^{18}F PSMA-1007 and ^{18}F FDG PET-CT in an Advanced Prostate Cancer Patient - A Case Report

[1]Pupree Mutsuddy, [2]Tapati Mandal, [3]Papia Akhter, [4]S M Arifur Rahman, [5]Md. Abu Bakker Siddique, [6]Fatima Begum, [7]Fatema Tuz Zohra, [8]Mohammad Anwar Ul-Azim and [9]Shamim M F Begum

[1]Associate Professor and Principal Medical Officer, National Institute of Nuclear Medicine & Allied Sciences (NINMAS)

[2] Assistant Professor and Senior Medical Officer, NINMAS

[3]Assistant Professor and Senior Medical Officer, NINMAS

[4]Medical Officer, NINMAS

[5]Professor and Chief Medical Officer, NINMAS

[6]Professor and Ex Director, NINMAS

[7]Assistant Professor and Senior Medical Officer, Institute of Nuclear Medical Physics, Savar

[8]Associte Professor and Principal Scientific Officer, Planning Division, Bangladesh Atomic Energy Commission

[9]Professor and Ex Member, Planning Division, Bangladesh Atomic Energy Commission

Correspondence Address : Dr. Pupree Mutsuddy. Associate Professor and Principal Medical Officer. NINMAS, Block-D, BSMMU Campus, Shahbag, Dhaka. Email:pupreesomc40@gmail.com

ABSTRACT

Positron Emission Tomography (PET) is currently playing a crucial role in the assessment of prostate cancer. ^{68}Ga/18F prostate-specific membrane antigen (PSMA), 11C Choline, and ^{18}F Fluciclovine are the most commonly used non-FDG PET tracers. F-18 FDG PET is not routinely recommended in prostate cancer due to the low glycolytic nature of the prostate tumor cells. However, in advanced and aggressive cases, ^{18}F FDG PET can detect lesions. Till September 2023, ^{18}F-FDG was the only available PET tracer in our country to detect recurrence and non-osseous metastases. We reported a case of a 53-year-old male who underwent an ^{18}F PSMA-1007 PET-CT scan for restaging in October 2023. The patient had a previous ^{18}F FDG PET-CT scan in January 2023. FDG PET showed hypermetabolic cervical, mediastinal, and abdominal lymph nodes as well as multiple skeletal lesions. Patient received chemotherapy and anti-androgen therapy. However, after 10 months, patients PSA raised from 225 ng/ml to 616.5 ng/ml. In the PSMA scan, we found extensive nodal and skeletal involvements with progression of disease. In this case, an FDG-positive scan reflects the aggressiveness of the disease; however, extensive PSMA-avid lesions, including the positive lesions in FDG, indicate the patient could benefit from PSMA-based therapy.

Keywords: Advanced Prostate cancer, 18F FDG (Fluorodeoxyglucose), 18F PSMA (Prostate Specific Membrane Antigen)-1007.

Bangladesh J. Nucl. Med. Vol. 28 No. 1 January 2025

DOI: https://doi.org/10.3329/bjnm.v28i1.79558

INTRODUCTION

Prostate cancer remains one of the most common malignancies in men, with metastatic forms presenting a high risk of mortality (1). Imaging plays a central role in managing prostate cancer, spanning from initial diagnosis to monitoring recurrence and assessing disease progression. Multiple imaging modalities are crucial, including MRI, CT, and PET scans. Recent studies have highlighted the effectiveness of PET imaging, particularly with tracers like ^{68}Ga-PSMA-11 and ^{18}F-PSMA-1007, in detecting metastatic disease and providing insights into treatment responses (2, 3). These advancements are particularly pertinent given that imaging results can directly influence therapeutic decisions and patient outcomes (4, 5).

Current studies indicate that PSMA-targeting radiopharmaceuticals, such as ^{177}Lu-PSMA-617, show promising efficacy and safety in treating metastatic castration-resistant prostate cancer, highlighting the potential of theranostics in this context (5). Advances in prostate cancer imaging have introduced PSMA-based PET tracers, such as ^{68}Ga-PSMA-11 and ^{18}F-PSMA-1007, which show higher sensitivity for detecting metastatic spread, especially in cases of biochemical recurrence (6, 7).

Although 18F-fluorodeoxyglucose (FDG) PET-CT has revolutionized oncologic imaging, its utility in prostate cancer is limited because prostate tumors typically exhibit low glycolytic activity. As a result, FDG PET-CT may miss lesions in low-glycolytic tumors but can still be

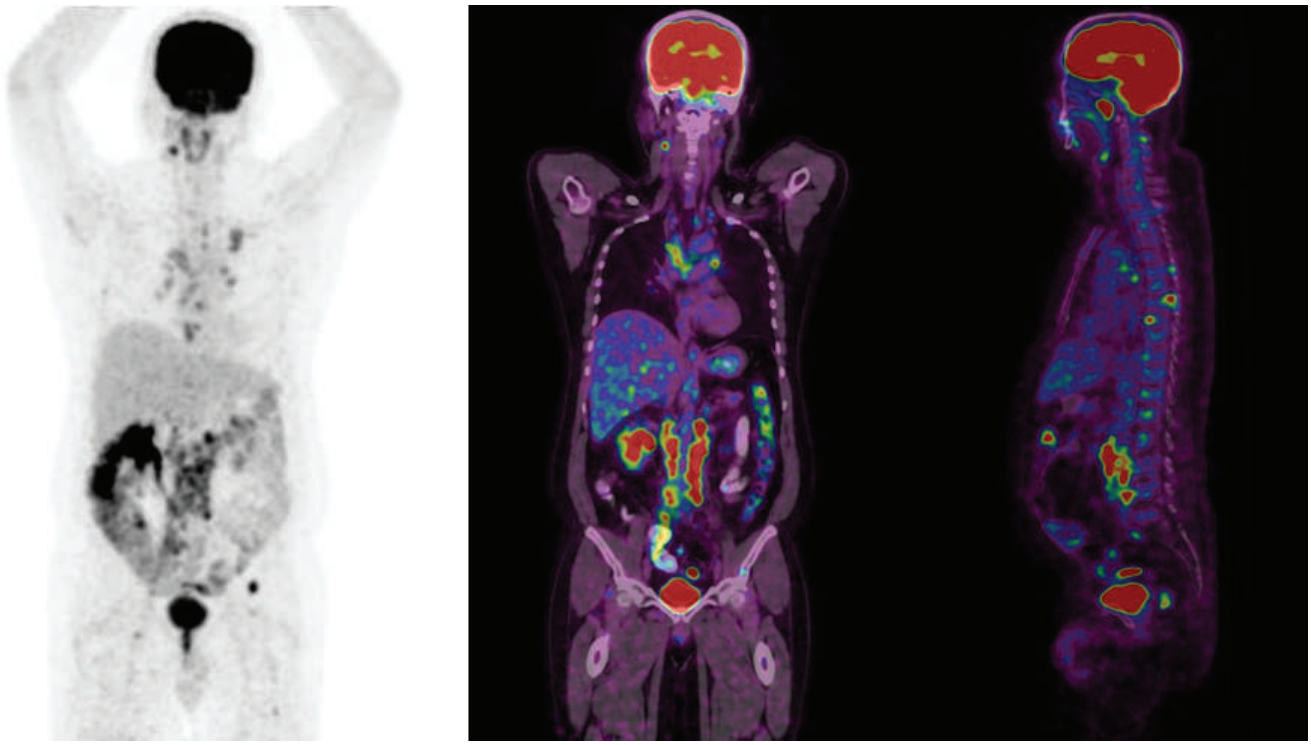
valuable in cases of aggressive disease where high metabolic activity is observed (2, 8).

Moreover, comparisons between different PSMA tracers, such as ^{18}F-PSMA-1007 and ^{68}Ga-PSMA-11, have demonstrated the former's superiority in restaging patients with PSA relapse (6, 9).

This report presents a case study showing ^{18}F-FDG and ^{18}F-PSMA-1007 PET-CT scans in detecting metastatic lesions in a patient with prostate cancer, emphasizing the advantages of PSMA-based imaging in restaging and guiding therapeutic decisions (10).

CASE REPORT

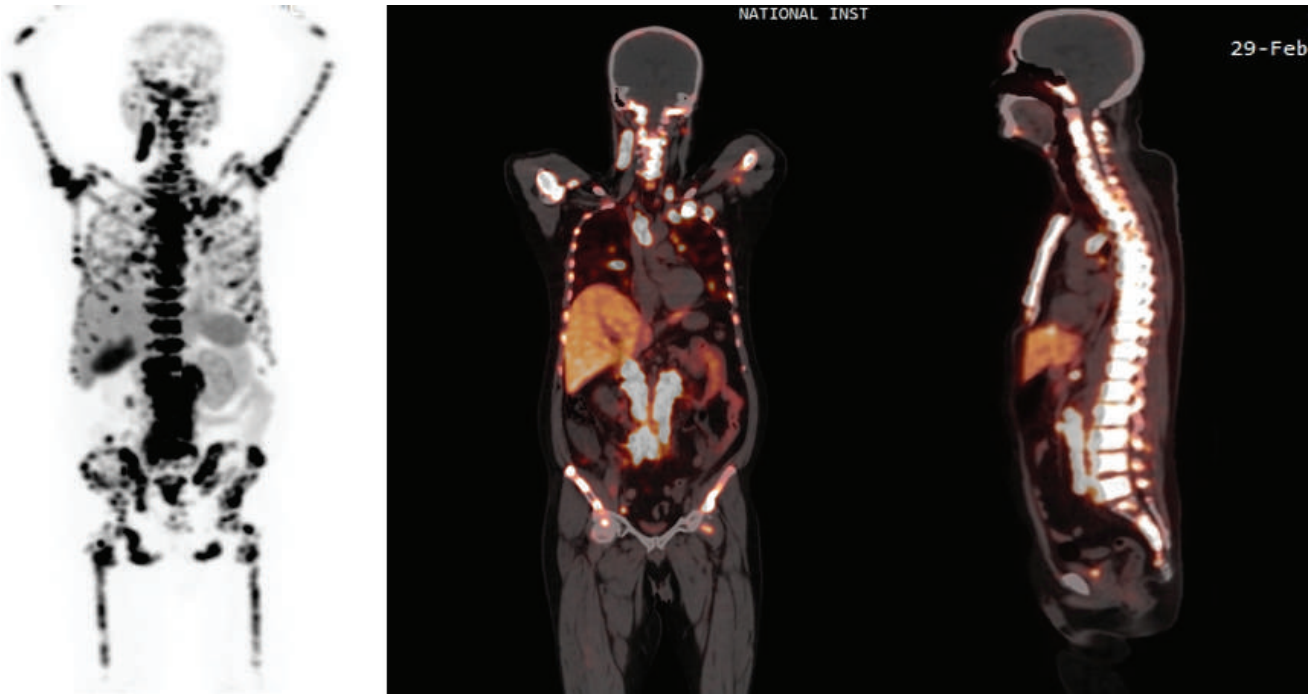
A 53-year-old male with prostate cancer presented with a history of lymph node and skeletal metastases. In January 2023, he underwent an ^{18}F-FDG PET-CT scan, which revealed hypermetabolic activity in multiple regions, including the cervical, mediastinal, and abdominal lymph nodes, as well as skeletal lesions, indicative of aggressive disease (Figure 1). The patient was subsequently treated with chemotherapy and anti-androgen therapy.



(a) (b) (c)

Figure 1: Maximum intensity projection (a), coronal (b) and sagittal (c) 18F FDG PET-CT images show hypermetabolic activity in multiple regions, including the cervical, mediastinal, and abdominal lymph nodes, as well as skeletal lesions.

In October 2023, after 10 months, a notable increase in PSA levels was observed, rising from 225 ng/mL to 616.5 ng/mL. This biochemical progression warranted restaging, and the patient underwent an ^{18}F-PSMA-1007 PET-CT scan. Upon restaging with ^{18}F-PSMA-1007 PET-CT in October 2023, extensive nodal and skeletal metastases were detected, revealing disease progression. The PSMA-avid lesions included all previously FDG-positive areas, with additional sites of metastasis not observed on the earlier FDG PET-CT scan in (Figure 2). This extensive disease burden highlighted the value of PSMA-based imaging in providing a more comprehensive assessment of metastatic spread.



(a) (b) (c)

Figure 2: Maximum intensity projection (a), coronal (b) and sagittal (c) ^{18}F-PSMA-1007 PET-CT images show extensive nodal and skeletal metastases, revealing disease progression. The PSMA-avid lesions included all previously FDG-positive areas, with additional sites of metastases.

DISCUSSION

The case presented involving a 53-year-old male with prostate cancer provides critical insights into the effectiveness of imaging modalities, specifically the comparison between ^{18}F-FDG PET-CT and 18F-PSMA-1007 PET-CT in detecting metastatic disease. Initially, the ^{18}F-FDG PET-CT scan revealed hypermetabolic activity in lymph nodes and skeletal lesions, which suggests the presence of an aggressive disease phenotype. This observation is consistent with literature indicating that FDG PET can benefit certain aggressive or poorly differentiated prostate cancers, with increased metabolic activity (2, 6). However, the consensus remains that FDG PET-CT has limitations in detecting metastatic lesions in prostate cancer due to the typically low glycolytic activity of prostate tumors (7).

In October 2023, the patient underwent an ^{18}F-PSMA-1007 PET-CT scan due to a significant rise in PSA levels, revealing extensive nodal and skeletal metastases that had not been observed on the previous FDG scan. This finding underscores the enhanced sensitivity of PSMA-based imaging, which is well-documented in the literature. Research indicates that ^{18}F-PSMA-1007 is particularly effective in identifying metastatic sites in patients with biochemical recurrence, providing a more comprehensive assessment compared to traditional FDG PET-CT (4, 5, 9). The identification of additional PSMA-avid lesions highlights the importance of using targeted imaging techniques, especially in cases where thorough disease staging is crucial for guiding treatment decisions.

Moreover, the case aligns with findings from previous studies which suggest patients with PSMA-targeted lesions may benefit from PSMA-targeted therapies, such as ^{177}Lu-PSMA, which have shown promising outcomes in metastatic castration-resistant prostate cancer (10). The comprehensive assessment provided by ^{18}F-PSMA-1007 PET-CT not only supports enhanced diagnostic capabilities but also aligns with the trend towards precision medicine in oncology, where treatment plans can be tailored based on individual patient characteristics (1, 8).

This case demonstrates the superior diagnostic capabilities of ^{18}F-PSMA-1007 PET-CT over ^{18}F-FDG PET-CT in restaging aggressive prostate cancer. The improved detection of metastatic lesions is essential for guiding treatment decisions, particularly for candidates for PSMA-targeted therapies (4). This case reinforces the growing body of evidence advocating for the routine integration of PSMA-targeted imaging in clinical practice to optimize patient management and outcomes in advanced prostate cancer (1, 4, 10). As the field progresses towards precision medicine, the role of advanced imaging modalities will be critical in accurately reflecting the biological behavior of prostate cancer and enhancing therapeutic strategies (2, 5, 9).

CONCLUSION

This case highlights the enhanced diagnostic capability of 18F-PSMA-1007 PET-CT compared to ^{18}F-FDG PET-CT in the restaging of aggressive prostate cancer. The improved detection of metastatic lesions with PSMA imaging is essential for guiding treatment decisions, particularly in candidates for PSMA-targeted therapies. As the field moves towards precision medicine, ^{18}F-PSMA-1007 PET-CT may become a cornerstone in the management of advanced prostate cancer.

REFERENCES

1. Ferlay J, Colombet M, Soerjomataram I, Parkin DM, Piñeros M, Znaor A, Bray F. Cancer statistics for the year 2020: An overview. International journal of cancer. 2021 Aug 15;149(4):778-89.
2. Jadvar H. Imaging evaluation of prostate cancer with 18 F-fluorodeoxyglucose PET/CT: utility and limitations. European journal of nuclear medicine and molecular imaging. 2013 Jul;40:5-10. Jadvar H. Imaging evaluation of prostate cancer with 18 F-fluorodeoxyglucose PET/CT: utility and limitations. European journal of nuclear medicine and molecular imaging. 2013 Jul;40:5-10.
3. Sachpekidis C, Pan L, Hadaschik BA, Kopka K, Haberkorn U, Dimitrakopoulou-Strauss A. 68Ga-PSMA-11 PET/CT in prostate cancer local recurrence: impact of early images and parametric analysis. American journal of nuclear medicine and molecular imaging. 2018;8(5):351.
4. Awenat S, Piccardo A, Carvoeiras P, Signore G, Giovanella L, Prior JO, Treglia G. Diagnostic role of 18F-PSMA-1007 PET/CT in prostate cancer staging: a systematic review. Diagnostics. 2021 Mar 19;11(3):552.
5. Yadav MP, Ballal S, Bal C, Sahoo RK, Damle NA, Tripathi M, Seth A. Efficacy and safety of 177Lu-PSMA-617 radioligand therapy in metastatic castration-resistant prostate cancer patients. Clinical nuclear medicine. 2020 Jan 1;45(1):19-31.
6. Hoffmann MA, von Eyben FE, Fischer N, Rosar F, Müller-Hübenthal J, Buchholz HG, Wieler HJ, Schreckenberger M. Comparison of [18F] PSMA-1007 with [68Ga] Ga-PSMA-11 PET/CT in restaging of prostate cancer patients with PSA relapse. Cancers. 2022 Mar 14;14(6):1479.
7. Mayor N, Sathianathen NJ, Buteau J, Koschel S, Antón Juanilla M, Kapoor J, Azad A, Hofman MS, Murphy DG. Prostate-specific membrane antigen theranostics in advanced prostate cancer: an evolving option. BJU international. 2020 Nov;126(5):525-35.
8. Oyama N, Akino H, Suzuki Y, Kanamaru H, Sadato N, Yonekura Y, Okada K. The increased accumulation of [18F] fluorodeoxyglucose in untreated prostate cancer. Japanese journal of clinical oncology. 1999 Dec 1;29(12):623-9.
9. Farolfi A, Calderoni L, Mattana F, Mei R, Telo S, Fanti S, Castellucci P. Current and emerging clinical applications of PSMA PET diagnostic imaging for prostate cancer. Journal of Nuclear Medicine. 2021 May 10;62(5):596-604.
10. El Fakiri M, Geis NM, Ayada N, Eder M, Eder AC. PSMA-targeting radiopharmaceuticals for prostate cancer therapy: recent developments and future perspectives. Cancers. 2021 Aug 5;13(16):3967.