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ORIGINAL ARTICLE

Comparison between findings of Gallium-68 Dota PET-CT and Contrast Enhanced CT scan in Neuroendocrine tumors.

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ABSTRACT… Objective: To compare the efficiency of contrast enhanced CT-SCAN and Gallium 68-DOTA PET CT for the detection of neuroendocrine lesions. **Study Design:** Cross Sectional and Analytical study. **Setting:** INMOL (Institute of Nuclear Medicine and Oncology Lahore). **Period:** February 2020 to December 2020. **Material & Methods:** Total of 70 patients between 18-68 year of age coming to Nuclear Medicine department of INMOL (Institute of Nuclear Medicine & Oncology Lahore) were included in the study convenient sampling technique were used to collect the data. **Results:** 70 patients were selected who had malignant type of tumor (mass forming or metastatic) patients, 29(41%) were diagnosed with Pancreatic Tumors, 12 (17%) were diagnosed with Metastatic Tumors, 10 (14%) were diagnosed with Mesenteric Tumors, 7 (10%) were diagnosed with Renal Tumors, 7 (10 %) were diagnosed with Liver Tumors, 3 (4%) were diagnosed with Thyroid Tumors, 1(1.4 %) was Breast Tumor and 1(1.4%) was mediastinal Tumor. In CT-Scan out of 70 patients 42(60%) patients were diagnosed with tumor while 28(40%) patients were normal, meanwhile in PET CT, out of 70 patients 55(79%) patients were diagnosed with tumor while 15(21%) patients were normal. Out of 70 patients PET CT was able to identify all 55/55 tumor patients correctly while CT visualized 42 patients correctly but omitting I 3 patients, causing false negative diagnosis. PET CT has sensitivity and Specificity of 100% & 99.9% respectively whereas CT had sensitivity & Specificity of 76.8 % and 51.8% respectively. **Conclusion:** In contrast with international studies PET CT have better diagnostic finding for evaluation and follow up of Neuroendocrine tumors as compared to contrast enhanced CT Scan. We can say PET CT is a good and better modality other then any contrast enhanced modality like contrast enhanced CT scan for the evaluation of neuroendocrine tumors.

Key words: CECT, PET-CT, NETs.

INTRODUCTION

Neuroendocrine system formed by the neuroendocrine cells and these cells are found in the whole body. These are behaving like neurons which produce hormones like endocrine cells. When they receive signal in respond they make and release hormones and it regulate most of the functions of the body. These cells are present in the organs of the whole body. Specially these are found in GIT which include esophagus, stomach, small intestine, colon, rectum and appendix they also present in gall bladder, pancreas and in thyroid. In the respiratory tract they are present in airways of lungs. Neuroendocrine cells present throughout the body. The pituitary gland, parathyroid gland, thyroid and adrenal glands are formed by the neuroendocrine cells.[1-2]

Hypothalamus is the central organ of neuroendocrine system. Hypothalamus and pituitary mostly control the peripheral hormone systems.[3]

The effects of the tumor is excess secretion of hormones from neuroendocrine cells and due to this excess secretion patients experience symptoms and demonstrate clinical effects-carcinoid syndrome which is caused by the

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tumors.[4]

The grading of neuroendocrine tumors describes the degree of differentiation that how fast a tumor cell is dividing and growing.

- Grade 1: Low grade tumor (slow growing cells)
- Grade 2: Intermediate grade tumor (intermediate rate growing cells)
- Grade 3: High grade tumor(rapidly growing cells)

The degree of differentiation is also defined by two phases as, well differentiated (the cells look more like healthy cells) and poorly differentiated (the cells look less like healthy cells).

CT scan can be done with or without the administration of contrast media (a pharmacological agent which increases or decreases the radio-opacity of a structure). Optimal contrast enhancement is important for the successful diagnostic CT scan. Significant of contrast enhanced CT is to highlight the area where any abnormality is present like between the lesions and surrounding tissues.[5]

Non contrast enhanced computed tomography is done without administration of contrast media which is useful in the evaluation of calcifications, fatty part in tumors seen in inflammation like appendicitis and infarction etc.[6]

PET CT is the modality which shows the anatomical structure of the body as well as also the function of the organs. Anatomical information is given by CT and metabolic function is seen by the PET. Firstly the patients goes into the CT machine and then in PET so it also showed the metabolic function of the organ under the same procedure.[7]

The key advantage of PET CT scanners is more useful because they have ability to change the data rapidly into the high statistical quality which is useful for the attenuation correction of PET.[8]
With the help of attenuation correction in PET it can control the loss of counts, scatter, distortion and random image noise. Without attenuation correction, artifacts can appear. The use of the CT scanner in this case, with the help of attenuation correction the data which is received by the two imaging modalities can be electronically and display on the screen. [9]

The objective of this study was the comparison of the efficiency of contrasts enhanced CT-SCAN and Gallium 68-DOTA for the evaluation of neuroendocrine tumors.

The aim of the study was to determine the diagnostic efficiency of Gallium68 PET-CT and contrast enhanced CT-Scan in neuroendocrine tumor. This study will help out the physician to evaluate neuroendocrine tumor with better modality.

MATERIAL & METHODS

This research study was approved by Institute of Nuclear Medicine and oncology Lahore. 70 patients with neuroendocrine tumors were selected in Institute of Nuclear Medicine and oncology Lahore between February 2020 to December 2020. Sample size were collected through

$n = \frac{z^2_{1-\alpha} p(1-p)}{d2}$ of 70 patients

A sample of size 70 patients were collected.[10]
Following quantities are used in the sample size calculation.
P=7.1 %
L=margin of error=5%
Level of significance =5% ($Z_{1-\alpha/2}$=1.64). We use Convenient sampling technique. This study was approved by ethical committee Ref. No. BOS/UIRSMIT/0084/19 on 10.07.2019.

Dual gantry PET-CT used in this study. PET CT is the modality which shows the anatomical structure of the body as well as also the function of the organs. Anatomical information is given by CT and metabolic function is seen by the PET. Firstly the patients goes into the CT machine and then in PET so it also showed the metabolic function of the organ under the same procedure.[11]

A DOTATATE PET CT helpful to diagnose the neuroendocrine tumors. These neuroendocrine tumors can occur throughout the body. A

radioactive conatins the somatostatin analogue tyrosine-3-ocetreotate with the PET to trace Gallium 68 which is chelating agent are DOTA. They are used as somatostatin receptors the agent which is in conjunction with the positron emission tomography to diagnosed the neuroendocrine tumors. Gallium 68-DOTATATE binds to somatostatin receptors which have much higher affinity then the type II somatostatin. They are found on the membrane of neuroendocrine tumors. They allowed the visualization of many somatostain receptors. Their subtype showed a large number on neuroendocrine tumors and their Mets.[12]

A small amount of DOTATATE is given to the patients via injection before the PET scan. It attaches to the neuroendocrine tumors and appear as bright spots on the image.

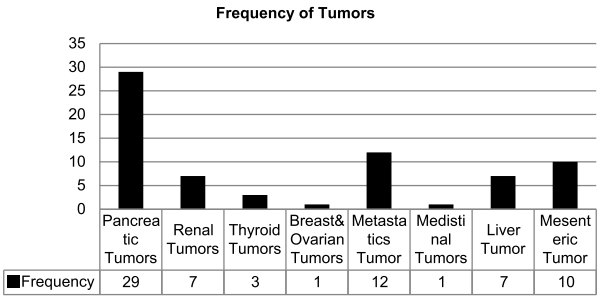
This study was compared the diagnostic efficiency of Gallium-68 PET CT and contrast enhanced CT scan in neuroendocrine tumors. This study was assisted in identifying better modality for the evaluation neuroendocrine tumors.

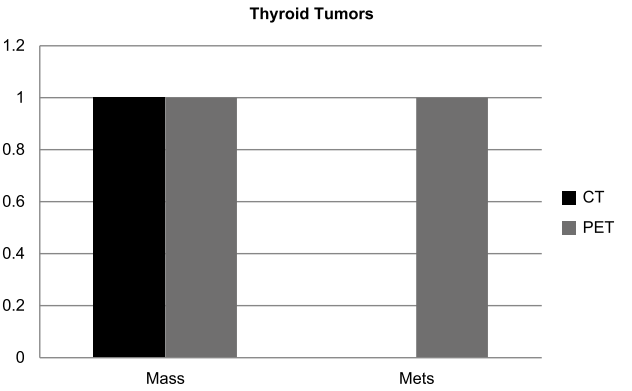
With the help of attenuation correction in PET it can control the loss of counts, scatter, distortion and random image noise. Without attenuation correction, artifacts can appear. The use of the CT scanner in this case, with the help of attenuation correction the data which is received by the two imaging modalities can be digitally displayed on the screen.[13]

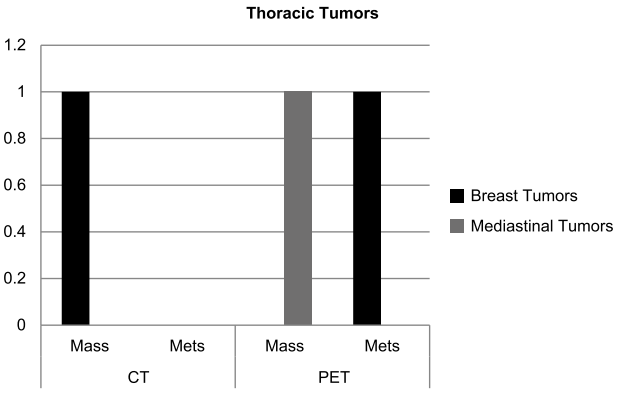
RESULTS

In this study seventy (70) patients were taken as a sample size out of which 41 (59%) were male and 29 (41%) were female who fulfilled the criteria, with neuroendocrine tumors were involved in this study. The mean age of patients ranged from 18 to 68 years with a mean of 41.19 ± 16.364.

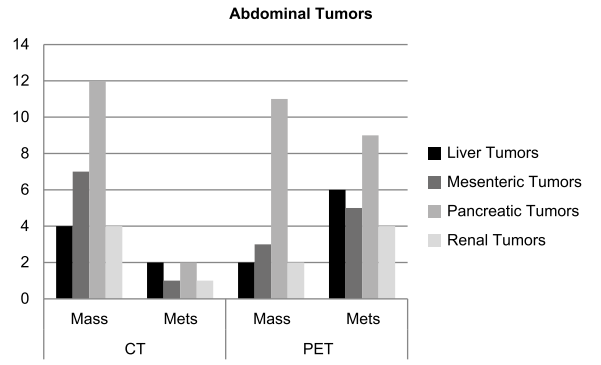
Fig shows that Out of seventy patients were selected who had malignant type of tumor (mass forming or metastatic) patients 29 (41%) were diagnosed with Pancreatic Tumors, 12 (17%) were diagnosed with Metastatic Tumors, 10 (14%) were diagnosed with Mesenteric Tumors,

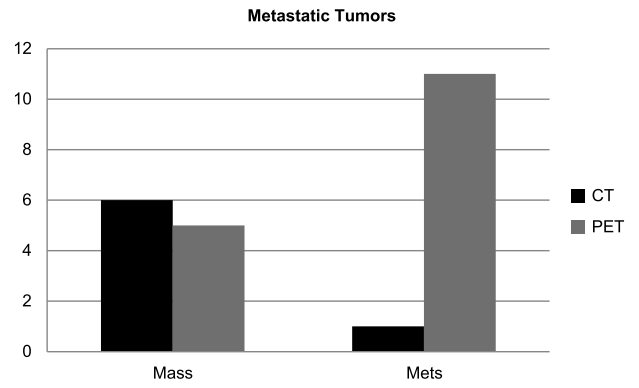






7 (10%) were diagnosed with Renal Tumors, 7 (10%) were diagnosed with Liver Tumors, 3 (4%) were diagnosed with Thyroid Tumors, 1(1.4 %) was Breast Tumor and 1(1.4%) was mediastinal Tumor.





In head and neck region out of 70 patients, 2 were presented with thyroid tumor. CT shows mass but no Mets, In PET-CT shows mass and multiple lesions (Mets). In thoracic region out of 70 patients, 1 was presented with breast tumor, CT shows mass but no multiple lesions (Mets) simultaneously PET-CT shows multiple lesions (Mets). Patient presented with mediastinal tumor, CT shows no mass and no Mets, while in PET-CT patient shows mass but no multiple lesions. In abdominal region out of 70 patients, 9 were presented with Hepatic tumor, CT shows mass in 4 and Mets in 2 simultaneously PET-CT shows mass in 2 and multiple lesions (Mets) in 6. 11 patients were presented with mesenteric tumor, CT shows mass in 7 and Mets in 1 while on PET-CT shows mass in 3 and multiple lesions in 5. 27 were presented with pancreatic tumors, CT shows mass in 12 and Mets in 2 simultaneously PET-CT shows mass in 11 and multiple lesions (Mets) in 9. 7 patients were presented with renal tumor, CT shows mass in 4 and Mets in 1 simultaneously PET-CT shows mass in 2 and multiple lesions (Mets) in 4.

Tumor	CT	PET CT
Seen	42	55
Not Seen	28	15

*** Specificity= (True Negative/True Negative + False Positive) *100**

***Sensitivity= (True positive/ True Positive+ False Negative) *100**

Out of 70 individuals PET-CT was able to identify all 55 / 55 tumor patient correctly while CT visualized 42 patients correctly but omitting 13 patients, causing false negative diagnosis. Whereas PET successfully pointed out 15 tumor free patients while CT identified 28 patients's tumor free diagnosing 13 additional false positive patients. Making PET-CT to have sensitivity & Specificity of 100% & 99.9% respectively whereas CT had sensitivity and Specificity of 76.8% & 51.8% respectively.

DISCUSSION

According to our study, seventy (70) patients were taken as a sample size out of which 41 (59%) were male and 29 (41%) were female who fulfilled the criteria of neuroendocrine tumors. The most common tumor which was found according to our study was pancreatic tumor, 12 patients presented with pancreatic tumor on contrast enhanced CT- scan most of the patient shows a single lesion while on PET-CT confirmed the multiple lesions are present and spread in the whole body. Sensitivity and specificity of PET-CT to finding the tumors were more than contrast enhanced CT-scan. Gallium-68-dotatate PET/CT was better than CT in detecting primary sites of the disease and highly sensitive and specific for diagnosis and treatment of neuroendocrine tumors.

A study conducted (Lawal IO, Olodae KO, Legana T) that "Role of Gallium-68-dotatate with positron emission tomography, computed tomography (^{68} Ga-dotatate PET/CT) in the management of neuroendocrine tumors (NET) and other somatostatin expressing".[5] In this study the commonest tumor was Gastro-enteropancreatic NET (41% of patients) and the commonest sites of distant metastases were lymph nodes and the liver which was 34.0% and 30.5% respectively. Positron emission tomography detected tumors in 19 patients where CT was falsely negative. The sensitivity, specificity, positive predictive value, negative predictive value and accuracy of 68 Ga-dotatate PET/CT imaging of NET and other SST expressing tumors were 94.16%, 91.89%, 95.55%, 89.47% and 96.55% respectively. According to my study Contrast enhanced CT- scan most of the patient shows a single lesion while PET-CT confirmed that the multiple lesions are present and are spread in the whole body (Mets). Making

PET-CT to have sensitivity and Specificity of 100% and 99.9% respectively whereas CT had sensitivity and Specificity of 76.8% and 51.8% respectively.[14]

A study conducted by Nils F. Schreiter, Martin Maurer, Detection of neuroendocrine tumors in the small intestines using contrast-enhanced multiphase Ga-68 DOTATOC PET/CT. Ga-68 DOTA PET/CT might improve the localization of intestinal NETs and improve the overall diagnostic accuracy of this modality in the assessment of intestinal NETs by adding information about lesion perfusion not available when only venous CT is performed. According to current study PET CT in the comparison of CECT is a good alternative imaging method to avoid contrast-related nephrotoxicity in patients who often develop.[15]

A study conducted Bryszewska M, e.g Positron emission tomography (PET) combined with computer tomography (CT) using (68)Ga-DOTATATE is a promising method for the evaluation of patients with recognized or suspected neuroendocrine tumors (NET). According to our study PET may detect the early onset of disease before other imaging tests can detect the changes on the cellular level, which the medical faculty can have better and precise diagnostics and the follow-up of Neuroendocrine tumors by Positron emission tomography (PET).[16]
Limitations of my study are following

- Costly imaging
- Not easily available modalities.
- Small tumors (less than 7mm) may not be detectable.

CONCLUSION

Positron emission tomography can detect the changes at cellular and early by other imaging modalities. We may conclude that PET CT is a good and better modality other then any contrast enhanced modality like contrast enhanced CT scan for the evaluation of neuroendocrine tumors.

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AUTHORSHIP AND CONTRIBUTION DECLARATION

No.	Author(s) Full Name	Contribution to the paper	Author(s) Signature
1	Sheikh Danial Hanan	Research contribution, Design of the work, Data analysis, Data interpretation, Drafting the article.	
2	Sajid Shaheen Malik	Content given, Methodology design, Final approval.	
3	Muhammad Numair Younis	Conception of the work. Data collection & provider, Clinical supervisor.	
4	Syed Amir Gillani	Revision of the article, Final approval of the version of published.	
5	Syed M. Yousaf Farooq	Statistical Techniques.	
6	Abubaker Shahid	Clinical oncology assessment, Revision of article.