitrates
5. Estrogens
6. Viruses
7. Stress
8. Age

Positron Emission Tomography/Computed Tomography (PET/CT)

PET/CT is an advanced imaging modality that evaluates tissue and organ physiology based on the difference in the cellular metabolism that is opposite to the anatomic abnormalities that serve well as the basis for CT, MRI, and EUS. PET scanning widely uses the fluorine-18 (18F) fluorodeoxyglucose (FDG) tracer in clinical oncology called 18F FDG PET. FDG is a glucose analog. It decays by positron emission that is taken up by glucose using cells, whose mitochondrial form is significantly elevated in rapidly growing metastatic tumors and phosphorylated by hexokinase. At the tissue level, FDG uptake is closely linked to the number of viable cells, proliferation activity, tissue perfusion, hypoxia, and the presence of inflammatory cells. At the organ level, the amount of FDG uptake is closely linked to organ perfusion, tumor volume, intrinsic glucose metabolism, and the presence of inflammatory responses such as concurrent chemotherapy and radiation therapy

or stimulated glucose metabolic activity from the use of medications. The images obtained by the PET may be more sensitive than the other traditional modalities because they reflect an alteration in tissue metabolism.

PET has some limitations like poor anatomic detail so difficult to separate primary tumor from adjacent lymph nodes, quite expensive than other modalities and it is highly sensitive, in case a patient was suffering from chemical imbalance for instance those who are diabetic or just ate something before undergoing the procedure, the likelihood of PET imaging false results is high.

PET-CT scans are for many types of cancer. They are generally thought to be more accurate in diagnosing cancer than PET or CT scans alone. PET-CT scans can help to:

- Diagnose cancer
- Find out how big a cancer is and whether it has spread (stage a cancer)
- Decide whether you can have surgery to remove your cancer
- Decide which is the best treatment for your cancer
- Check whether your cancer has come back
- Plan radiotherapy treatment

Contrast – Enhanced Computed Tomography (CECT)

The full form of CECT stands for Contrast-Enhanced Computed Tomography also called a CT scan with contrast. CECT (contrast-enhanced computed tomography) is an imaging diagnostic method that helps your doctor to take a clearer and closer view of your internal organs and soft tissues in the body.

CECT (Contrast Enhanced Computerized Tomography) chest scan is used to create a detailed three-dimensional image of the chest or thorax to identify problems associated with the heart, lungs, food pipe, rib cage, spinal column, and surrounding soft tissues.

CECT scanning is often considered the best method for detecting abdominal pain, suspected cancer, kidney or gall bladder stones, and infections. It also helps assess treatment progress of any illness.

METHOD

PET SCAN

- The patient was instructed for 6 hours fasting before acquisition to decrease physiologic glucose levels and to reduce serum insulin levels.
- The patient was kept in a dimly lit room for 18F-FDG (FDG) administration and the subsequent uptake phase.
- Patient was asked to remove all metal ornaments like belts, jewellery, ear rings, bra, dentures, hearing aids, coins, pin, bracelets etc from the patient's body and the patient was asked to wear zipless hospital gown.
- IV cannula was inserted into the patient's arm for the administration of radiopharmaceutical (FDG).
- Patient was screened for contrast sensitivity before contrast administration and the history of renal disease was taken. Patient was asked for metformin treatment of diabetes Mellitus.
- Patient blood glucose level was checked prior to the FDG administration because tumor uptake get reduced in hyperglycaemic state
- Patient was asked to void before acquisition.

CECT SCAN

Though CT scans is a fast reliable and painless procedure which does not require special preparation. However, the uses of contrast material do need some precautions and preparations:

- 4-6 Hours of fasting is mandatory. A patient should not eat anything before the scan.
- Do not carry any kind of material objects.
- Inform the Doctor about pregnancy, existing allergy etc.
- The patient is asked to lie supine on the CT scan table. Then contrast is given intravenously on the table and CT scan is performed. The images from CT scan are read by the doctors to prepare the report.
- CECT Abdomen usually takes 15-30 minutes. However, actual scan time is less than 2 minutes.
- Drink Plenty of water after the scan.

DIFFERENCE BETWEEN PET/CT AND CECT

PET/CT	CECT
A PET/CT scan shows doctors how the tissues in your body work on a cellular level.	A CECT scan creates a detailed non-moving image of organs, bones and tissues.
A PET/CT scan shows molecular activity and helps doctors identify diseases in the earliest stages.	CECT scans show signs of an issue after a disease begins to change the structure of tissues or organs
PET/CT can detect both anatomical information as well as metabolically information.	CECT can detect only anatomical information.
Detect cancer earlier than other tests.	Pass X-Ray through the body to create images.
PET has its ability to detect distant metastasis organs outside the central nervous system.	CECT doesn't have the ability to detect distant metastasis organs outside the CNS.
More time consuming.	Takes 2 minutes.
More reliable when diagnosing cancer.	Less reliable than pet/ct.
a PET/CT scan is more costly than a contrast-enhanced CT scan	A Contrast-Enhanced CT scan is much less costly than a PET/CT scan

CONCLUSION

PET/CT using 18F-FDG is considered one of the leading oncologic imaging modalities at the present time with valuable applications in oncology for the detection of the disease at early stage to go for further treatment.

One cannot just rely on a CECT Scan or any other tests for the detection of cancer. It is only with the PET/CT scan that you will know for sure.

PET/CT can accurately detect the therapeutic response for the treatment with higher sensitivity than CECT as it shows both anatomical as well as metabolically information and the weakness of the conventional imaging is also reduced because of this.

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