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Original Article

Disease Burden and Clinicopathologic Spectrum of Solid Tumors - Initial Experience at a Newly Established Pet-CT Centre in Northern Pakistan

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ABSTRACT

Objective: To evaluate the disease burden and clinicopathologic spectrum of solid tumors presenting at a newly established PET-CT center in Northern Pakistan for staging, restaging and response to treatment evaluation.
Study Design: Cross-sectional study.
Place and Duration of Study: Armed Forces Institute of Radiology and Imaging, Pakistan from Jul 2019 to Aug 2020.
Methodology: The study included 663 patients referred for PET-CT imaging for staging, restaging and response to treatment evaluation of various solid tumors. Data on demographic characteristics, primary tumor type and sites were collected. The type and distribution of primary solid malignancies and common clinical indications for PET-CT were analyzed.
Results: Of 663 patients, 405(61.1%) were male while 258(38.9%) were female. Majority of the patients were 45-65 years of age. PET-CT imaging was primarily performed for restaging in 265(40.0%) and initial staging in 235(35.4%) patients. Lymphoma was the most frequently diagnosed malignancy in 273(41.2%), followed by breast cancer in 70(10.6%) and lung cancer in 62(9.4%) patients.
Conclusion: PET-CT imaging enhances diagnostic precision, guiding treatment decisions in oncology. The initial experience at this new center demonstrates clinicopathologic spectrum of disease burden of various solid tumors and PET-CT imaging potential to improve cancer care in Northern Pakistan, addressing the rising regional cancer burden and supporting efficient healthcare resource utilization.

Keywords: F-18 FDG; PET-CT; Solid tumors; Lymphoma.

How to Cite This Article: *Nouman MI, Riaz MO, Saeed T, Amin Z. Disease Burden and Clinicopathologic Spectrum of Solid Tumors - Initial Experience at a Newly Established Pet-CT Centre in Northern Pakistan. Pak Armed Forces Med J 2025; 75(Suppl-7): S1154-S1157.*
DOI: https://doi.org/10.51253/pafmj.v75iSUPPL-7.13032

INTRODUCTION

Cancer is a significant global health concern, with incidence and mortality rates escalating rapidly across all regions.[1] Currently, cancer is the second leading cause of death globally and is projected to surpass cardiovascular diseases as the foremost cause of mortality in the coming years.[2] This projected transition highlights an urgent need for early detection, accurate diagnosis and effective management of cancer to mitigate its growing impact on healthcare systems.[3] Early and accurate diagnosis is pivotal in optimizing treatment outcomes, improving survival rates, and enhancing the quality of life for patients.[4] Delayed diagnosis not only compromise therapeutic effectiveness but also significantly increase the overall costs associated with disease management further burdening healthcare system.[5]

Post-treatment assessment is a critical component of cancer care, guiding ongoing disease management, ensuring monitoring and facilitating the early detection of recurrence.[6] Traditional diagnostic imaging modalities such as computed tomography (CT), magnetic resonance imaging (MRI), and ultrasound have inherent limitations, particularly in differentiating between viable tumor tissue and post-treatment changes, such as fibrosis or necrosis.[7] Positron Emission Tomography-Computed Tomography (PET-CT) has emerged as a superior imaging modality, revolutionizing oncological diagnostics.[8] It integrates functional and anatomical imaging, allowing for a more detailed evaluation by detecting metabolic activity within tissues, which can identify malignant changes even before anatomical abnormalities become evident.[9] PET-CT enhances staging, restaging, and treatment response evaluation, playing a crucial role in personalized cancer care.[10]

This study aims to assess the disease burden and clinicopathologic spectrum of solid tumors at a newly established PET-CT center in Northern Pakistan. It will evaluate the initial clinical experiences and diagnostic performance of PET-CT Imaging for staging, restaging, and treatment response assessment. By analyzing data from this center, the study seeks to

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Received: 26 Dec 2024; revision received: 09 Apr 2025; accepted: 08 May 2025

highlight the regional cancer burden and the potential impact of PET-CT in enhancing cancer management in Pakistan.

METHODOLOGY

This cross-sectional descriptive study was conducted from July 2019 to August 2020 at the Armed Forces Institute of Radiology and Imaging (AFIRI) in Rawalpindi, Pakistan. A total of 663 patients with solid tumors, who were referred to the newly established PET-CT Imaging center for imaging of suspected or confirmed solid tumors were included in the study. All patients were selected by non-portability consecutive sampling technique. The study was conducted in accordance with ethical standards and was approved by the institutional review board of AFIRI Rawalpindi (IERB approval certificate no. 007). Informed consent was obtained from all patients prior to imaging, ensuring confidentiality and the right to withdraw from the study at any stage.

Inclusion Criteria: All patients irrespective of age and gender with histologically confirmed or clinically suspected solid tumors.

Exclusion Criteria: Patients with incomplete imaging data or those who did not consent to participate in study were excluded.

The study aimed at evaluating the disease burden and clinicopathologic spectrum of solid tumors using PET-CT imaging. Data was collected from patients presenting to the PET-CT Imaging facility at AFIRI Rawalpindi during the study period. The study included 663 patients who underwent PET-CT Imaging scans for the assessment of solid tumors. Participants were selected based on their referral for PET-CT imaging for staging, restaging, or follow-up purposes.

Data was obtained from PET-CT imaging reports and clinical records. Each patient underwent a standardized PET-CT protocol, which included fasting for at least 6 hours prior to imaging, intravenous administration of a radiotracer Flourine-18 Fluorodeoxyglucose (F-18 FDG), and subsequent imaging to assess metabolic activity within the tumor lesions. Imaging parameters and findings were recorded, including primary tumor sites, metastatic involvement, and any post-treatment response.[11]

All the data was collected and analyzed using Statistical Package for Social Sciences (SPSS-26) software. Data was expressed as frequencies and percentages.

RESULTS

Of 663 patients, 405(61.1%) were male while 258(38.9%) were female with male predominance. Age ranges from less than 12 years to over 65 years with majority of the patients between 45-65 years of age group (Table-I). 619(93.4%) patients had a known primary tumor, while 44(6.6%) had an unknown primary. The F-18 FDG PET-CT scans were primarily performed for restaging in 265(40.0%), initial staging in 235(35.4%), treatment response assessment in 129(19.5%) and for recurrence in 34(5.1%) (Table-II).

Table-I: Distribution of Patients as per Gender and Age Groups (n = 663)

Variables	n(%)
Gender	
Male	258(38.9%)
Female	405(61.1%)
Age (Years)	
≤12	17(2.6%)
13-18	23(3.5%)
19-44	181(27.3%)
45-65	303(45.7%)
>65	139(21.0%)

Table-II: Distribution of Patients as per Indication for Imaging (n = 663)

Variables	n (%)
Staging	235(35.4%)
Restaging	265(40.0%)
Response	129(19.5%)
Relapse	34(5.1%)

Lymphoma was the most frequently encountered malignancy in 273(41.2%), followed by breast cancer in 70(10.6%) and lung cancer in 62(9.4%) patients. A small number of patients underwent PET-CT for non-oncologic applications (0.9%) (Table-III).

Table-III: Spectrum of PET-CT Findings (n=663)

Variables	n (%)
Lymphoma	273(41.2%)
Lung cancer	62(9.4%)
Head and neck tumors	18(2.7%)
Thyroid cancer	13(2.0%)
Breast cancer	70(10.6%)
Esophageal & gastroesophageal junction cancer	19(2.9%)
Gastrointestinal tract tumors	30(4.5%)
Hepatopancreatobiliary tumors	21(3.2%)
Colorectal & anal cancer	40(6.0%)
Gynecological malignancy	21(3.2%)
Urological malignancy	27(4.1%)
Myeloma	10(1.5%)
Skin tumors	12(1.8%)
Musculoskeletal tumors	24(3.6%)
Neuroendocrine tumors	2(0.3%)
Non-oncologic applications	6(0.9%)
Brain tumors	3(0.5%)
Pleural malignancy	1(0.2%)
Thymic tumors	3(0.5%)
Pyrexia of unknown origin	8(1.2%)

A significant proportion of lymphomas were detected during restaging [112 (16.89%)], followed by

staging [65 (9.8%)] and response assessment [77 (11.61%)]. Breast tumors were predominantly staged [30 (4.52%)] and restaged [30 (4.52%)], while lung cancer was primarily staged [39 (5.88%). A notable pattern was observed with GI tumors, where staging and restaging were evenly distributed, and response assessments were notably fewer.

DISCUSSION

This study which is the first such comprehensive study from Pakistan provides valuable insights into the disease burden and clinicopathologic spectrum of solid tumors presented for disease staging or using PET-CT imaging at a newly established center in Northern Pakistan. The findings underscore the pivotal role of PET-CT imaging in cancer diagnosis, staging, and management, highlighting its importance in improving patient outcomes in the regional context.[12-14]

The study population predominantly consisted of middle-aged and older adults, with the highest frequency observed in the 45-65 age group, aligning with global trends where cancer incidence increases with age.[15] A male predominance was evident, with males comprising 61.1% of the study population. This gender disparity may reflect regional differences in healthcare access, referral patterns, or inherent biological differences in cancer susceptibility.[16]

The most common malignancy identified in this cohort was lymphoma, accounting for 41.2% of all cases. This finding is particularly significant as it contrasts with global cancer patterns, where solid tumors such as lung, breast, and colorectal cancers predominate.[17] The high prevalence of lymphoma may reflect environmental, genetic, or infectious etiologies unique to the region, such as the association of certain lymphomas with viral infections like Epstein-Barr virus.[18] Additionally, the frequent use of PET-CT Imaging in lymphoma management for staging, restaging, and response assessment further contributes to its predominance in this dataset.[19]

Breast cancer was the second most common malignancy, constituting 10.6% of the cases. The high incidence of breast cancer in Pakistan is consistent with global data, where it remains the most frequently diagnosed cancer in women.[20] Early detection through PET-CT imaging is critical for breast cancer management, as it allows precise staging, identification of metastatic disease, and monitoring of treatment response. The study's findings underscore the importance of enhancing cancer awareness and screening programs, particularly for breast cancer, to facilitate early diagnosis and improve survival outcomes.[21]

Lung cancer, the third most common malignancy identified, accounted for 9.4% of the cases. This reflects the global burden of lung cancer, which remains a leading cause of cancer-related mortality worldwide. PET-CT Imaging plays a crucial role in the evaluation of lung cancer, providing superior accuracy in staging and detection of metastatic disease compared to conventional imaging modalities.[22] Given the rising rates of smoking and environmental pollution in Pakistan, the burden of lung cancer is expected to increase, underscoring the need for advanced diagnostic tools like PET-CT imaging in managing this challenging disease.

The use of PET-CT imaging was primarily for restaging (40.0%) and initial staging (35.4%), highlighting its integral role in the comprehensive management of cancer patients. PET-CT imaging's ability to combine functional and anatomical imaging allows for a more precise evaluation of tumor biology, which is essential for tailoring treatment strategies. This is particularly important in resource-limited settings where the cost-effectiveness of advanced imaging can significantly impact overall management costs and patient outcomes. By providing early and accurate assessment, PET-CT Imaging can reduce unnecessary treatments, minimize healthcare expenses, and improve quality of life for cancer patients.[23]

The data also revealed a notable proportion of cases where PET-CT Imaging was used to assess response to treatment (19.5%) and relapse (5.1%). Effective monitoring of treatment response is crucial in oncology, as it guides clinicians in modifying treatment plans and identifying non-responders early, thereby optimizing therapeutic interventions.[24] PET-CT Imaging's ability to detect metabolic changes before structural alterations appear makes it an invaluable tool in the follow-up of cancer patients, enhancing the precision of post-treatment assessments.

This study's findings underscore the growing importance of PET-CT Imaging in the diagnostic landscape of oncology in Pakistan. The high prevalence of certain tumor types, such as lymphoma, highlights the need for tailored public health strategies and research into the unique etiological factors contributing to the regional cancer burden.

Furthermore, the role of PET-CT Imaging in improving diagnostic accuracy and guiding patient management cannot be overstated, particularly as cancer incidence continues to rise.[25]

LIMITATIONS OF STUDY

This study is limited by its single-center design, short duration, and potential referral bias, restricting generalizability. Lack of histopathological correlation, treatment, and survival data limits outcome assessment.

CONCLUSION

PET-CT imaging enhances diagnostic precision, guiding treatment decisions in oncology. The initial experience at this new center demonstrates clinicopathologic spectrum of disease burden of various solid tumors and PET-CT imaging potential to improve cancer care in Northern Pakistan, addressing the rising regional cancer burden and supporting efficient healthcare resource utilization.

Conflict of Interest: None.

Funding Source: None.

Authors Contribution

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

MIN & MOR: Data acquisition, critical review, approval of the final version to be published.

TS & ZA: Conception, study design, drafting the manuscript, 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.

REFERENCES

1. Sung H, Ferlay J, Siegel RL. Global cancer statistics 2020: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. CA Cancer J Clin 2021; 71(3): 209-249. http://doi.org/10.3322/caac.21660
2. Siegel RL, Miller KD, Wagle NS, Jemal A. Cancer statistics, 2023. CA Cancer J Clin 2023; 73(1): 17-48. http://doi.org/10.3322/caac.21763
3. Wild CP, Weiderpass E, Stewart BW. World Cancer Report: Cancer Research for Cancer Prevention. IARC Publications. 2020.
4. Sullivan R, Alatise OI, Anderson BO. Global cancer surgery: delivering safe, affordable, and timely cancer surgery. Lancet Oncol 2015; 16(11): 1193-1224. http://doi.org/10.1016/S1470-2045(15)00223-5
5. Khan HM, Ramsey S, Shankaran V. Financial toxicity in cancer care: implications for clinical care and potential practice solutions. J Clin Oncol 2023; 41(16): 3051-3058.http://doi.org/10.1200/JCO.22.01799
6. Miller KD, Nogueira L, Devasia T. Cancer treatment and survivorship statistics, 2022. CA Cancer J Clin 2022; 72(5): 409-436. http://doi.org/10.3322/caac.21731
7. Smith AF, Hall PS, Hulme CT. Cost-effectiveness analysis of PET-CT-guided management for locally advanced head and neck cancer. Eur J Cancer 2017; 85: 6-14. http://doi.org/10.1016/j.ejca.2017.07.054
8. Rowe SP, Pomper MG. Molecular imaging in oncology: current impact and future directions. CA Cancer J Clin 2022; 72(4): 333-352. http://doi.org/10.3322/caac.21713
9. Greenspan BS. Role of PET/CT for precision medicine in lung cancer: perspective of the Society of Nuclear Medicine and Molecular Imaging. Transl Lung Cancer Res 2017; 6(6): 617-620. http://doi.org/10.21037/tlcr.2017.09.01
10. Vijayakumar S, Yang J, Nittala MR. Changing role of PET/CT in cancer care with a focus on radiotherapy. Cureus 2022; 14(12): e32840. http://doi.org/10.7759/cureus.32840
11. Salem AE, Shah HR, Covington MF. PET-CT in clinical adult oncology: I. hematologic malignancies. Cancers 2022; 14(23): 5941. http://doi.org/10.3390/cancers14235941
12. Treglia G, Pascale M, Lazzeri E. Diagnostic performance of 18F-FDG PET/CT in patients with spinal infection: a systematic review and a bivariate meta-analysis. Eur J Nucl Med Mol Imaging 2020; 47(5): 1287-1301. http://doi.org/10.1007/s00259-019-04571-6
13. Santo G, Miceli A, Lazzarato A. Clinicians' perspectives on PET/CT in oncological patients: an Italian National Survey. Clin Transl Imaging 2024; 12: 99–107. http://doi.org/10.1007/s40336-023-00591-3
14. Reinert CP, Sekler J, la Fougère C, et al. Impact of PET/CT on clinical management in patients with cancer of unknown primary: a PET/CT registry study. Eur Radiol 2020; 30(3): 1325-1333. http://doi.org/10.1007/s00330-019-06518-9
15. Bray F, Laversanne M, Weiderpass E, Soerjomataram I. The ever-increasing importance of cancer as a leading cause of premature death worldwide. Cancer 2021; 127(16): 3029-3030. http://doi.org/10.1002/cncr.33587
16. Li C, Lei S, Ding L. Global burden and trends of lung cancer incidence and mortality. Chin Med J 2023; 136(13): 1583-1590. http://doi.org/10.1097/CM9.0000000000002529
17. Morton LM, Wang SS, Devesa SS. Lymphoma incidence patterns by WHO subtype in the United States, 1992-2001. Blood 2006; 107(1): 265-276. http://doi.org/10.1182/blood-2005-06-2508
18. Hsu YC, Tsai MH, Wu G. Role of Epstein-Barr virus in breast cancer: correlation with clinical outcome and survival analysis. J Cancer 2024; 15(8): 2403-2411. http://doi.org/10.7150/jca.93631
19. Barrington SF, Mikhaeel NG, Kostakoglu L. Role of imaging in the staging and response assessment of lymphoma: consensus of the International Conference on Malignant Lymphomas Imaging Working Group. J Clin Oncol 2014; 32(27): 3048-3058. http://doi.org/10.1200/JCO.2013.53.5229
20. Sung H, Ferlay J, Siegel RL. Global cancer statistics 2020: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. CA Cancer J Clin 2021; 71(3): 209-249. http://doi.org/10.3322/caac.21660
21. Burguin A, Diorio C, Durocher F. Breast cancer treatments: updates and new challenges. J Pers Med 2021; 11(8): 808. http://doi.org/10.3390/jpm11080808
22. Ramaswamy A. Lung cancer screening: review and 2021 update. Curr Pulmonol Rep 2022; 11(1): 15-28. http://doi.org/10.1007/s13665-021-00283-1
23. Paydary K, Seraj SM, Zadeh MZ. The evolving role of FDG-PET/CT in the diagnosis, staging, and treatment of breast cancer. Mol Imaging Biol. 2019; 21(1): 1-10. http://doi.org/10.1007/s11307-018-1181-3
24. Ming Y, Wu N, Qian T. Progress and future trends in PET/CT and PET/MRI molecular imaging approaches for breast cancer. Front Oncol 2020; 10: 1301. http://doi.org/10.3389/fonc.2020.01301
25. Saif MW, Tzannou I, Makrilia N, Syrigos K. Role and cost-effectiveness of PET/CT in management of patients with cancer. Yale J Biol Med 2010; 83(2): 53-65.