Contribution of [18F]FDG PET/CT in the detection of a penile metastasis from pulmonary squamous cell carcinoma

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Abstract

Introduction: Lung cancer remains one of the leading causes of cancer-related mortality worldwide and is characterized by marked biological aggressiveness, resulting in frequent and often early metastases. Positron emission tomography combined with computed tomography (PET/CT) using ^{18}F-fluoro-deoxyglucose ([18F]FDG) has become an essential tool in the staging workup of non–small cell lung cancers, particularly squamous cell carcinomas, which are known for their high glucose avidity. While common metastatic sites include lymph nodes, bone, liver, brain, and adrenal glands, penile metastases are exceptionally rare and are associated with a poor prognosis.
Case report: We report the case of a 65-year-old patient with a long history of heavy smoking, who presented with a persistent cough associated with chest pain. Thoracic imaging revealed a mass in the left lower lobe, and histological and immunohistochemical analyses confirmed the diagnosis of pulmonary squamous cell carcinoma. As part of the initial staging workup, an ^{18}F-FDG PET/CT scan was performed. This examination demonstrated an intensely hypermetabolic primary lung lesion with extensive mediastinal involvement, associated with adrenal and bone metastases. Incidentally and in the absence of any related symptoms, a well-circumscribed hypermetabolic focus was detected within the corpus cavernosum, consistent with a penile metastasis. This finding allowed the disease to be classified as stage IV and led to an adaptation of the therapeutic strategy.
Conclusion: This case highlights the major contribution of [18F]FDG PET/CT in the initial staging of lung cancers by enabling accurate disease staging and the detection of rare, clinically silent metastatic sites. Early identification of such metastases prevents the initiation of inappropriate curative-intent treatments and guides clinicians toward an appropriate, predominantly palliative therapeutic approach, thereby optimizing patient care.

Keywords: Lung Neoplasms, Penile Neoplasms, Positron-Emission Tomography, Computed Tomography

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Introduction

Lung cancer is among the most frequently diagnosed cancers worldwide and remains the leading cause of cancer-related mortality [1]. Due to its generally aggressive nature, which can rapidly lead to metastatic spread, it is often diagnosed at an advanced stage, with stages III and IV accounting for nearly 80% of cases [2].

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Early detection of metastases is crucial for staging and treatment planning. Positron emission tomography combined with computed tomography using 18F-fluorodeoxyglucose ([18F]FDG PET/CT) is now an indispensable cornerstone in the management of lung cancers. In squamous cell carcinomas, which overexpress glucose transporters (GLUT-1) and exhibit high glucose avidity, [18F]FDG PET/CT demonstrates remarkable diagnostic performance, with high sensitivities confirmed by numerous studies. Compared with thoracic CT alone, [18F]FDG PET/CT allows the detection of occult metastases, refines staging, and significantly influences therapeutic management [3].

The most frequent extrathoracic sites of metastases from lung cancers involve the adrenal glands, liver, brain, and skeleton [4]. In contrast, penile metastases remain exceptional, accounting for only 4 to 6.2% of cases [5]. Although the penis is richly and complexly vascularized and has an extensive lymphatic network, penile metastases are rare, with fewer than 600 cases reported in the literature [6]. Among these patients, only 40 cases of penile metastases originating from a primary lung cancer have been documented, with the following histopathological incidences: squamous cell carcinoma (63%), adenocarcinoma (18%), and a single reported case of adenosquamous carcinoma. Approximately one third of penile metastases of pulmonary origin are detected at the time of diagnosis of the primary tumor, with the vast majority being discovered several months later, often at an advanced stage of the disease [7].

We report a rare case of penile metastasis arising from squamous cell carcinoma of the lung and discuss its clinical characteristics, diagnosis, treatment, and prognosis.

Case report

This concerns a 65-year-old patient whose main oncological risk factor was chronic active smoking estimated at 75 pack-years. He sought medical attention due to the persistence of a chronic cough associated with chest pain. The computed tomography scan performed showed a pulmonary mass in the left lower lobe.

The diagnosis of lung carcinoma was established following bronchoscopy with biopsies prompted by the CT discovery of the left lower lobe mass. Histopathological examination concluded to a poorly differentiated carcinomatous proliferation of the non–small cell type. Complementary immunohistochemical analysis confirmed the squamous cell carcinoma subtype. Based on the initial imaging, the lesion was classified as cT4 due to close contact with the thoracic aorta.

An [18F]FDG PET/CT scan was performed as part of the initial staging work-up to verify mediastinal nodal status and to search for potential secondary localizations. The primary pulmonary lesion, located in the left lower lobe, appeared as a large tissue mass with irregular and spiculated margins. Its hypermetabolism was very intense, with a maximum standardized uptake value (SUVmax) measured at 18. This process encased the wall of the descending thoracic aorta, indicating T4 stage invasion (cT4). Its metabolic aggressiveness was quantified by a metabolic tumor volume (MTV) of 55.3 cm^3, calculated using a threshold of 42 (Figure 1).

Regional nodal involvement was massive and extensive. The mediastinum showed a hypermetabolic confluent extension in places, involving nodal stations 2R, 3A, 4R, 4L,

3P, 5, and 7. In addition, a conglomerate of hypermetabolic lymphadenopathies was noted at the left hilar level (Figure 2).

The assessment revealed several distant metastatic sites. These included a hypermetabolic left adrenal nodular lesion, hypermetabolic lytic bone lesions with cortical breakthrough (middle arch of the second right rib and at the proximal third of the left femoral diaphysis) (Figure 2). The most significant finding, as it was totally unexpected and asymptomatic, was a well-defined hypermetabolic nodular focus (SUVmax = 6.5) located within the corpus cavernosum (Figure 3).

The [18F]FDG PET/CT allowed a complete staging assessment to be established in a single examination, classifying the disease as stage IV (cT4 cN3 cM1c) due to adrenal, bone, and penile metastases. The latter, being totally asymptomatic, would likely not have been detected by conventional imaging examinations or clinical examination.

Discussion

Penile metastases from lung cancer are exceptionally rare and generally indicate advanced systemic disease, associated with a poor prognosis [8]. Despite the rich vascularization and lymphatic network of the penis, metastatic involvement remains uncommon, and its pathophysiology is still not fully understood [10]. Among the proposed mechanisms, retrograde venous dissemination through communication between the pelvic venous plexuses and the dorsal vein of the penis is considered the most plausible route [10].

In the present case, the penile lesion was asymptomatic and incidentally detected during a whole-body [18F]FDG PET/CT performed for initial staging. This finding highlights the unique advantage of PET/CT in providing whole-body evaluation in a single examination, allowing the identification of unexpected metastatic sites that may be overlooked by conventional imaging or routine clinical examination.

From an imaging perspective, conventional computed tomography (CT) has limited sensitivity for detecting small lesions or isodense soft tissue lesions of the penis, particularly in the absence of associated structural abnormalities [11]. Although magnetic resonance imaging (MRI) offers superior soft tissue characterization and is considered the modality of choice for local evaluation of penile lesions, it is not routinely included in the staging workup of lung cancer [11]. In contrast, [18F]FDG PET/CT provides a comprehensive functional and anatomical assessment, enabling the detection of metabolically active lesions regardless of their location or clinical presentation [11].

A major clinical implication of this case lies in the impact of PET/CT findings on staging and management. The identification of an additional metastatic site, particularly in an unusual location such as the penis, led to disease upstaging to stage IV (T4 N3 M1c2) and helped avoid the initiation of inappropriate curative-intent treatment. Instead, it supported the adoption of a systemic palliative therapeutic strategy, thereby optimizing patient management.

In the absence of histopathological confirmation, the diagnosis of penile metastasis in this case was based on imaging features, metabolic activity, and the presence of

widespread metastatic disease. In this clinical context, biopsy was not deemed necessary, as it would not have altered management and could have exposed the patient to unnecessary risks.

This case highlights an important point for nuclear medicine physicians and radiologists: unusual hypermetabolic foci identified on PET/CT, even in asymptomatic and unexpected anatomical regions, should be carefully evaluated and not overlooked. Awareness of rare metastatic patterns is essential to ensure accurate staging and appropriate therapeutic decision-making.

In summary, [18F]FDG PET/CT plays a crucial role in the comprehensive staging of lung cancer by enabling the detection of both common and rare metastatic sites. Its ability to identify clinically occult lesions can significantly influence patient management and underscores its value as a whole-body imaging modality in oncology.

Conclusions

The penis can be a site of metastasis from a primary lung cancer. Given the rarity of penile metastases secondary to lung cancer and the poor prognosis associated with their identification, awareness of this atypical lesion—allowing investigations to be directed toward extrapelvic metastasis in the terminal phase—is crucial when evaluating these patients. In our case, PET/CT prevented the unnecessary and potentially morbid initiation of an aggressive curative-intent treatment for a disease that was in fact disseminated, redirecting management toward a more appropriate palliative systemic therapy. It thus represents a diagnostic investment that optimizes care pathways and avoids inappropriate treatments.

Author Contributions

All authors have reviewed the final version to be published and agreed to be accountable for all aspects of the work.

Batani Halima: Conceptualization, Investigation, Data curation, Writing – original draft

Bensimimou Hafsa: Methodology, Supervision, Writing – review & editing

Gbadamassi Abdel Amide: Formal analysis, Visualization

Adjal Akram: Investigation - Writing

Nato Cosme Boutros: Writing – Review

Ouassafrar Zakaria: Visualization, Review

Amal Guensi: Supervision, Project administration, Validation

Figures

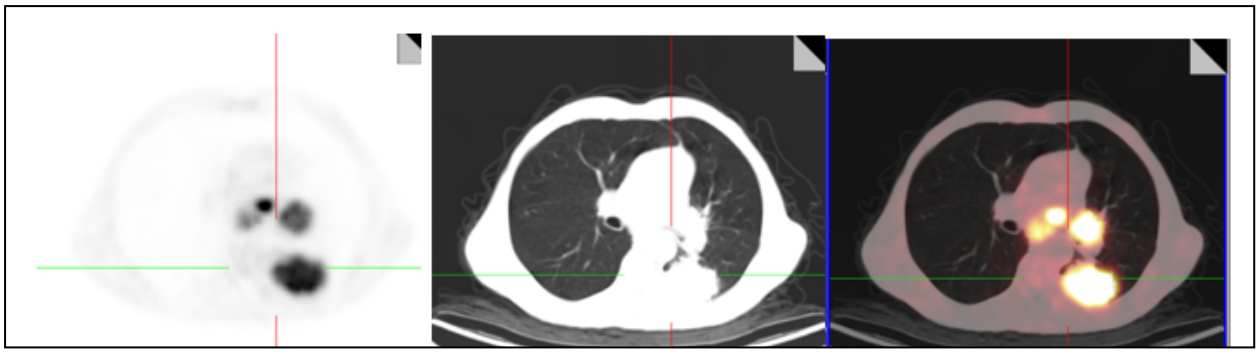


Figure 1: Pulmonary lesion of the left lower lobe

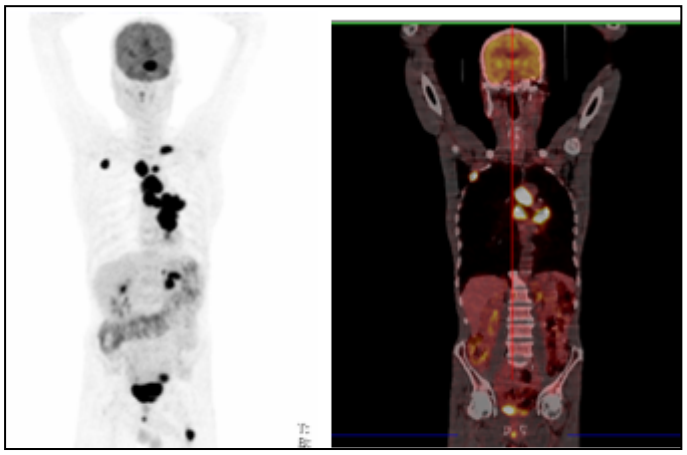


Figure 2: Lymph node, adrenal, and bone involvement

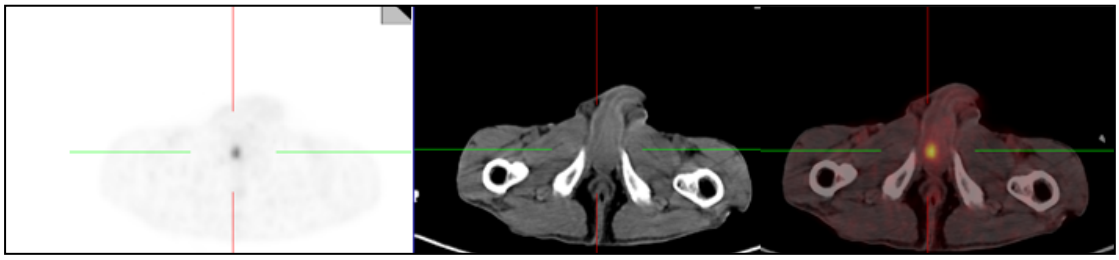


Figure 3: Penile nodular lesion

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Declarations
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