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# Distribution of Diseases on F-18 FDG PET/CT at Armed Forces Institute of Radiology and Imaging, Rawalpindi

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## ABSTRACT

***Objective:*** To determine the spectrum of diseases on F-18 FDG PET/CT imaging at the Armed Forces Institute of Radiology and Imaging, Rawalpindi.

***Study Design:*** Cross-sectional study.

***Place and Duration of the Study:*** PET/CT and Cyclotron Department, Armed Forces Institute of Radiology and Imaging, Rawalpindi Pakistan, from Jul 2019 to Mar 2021.

***Methodology:*** The patients were scanned for staging, restaging, interim/response assessment and relapse/recurrence purposes. In addition, the frequency of various cancers and types of scans were determined. Scanning has been performed using GE Health care MiDR PET-CT Scanner.

***Results:*** A total of 1573 patients were included in the study. Male patients were 927(58.93%), and female patients were 646(41.06%). The most common diseases encountered were lymphoma 623(39.6%), breast cancer 193(12.2%), lung cancer 12(7.6%), colorectal cancer 88(5.5%) and unknown primary 84(5.3%). Amongst lymphoma, Non-Hodgkin's lymphoma was the most common 276(44.3%), followed by Hodgkin's lymphoma 267(42.8%).

***Conclusion:*** F-18 FDG PET/CT hybrid imaging is an important modality and can significantly alter patient management plans. Lymphomas were the most common disease in our spectrum, followed by cancers of the breast, lungs, colon-rectum and unknown primary cases, which can be managed well by PET/CT's routine utilization.

**Keywords:** Cancer, Hodgkin's lymphoma, Non- hodgkin's lymphoma, PET-CT scan.

***How to Cite This Article:*** *Jamal A, Slehria AR, Bilal R, Baig AZ, Shafique M, Haleem A. Distribution of Diseases on F-18 FDG PET/CT at Armed Forces Institute of Radiology and Imaging, Rawalpindi. Pak Armed Forces Med J 2022; 72(6): 2051-2054. DOI: https://doi.org/10.51253/pafmj.v72i6.7388*



## INTRODUCTION

Positron emission tomography/computed tomography (PET/CT) hybrid imaging using Fluorine-18 fluorodeoxyglucose (F-18 FDG) is a valuable modality in oncology. Staging, response to treatment, restaging, residual disease, recurrence, follow-up for various malignancies, lesion characterization/directing biopsy, carcinoma of unknown origin, fever of unknown origin, radiation treatment planning and delineating tumour volumes remain important indications.[1] The most commonly used quantitative measurement is standard uptake value (SUV) which represents the tissue radioactivity concentration normalized to injected activity and body weight.[2,3]

F-18 FDG is the most commonly used tracer for PET/CT imaging. FDG accumulation is directly proportional to the amount of glucose utilization, and most cancers have increased glucose consumption related to the over-expression of GLUT glucose transporters and hexokinase activity.[4,5]

Cancers are one of the major issues being observed in Pakistan.[6] Thus studies on cancers should be frequently carried out to investigate the major cancers in Pakistan and determine the possible treatment management for the patients. PET-CT being the revolutionized technology in diagnosing cancers like lymphoma and carcinomas of the lungs, breast helped the clinician properly treat even minute disease components. Thus such spectrum studies should be conducted to benefit clinicians and physicians for in-depth knowledge of the prevalence of local cancers so they can properly manage them.

## METHODOLOGY

This cross-sectional study was carried out at the PET/CT & Cyclotron Department, the Armed Forces Institute of Radiology and Imaging, Rawalpindi. Approval of the ethical committee (IERB Approval Certificate No. 48) was sought prior to the commencement of this study. The sample size was calculated using the WHO sample size calculator with a 95% confidence level, having a 5% margin of error 5% with an 8.76% prevalence.[7]

**Inclusion Criteria:** The cancer patients of either gender, referred by an oncologist for a PET-CT scan & were not treated with chemotherapy and radiation

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*Received: 15 Sep 2021; revision received: 15 Apr 2022; accepted: 19 Apr 2022*

therapy for the last six weeks and 12 weeks were included in the study.

**Exclusion Criteria:** Patients having a height of more than 180cm were excluded from the study. All those patients were excluded from whose scans were cancelled for any reason.

The study included 1573 consecutive patients from July 2019 to March 2021 who got their PET/CT scans done. Our main concern was cancer patients undergoing PET-CT scans. The patients included were scanned for staging, which includes baseline scans that a patient has not yet undergone any treatment. Restaging, i.e., the patient has gone through any treatment like chemotherapy, radiation therapy or surgery, interim/response assessment, which includes the midtreatment response assessment and relapse/ recurrence purposes.

Data were analyzed using Microsoft Excel 2013, frequencies and percentages were calculated for categorical variables. Quantitative variables like age and qualitative variables like gender were analyzed. The frequency of staging, restaging, interim/response assessment and relapse/recurrence scans was determined.

## RESULTS

One thousand five hundred seventy-three patients were included in the study, of which male patients 927(58.9%) and female patients 646(41.1%). The age ranges between 4 to 88 years. Out of a total of 1573 scans done, restaging scans were 929(59.0%), staging scans 569(36.2%), and scans for recurrence /relapse were 75(4.8%). This shows that the restaging issue was addressed by PET/CT in 929(59.0%) patients, whereas 569(36.2%) patients underwent scanning before starting treatment and 75(4.8%) patients were evaluated for relapse/recurrence, demonstrating that PET/CT had an important role throughout the management plan.

In our study, the most common disease encountered was lymphoma 623(39.6%), followed by breast cancer 193(12.2%), lung cancer 121(7.6%), colorectal cancer 88(5.5%), unknown primary/PUO 84(5.3%), oesophageal cancer 61(3.8%), pancreatic cancer 35 (2.2%), urinary bladder cancer 33(2.1%). Figure-1 showed the frequency of different diseases for which scans were done at the PET/CT Department. Non-Hodgkin's lymphoma (NHL) was the commonest 276(44.3%), followed closely by Hodgkin's Lymphoma (HL) 267(42.8%) (Figure-2).


**Figure-1: Spectrum of Diseases (n=1573)**

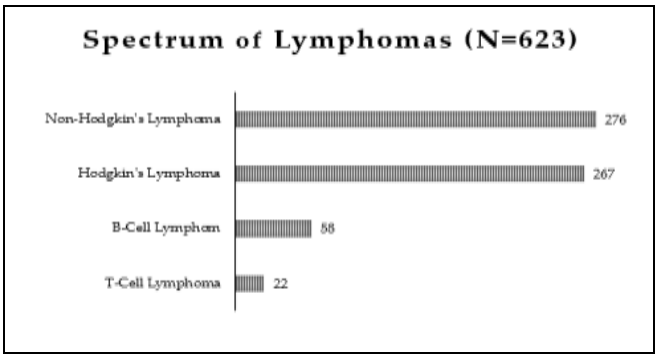


**Figure-2: Spectrum of Lymphomas (n=623)**

Our study found that PET-CT was important in managing 84 unknown primary cases. Out of 84 cases, 67 were positive (79.7%), and 17 were negative (20.2%). Among the positive cases, osseous metastases were present in 19 cases, adrenal lesions in 6, mediastinal lymphadenopathy in 6 and brain metastases in 6 (Figure-3). Among the 75 cases of recurrence of diseases, our study showed that 71% (53 cases) were negative for any recurring disease while 29% (22 cases) had the recurring disease in them.

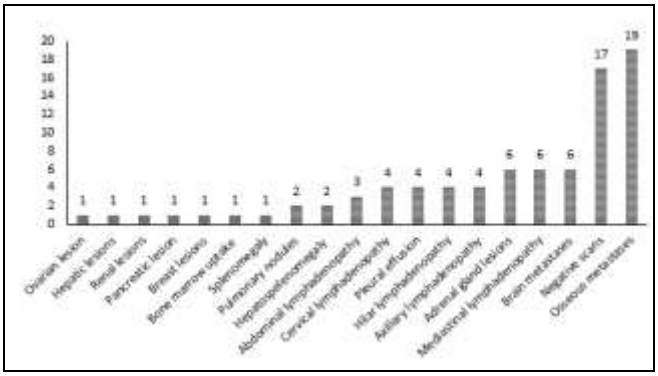


**Figure-3: Spectrum of Unknown Primary Cases (n=84)**

## DISCUSSION

Our study depicts that the PET-CT scan was majorly done for male patients, in which most patients were between the age range of 45-65 years. The children were less affected by the disease. Our study found that most clinicians referred patients for PET/CT scans after the initial treatment to assess the treatment response. The major disease in our study was Lymphoma, as the PET/CT is an important modality in assessing Lymphoma as it captures the smallest hypermetabolic lymph node.

Carcinoma of the Breast was the second most common disease in our spectrum, with 12.2% (193 cases). Globally, CA breast is commonest female cancer in females, with an approximation of one million new cases each year and the second leading cause of female death.[8-10] CA breast is most leading cancer found in the Pakistani female population. According to research, every one in nine females is diagnosed with CA breast.[11] The incidence of CA breast is 2.5 times higher than in neighbouring countries like Iran and India.[12,13]

Lung cancer was at third place in our disease spectrum with 7.6% (121 cases) matching well with available data.[14] According to GLOBOCON, lung cancer is the third most common cancer in Pakistan and is the leading cause of cancer deaths in the country, with an estimated 4.6% new cases and 5.9% deaths.[11] Lung cancer is a deadly disease with very high morbidity and mortality; globally, more people die yearly than from breast, colorectal and prostate cancer combined.[15]

In our study, unknown primary cases were 5.3% (84 cases). Out of 84 cases, 67 were positive (79.7%), and 17 were negative (20.2%). Among the positive cases, osseous metastases were present in 19 cases, adrenal lesions in 6, mediastinal lymphadenopathy in 6 cases and brain metastases in 6 cases. PET/CT imaging is an established modality for the diagnostic dilemma in unknown primaries, as shown by Riaz *et al.* enabling correct identification in up to 57.3% of unknown primary.[13]

In our spectrum of diseases, oesophageal cancer was present in 3.8%(61 cases), which is close to the data available. Oesophageal cancer ranks 9th in Pakistani males and 5th in females.[16] Remaining cancers in the spectrum included pancreatic cancer 2.2%(35 cases), urinary bladder cancer 2.1%(33 cases), gastric cancer 1.9%(31 cases), endometrial cancer 1.8% (29 cases), cervical cancer 1.6%(25 cases), thyroid cancer 1.3%(23 cases), ovarian cancer 1.2%(20 cases), GIST 1.2%(19 cases), melanoma 1.1%(18 cases), vaginal cancer 1.0%(17 cases), renal cell cancer and multiple myeloma 1.0%(16%cases)respectivel being the major ones.

Results from the National Oncologic PET Registry, which included data from 85,658 patients with a wide variety of cancer types, concluded that FDG PET imaging changed physicians' intended management in about 36%of patients. The dominant impact was a change from non-treatment to treatment, which occurred in 29% of patients; the reverse pattern, changing from treatment to non-treatment, occurred in about 7% of patients.[17,18]

Since the emergence of hybrid imaging diagnostic systems, several researches have been dedicated to improvement in these methodologies. Zhang *et al.* recently demonstrated for the first time a PET/CT system capable of obtaining diagnostic quality images in significantly lesser time than conventional devices, which can take up to 20-30 minutes approximately. In addition, this system was the pioneer in real-time tracking of the distribution of F-18 FDG throughout the body, demonstrating its app-licability in cancers and inflammatory and metabolic disorders. This new technology may be important for reducing the time of anaesthesia or sedation in pediatric patients and those who cannot remain idle for long periods.[19]

Several studies have focused on increasing the performance of F-18 FDG PET/CT by developing more efficient radiation detectors. Scanners based on Silicon photomultipliers (SiPM) technology can digitally count the annihilation photons, reducing analogue noise and increasing the volumetric resolution and method sensitivity. In a comparative study between conventional and digital PET/CT systems, digital technology showed a 54% improvement in image quality, an increase in tumour detection in 26.5% of cancer patients, a modification of tumour staging in 32% of cases and an increase in sensitivity of approximately 70% when using digital scanners.[20]

## CONCLUSION

F-18 FDG PET/CT hybrid imaging is an important modality and can significantly alter patient management plans. Lymphomas were the most common disease in our spectrum, followed by breast, lung, colon-rectum cancers and unknown primary cases, which can be managed well by PET/CT's routine utilization.

**Conflict of Interest:** None.

**Author's Contribution**

Following authors have made substantial contributions to the manuscript as under:

AJ & AUR: Conception, drafting the manuscript, approval of the final version to be published.

RB & AZB: Data acquisition, data analysis, drafting the manuscript, critical review, approval of the final version to be published.

MS & AH: Study design, drafting the manuscript, data interpretation, critical review, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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