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Internal Dose Assessment of Lymphoma Patients Administered with 18F-FDG Radiopharmaceutical in PET-CT Examination

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Background
Nuclear medicine is based on the use of radioactive tracers which provides specific images of the human body and its pathologies. However, the use of radioactive pharmaceuticals carries potential risk toward biological effects. This could be potentially the case with Positron Emission Tomography (PET) examination administered with 18F-FDG tracer. The aim of this study was to evaluate the internal dose assessment involving absorbed dose and effective dose using the IDAC-Dose 2.1 program. IDAC-Dose 2.1 was developed by the International Commission of Radiological Protection (ICRP) to estimate the internal dose of patients' organ or tissue in diagnostic nuclear medicine based on the newest model of kinetics of radiopharmaceuticals in the human body proposed in ICRP Publication.

Methodology
Data of 30 lymphoma patients administered with 18F-FDG for PET-CT scan (Siemens Biograph 64-slice, Germany) examinations at our institution were collected retrospectively. The data collected including patients' age, weight, fasting blood glucose (FBG), height, BMI, race, gender, date of scanning, type of examination and scan duration. In addition, the administered activity of radiopharmaceutical used and its biokinetic data were also recorded. The biokinetic data of 18F-FDG was in the form of cumulated activity per administered activity Ã/Ao. Based on the current practice, the dosage of 18F-FDG administration depends on the patient's blood glucose level. If the level was <7.0 mmol/L, a dosage of 8 mCi 18F-FDG was injected to the patient with weight of 40 kg and above. For a patient with weight below 40 kg, a dosage of below 8 mCi of 18F-FDG was administered. If the level is >7.0 mmol/L, a further investigation by physician was required. The administered activity was determined by measuring the residual in the syringe. Subject's absorbed dose and effective dose were calculated using the IDAC-Dose 2.1 program. The program has listed 83 source regions and 47 target tissues or organs. In this work, adrenals, brain, breast, kidneys and liver were included for measurement. All data was further analysed using a statistical method such as Pearson correlation coefficient and Spearman rank correlation for correlation analysis. Analysis of variance (ANOVA) was used to evaluate the statistical significance between groups with p-value set at 0.05.

Results
The effective dose for all patients was found out to be 4.85±0.37 mSv while the ratio of effective dose to administered activity was 1.611×10-2 mSv/MBq. Thus, the radiation exposure in PET examination practiced by our institution was considered safe according to ICRP Publication 106 as the ratio of effective dose to administered activity did not exceed 1.9×10-2 mSv/MBq. As for the relationship between effective dose and weight of patients, there was a significant difference threshold for 40 kg of patient's weight.

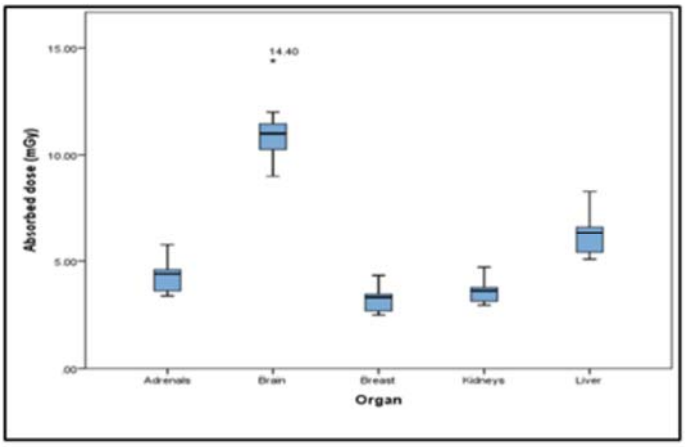

Figure 1 shows box-plot graph of selected organ absorbed dose received from PET/CT examinations.

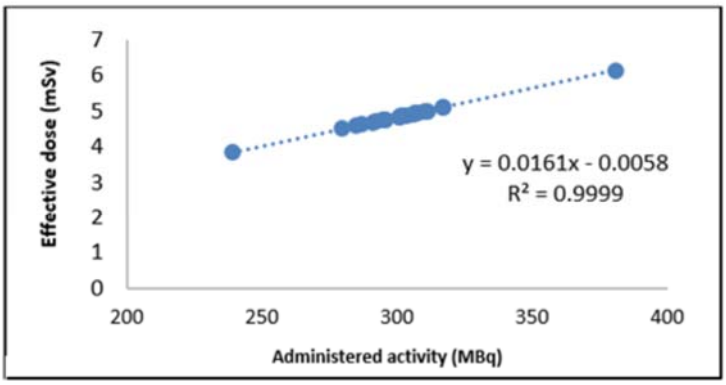

Figure 2: The scattered plot graph of effective dose against administered activity.

Conclusion

The radiation dose from the PET-CT examinations has been obtained and found to have high correlation activity with high “goodness of fit”.

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Background

Pulmonary artery leiomyosarcoma is a very rare malignancy characterized by malignant endothelial lining of pulmonary artery. This disease is often misdiagnosed as pulmonary thromboembolism. Symptoms at presentation are similar to pulmonary embolism as well as diagnostic CT features. Since leiomyosarcoma shows as metabolically active, 18F-FDG PET-CT plays an important role to make a diagnosis and evaluate distant metastasis.

Case Report

This is a report of a very rare case of pulmonary leiomyosarcoma in a 45-year-old woman. The patient was diagnosed with leiomyosarcoma of the pulmonary valve in 2005 and underwent open heart surgery to remove the tumour, excise the pulmonary valve, and had a Devega annuloplasty. Adjuvant chemotherapy was given. In 2019, she presented with acute dyspnea and clinical heart failure. The echocardiography showed right ventricular outflow tract obstruction. An urgent 18F-FDG PET-CT was performed under a prolonged fasting period of 15 hours and low carbohydrate diet for 48 hours. The 18F-FDG PET-CT showed a hypermetabolic intracardiac mass occupying the right ventricular apex, right ventricular outflow tract, and right pulmonic valve ring. Another focus of hypermetabolic tumour was also found occupying in pulmonary trunk and right main pulmonary artery without any extrathoracic distant metastasis.

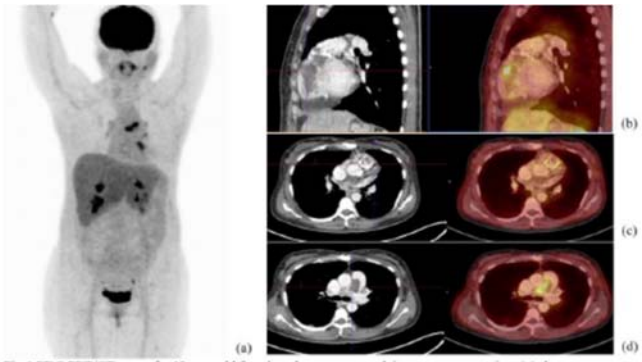

Fig.1 FDG PET/CT scan of a 45 year-old female pulmonary artery leiomyosarcoma patient (a) shows recurrent hypermetabolic tumor occupying in the right ventricle, right ventricular outflow tract (b) and pulmonary valve ring (c). Also seen another one skip malignancy at the pulmonary trunk and right main pulmonary artery (d).

Conclusion

18F-FDG PET-CT is of value to differentiate between malignant intraluminal mass and pulmonary thromboembolism and it is also a useful tool for accurate disease staging.

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Incidence and Patterns of Pancreatic Metastasis on FDG PET-CT

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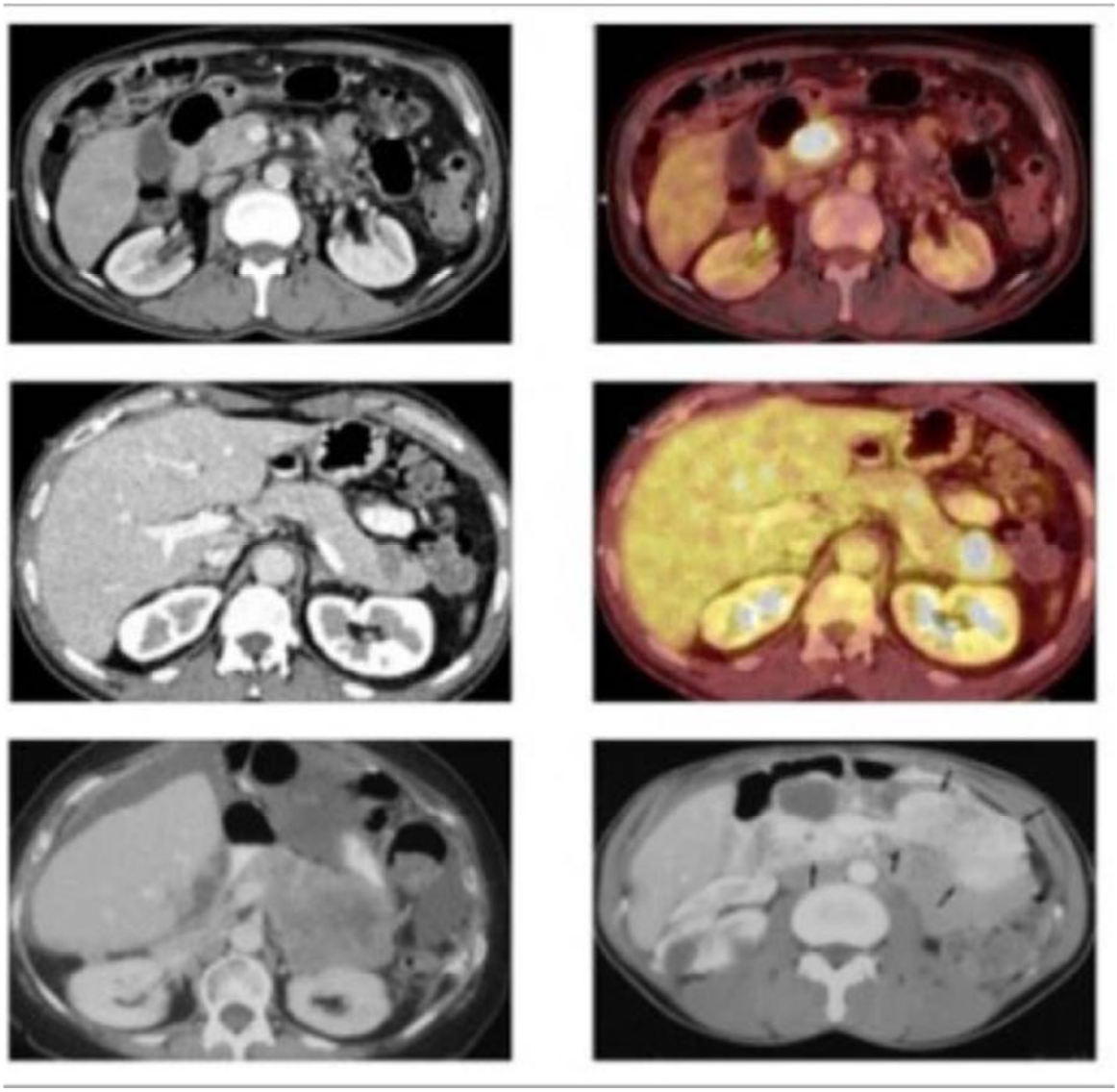
Background
Pancreatic involvement by metastases from other primaries is rare and accounts for approximately 2% to 4% of pancreatic tumours and is found in 12% of patients with advanced malignancy, at autopsy. Metabolic imaging can be a convenient noninvasive method of early detection of recurrence and in monitoring metastatic disease during follow-up.

Methodology
The most frequent primary sites include lung, breast, kidney and GIT. Metastases do not appear to show a predilection for a particular part of the pancreas. A retrospective study was done comprising of the last 2000 PET-CT WB cases to look for incidence and pattern of these metastases in our oncology patients.

Results
In total, 1.2% (24 cases) of cases showed pancreatic involvement, mostly (> 90%) in advanced stages (III/ IV) with mainly three patterns: first and most common (0.8% - 16 cases) that of an FDG avid single localized mass either isodense or hypodense on corresponding unenhanced CT images. Distortion, compression, or obstruction of the CBD/ MPD was seen in two cases, simulating primary pancreatic adenocarcinoma. Rarely, vascular involvement with splenic vein obstruction and varices can be observed as per literature, but none was observed in our study. A second pattern (0.3% - 6 cases) was of multiple FDG avid pancreatic nodules. In the third type (0.1% - 2 cases), FDG avid diffuse pancreatic enlargement, with smooth or lobulated contour, was seen. The morphologic and enhancement features of pancreatic metastases on corresponding CT images closely resembled those of the distant primary neoplastic source in 30% of total cases. More than 75% of metastases exhibit enhancement; larger lesions showing peripheral enhancement, whereas masses smaller than 1.5 cm diameter showing more homogeneous enhancement. Renal carcinoma (2 cases) metastatic to the pancreas exhibited rapid enhancement on the arterial phase beginning 25 sec from the start of injection with no relation to the size; and washout in the delayed phase images.
Other sites of metastases were also frequently noticed (> 95%) on PET-CT which in fact, reinforced the likelihood that the pancreatic mass seen represents metastasis.



Conclusion

Symptomatically speaking, most patients (83%) are free of organ-specific complaints when the metastases is detected incidentally on conventional imaging and that's why, interval from diagnosis of an extra-pancreatic primary tumour to subsequent detection of a pancreatic metastases varies between 1 and 3 years, which can be significantly reduced with PET-CT incorporation in oncology surveillance. Pancreatic metastases usually develop late in the course of a generalized malignant process, leaving room only for palliative measures; but with 90% sensitivity of FDG PET in detecting recurrence/ metastases in patients, especially with asymptomatically elevated tumour markers and/or equivocal conventional imaging results, FDG PET-CT definitely has the role both in showing the presence of pancreatic metastases and in providing guidance to obtain a definitive tissue diagnosis.

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Diagnostic Usefulness of 18F-PSMA PET-CT in Patients with Hepatocellular Carcinoma, Comparison versus 18F-FDG

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Background
Hepatocellular carcinoma is the most common primary liver cancer in Mexico. Cirrhosis is the most important risk factor. The diagnostic method is computed tomography and magnetic resonance with sensitivities greater than 90%. PET-CT with 18F-FDG has limited role for detection with a sensitivity of 40% -50, currently other radiotracers are being sought that offer better detec tion, especially in early stages. We evaluate the diagnostic efficacy of PET-CT with the radiotracer 18F-PSMA versus 18F-FDG in patients with hepatocellular carcinoma.

Metodology
Observational, analytical, cross-sectional, retrospective study in patients diagnosed with hepatocellular carcinoma determined by tomographic study and pathology report. Nine patients were evaluated with age range between 24 and 71 years and who had PET-CT with 18F-PSMA and 18F-FDG were included. Visual analysis of the studies was carried out to determine whether they were positive or negative, as well as SUVmax and tumour / background ratio (T / N), a chi-square test was performed on each radiotracer to determine the association between the level of differentiation and uptake.

Results
Nine patients were included; the average age was 53.5 (24-71) years. The six patients with the most differentiated histological grades (Grades I-II) were all positive with 18F-PSMA and negative in the three patients with the less differentiated histological grades (Grades III-IV). In the PET-CT with 18F-PSMA, a T / N ratio > 1.11 was recorded for positive studies and T / N values <0.68 for negative ones. The positives for 18F-FDG were Grades III-IV. Chi-square test was performed to determine association between level of differentiation and uptake, for PSMA a value of 9 was obtained with a P of 0.029.