



[¹⁸F]FDG PET/CT Mapping of Metastatic Spread in Left Testicular Carcinoma: A Rare Visualization of Lymphatic Pathway

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Abstract

We report a rare case of metabolic visualization of the entire left testicular lymphatic drainage pathway by [¹⁸F]FDG-PET/CT (¹⁸F-fluorodeoxyglucose positron emission tomography/computed tomography) in a 22-year-old male with biopsy-proven non-seminomatous germ cell tumor (NSGCT) of the left testis, presenting with extensive metastases to the retroperitoneal lymph nodes (RPLNs), liver, lungs, and skeleton. Primary staging with [¹⁸F]FDG-PET/CT demonstrated intense radiotracer uptake in both the primary tumor and multiple metastatic sites. Notably, a rare linear pattern of [¹⁸F]FDG avidity was observed along the left testicular lymphatic drainage pathway, following the course of the left testicular vein. While the anatomical pathway of lymphatic dissemination in testicular malignancies is well-characterized and [¹⁸F]FDG avidity in RPLNs has been previously reported, direct metabolic visualization of the entire lymphatic drainage pathway on [¹⁸F]FDG-PET/CT has not been documented. This case further underscores the utility of [¹⁸F]FDG-PET/CT in the initial staging of advanced NSGCT, particularly in detecting skeletal metastases that may be subtle or occult on conventional imaging, bearing important clinical and prognostic implications.

Keywords

- ▶ testicular cancer
- ▶ [¹⁸F]FDG-PET/CT
- ▶ metastasis
- ▶ embryonal carcinoma

Introduction

Testicular malignancy is a rare tumor, accounting for 0.51% of all tumors affecting males in the United States in 2022.¹ However, it is the most common nonhematological malignancy among young males aged 15 to 40 years.² It has a propensity for lymphatic as well as hematological dissemination, with retroperitoneal lymph nodes (RPLNs) being the first echelon nodes, followed by distant metastasis to other lymph nodal stations, lungs, liver, brain, and bones.³ The staging of testicular malignancy, as outlined in the 8th edition of the American Joint Committee on Cancer guide-

lines, is comprehensive and incorporates clinical, radiological, and histopathological findings along with levels of circulating serum tumor markers.⁴ Currently, the European Association of Urology (EAU) guidelines recommends the use of [¹⁸F]-fluorodeoxyglucose positron emission tomography/computed tomography ([¹⁸F]FDG-PET/CT) only for restaging patients with seminomatous germ cell tumors (GCTs). However, its use is not advised for restaging of non-seminomatous GCTs [NSGCTs] or for primary staging of either tumor subtype owing to its similar detection rate as conventional imaging.⁵ Considering the excellent prognosis of this entity, accurate staging is crucial for optimal management.

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Lymphatic dissemination occurs early in the disease and its accurate detection alters staging and hence management. Currently, contrast-enhanced computed tomography (CeCT) of abdomen and thorax is indicated for primary staging. The lymphatic dissemination for left- and right-sided testicular masses is anatomically distinct.⁶ Although it has been extensively described in the literature,^{7,8} with multiple case reports and studies describing [¹⁸F]FDG uptake in RPLN, the actual visualization of this entire lymphatic drainage pathway by metabolic imaging has not been documented.

Case Report

A 22-year-old male presented with fever, significant weight loss, severe back pain, and a left-sided painless testicular swelling for 2 months. He also suffered from multiple episodes of vomiting, reduced urine output, dry cough, and fatigue. His blood workup showed leukocytosis (13,000/mm³), anemia (9 g/dL), and raised serum creatinine (4.8 mg/dL). Scrotal ultrasonography revealed an enlarged, heterogeneous left testis, along with thickening of the left epididymis and spermatic cord, with moderate hydrocele. Abdominal and thoracic CeCT demonstrated multiple enlarged, conglomerated RPLNs resulting in bilateral ureteric compression and hydronephrosis, a well-defined hypodense lesion in liver segment VII, and multiple soft tissue nodular opacities distributed throughout bilateral lung fields. CT-guided biopsy from para-aortic lymph nodes showed pleomorphic cells with a high nuclear-cytoplasmic ratio and necrosis. Immunohistochemistry (IHC) markers were positive for AE1/AE3, CD30, SALL4, and Oct 3/4, and negative for D2-40, confirming a NSGCT, likely embryonal carcinoma (►Fig. 1). His concurrent serum tumor markers were as follows: serum alpha-fetoprotein of 3,253 ng/mL (normal ≤ 7 ng/mL) and serum beta-HCG of 3,381 mIU/mL (normal ≤ 2.6 mIU/mL).

A staging whole-body [¹⁸F]FDG-PET/CT showed lower radiotracer uptake in the brain (SUVmax: 11.03) consequent to increased radiotracer concentration in the extensive met-

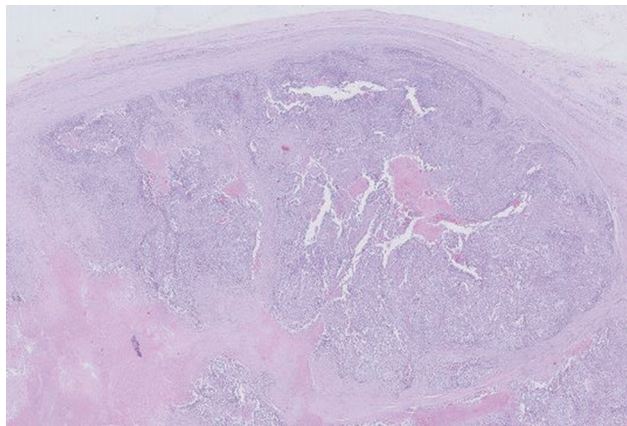


Fig. 1 H&E section from para-aortic lymph node biopsy showing pleomorphic and hyperchromatic cells with a high nuclear-cytoplasmic ratio. IHC markers were positive for AE1/AE3, CD30, SALL4, and Oct 3/4 and negative for D240. IHC, immunohistochemistry.

astatic lesions (►Fig. 2). High-grade [¹⁸F]FDG concentration was seen in the heterogeneous left testicular mass (SUVmax: 30.41) with thickened epididymis and spermatic cord. A linear pattern of [¹⁸F]FDG uptake was observed from the left testicular mass extending along the epididymis and spermatic cord (SUVmax: 12.76) up to the internal inguinal ring and then continuing along the course of the left testicular vein within the retroperitoneum, ultimately draining into the enlarged para-aortic lymph nodes (SUVmax: 21.29; ►Fig. 2). Intense radiotracer concentration was also noted in liver (SUVmax: 34.12) and lung (SUVmax: 25.87) lesions. Additionally, focal [¹⁸F]FDG uptake in an area of subtle sclerosis in the left iliac wing was also noted (SUVmax: 16.5). Considering the advanced stage and poor prognosis, the patient was planned for systemic therapy with Bleomycin–Etoposide–Cisplatin chemotherapy.

Discussion

NSGCTs, with the exception of choriocarcinoma, show lymphatic dissemination. Typically, testicular lymphatics course along the respective testicular veins. While the left testicular vein drains into the left renal vein, the right testicular vein drains directly into the inferior vena cava. Hence, the primary lymph nodal station involved in left testicular malignancy is the para-aortic group at the level of the left renal vein, whereas on the right side it is the inter-aortocaval nodes inferior to the right renal vessels.^{3,9} However, bulky disease can cross over and involve contralateral retroperitoneal nodes. Although this lymphatic pathway has been previously described in the literature with studies showing good [¹⁸F]FDG uptake in discrete and conglomerated RPLN,^{7,8} this case visually highlights the entire lymphatic pathway through metabolic imaging and reinforces our understanding.

[¹⁸F]FDG-PET/CT for initial staging in NSGCT has not been incorporated in the EAU 2024 guidelines owing to multiple studies showing similar diagnostic capabilities as compared to conventional imaging like CeCT or MRI.^{10,11} However, considering its ability to assess residual viable tumor cells in RPLN masses seen in patients post-chemotherapy, few studies have suggested its role in this particular clinical scenario, especially when CeCT is equivocal and serum tumor markers are stable.¹² This patient was staged as IIIB according to the 2016 TNM classification with poor prognosis in accordance with the International Germ Cell Cancer Collaborative Group (IGCCCG) classification.⁵ Though [¹⁸F]FDG-PET/CT is not indicated for initial staging of NSGCT, it revealed metabolically active metastatic disease in the RPLN, lung, liver, and a single skeletal lesion. The abdominopelvic CeCT showed subtle sclerosis, which was noted retrospectively after performing [¹⁸F]FDG-PET/CT. Skeletal metastasis in NSGCT is rare—around 3% at initial diagnosis and 9% in recurrent cases,¹³ mostly involving vertebrae (71%) and pelvis (24%).¹⁴ Presence of osseous metastasis can worsen the prognosis in the IGCCCG poor prognosis category patients. Update from a study by Gillessen et al in 2021 demonstrated an improvement in outcomes for patients in the poor prognosis category, with progression-free survival

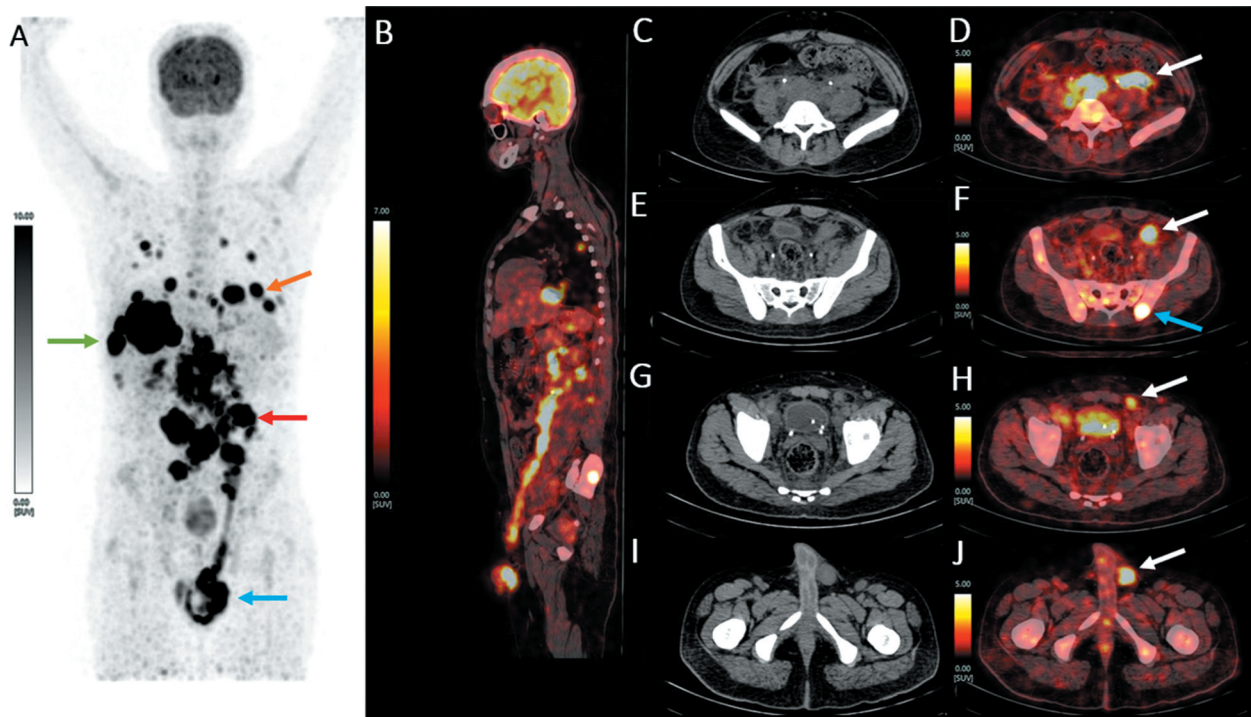


Fig. 2 [¹⁸F]FDG-PET/CT maximum intensity projection (MIP) demonstrating low brain uptake relative to the primary testicular lesion (blue arrow) as well as metastatic sites like retroperitoneal lymph nodes (red arrow), hepatic metastasis (green arrow), and pulmonary nodules [orange arrow] (A). Fused sagittal view showing linear [¹⁸F]FDG avidity along the entire lymphatic path of metastasis from the left testis to the para-aortic lymph nodes (B). CT and fused images showing metabolically active metastatic lesions—para-aortic lymph nodes (C, D), enlarged lymph nodes along the left testicular vein (white arrow), and wing of left ilium (blue arrow) (E, F), thickened left spermatic cord at the level of internal inguinal ring (G, H) and thickened, bulky left epididymis (I, J). [¹⁸F]FDG-PET/CT, [¹⁸F]-fluorodeoxyglucose positron emission tomography/computed tomography.

(PFS) increasing from 41 to 54% and overall survival (OS) improving from 48 to 67%, when compared to the original IGCCCG 1997 prognostic score.¹⁵ However, if the same category was associated with osseous metastasis, there was a significant reduction of PFS and OS to 34% and 45%, respectively.¹⁴ Hence, [¹⁸F]FDG-PET/CT in this case, by means of detecting an osseous lesion with very subtle sclerosis not visualized clearly on CeCT, played a significant role in staging and prognostication.

Conclusion

The present case illustrates a rare metabolic visualization of the lymphatic dissemination pathway in left-sided testicular embryonal carcinoma and shows the role of [¹⁸F]FDG PET/CT-PET/CT imaging in the primary staging of advanced NSGCT. The case presents a clinically relevant and visually good example of metastatic testicular cancer evaluated via [¹⁸F]FDG PET/CT and highlights a rare imaging phenomenon: metabolic visualization of the testicular lymphatic drainage pathway.

Authors' Contributions

A.S. and S.S.: Case data accumulation, case report drafting and revision. S.M.: Providing histopathology details including IHC findings. S.B.: Case discussion, concept guidance, and draft finalization.

Conflict of Interest

None declared.

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