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Oncology

^{18}F-FDG PET/CT images defined the true extent of a urothelial bladder carcinoma

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ABSTRACT

A patient was referred, after neoadjuvant chemotherapy, for pre-surgical evaluation of urothelial bladder carcinoma (single lesion). Two thickenings in the left ureter wall identified on the CT scan were equivocal for malignancy. 18F-FDG PET/CT with delayed pelvic images, hyperhydration, and furosemide showed hypermetabolic ureteral metastases and multifocal bladder tumors. There were no lymph nodes or distant metastases. These 18F-FDG PET/CT findings completely altered the surgical treatment. The patient underwent left nephroureterectomy, radical cystoprostatectomy, and lymphadenectomy, followed by a urinary transit reconstruction. Histopathology confirmed multifocal high-grade urothelial carcinoma in the bladder walls and left ureter and benign lymph nodes.

Introduction

Urothelial carcinoma (UCC) accounts for more than 90% of bladder cancers are initially multifocal and superficial, and 30% of patients already present with high-grade muscle-invasive tumors.

Meticulous initial staging with cystoscopy, ureteroscopy, biopsy, contrast-enhanced computed tomography (CECT), or magnetic resonance imaging (MRI) of the abdomen and pelvis is essential. Ten to 15% of patients will have metastases, and at least 50% of high-grade tumors, occult metastases. Despite prompt and aggressive treatment, metastases appear within two years; these are mainly located in pelvic and retroperitoneal lymph nodes, bones, liver, and lungs.

The use of 18F-FDG PET/CT in staging and restaging of UCC has been controversial due to the radiotracer activity excreted in the urine, and FDG-avid tumors may go undetected. However, several studies show better results for the locoregional and distant staging of UCC with 18F-FDG PET/CT than with CT or MRI[1,2] mainly using a proper 18F-FDG PET/CT protocol with delayed images after hyper-hydration, diuretics, and voiding.[3]

This case report illustrates the benefit of 18F-FDG PET/CT in staging UCC, especially to elucidate equivocal findings on conventional imaging.

Case presentation

A 55-year-old hypertensive, diabetic male patient (former smoker) was diagnosed with a high-grade urothelial carcinoma lesion in the bladder. After the cystoscopic biopsy and CeCT, the patient's final stage was T2N1M0, and two areas of slight wall thickening in the left ureter were equivocal for neoplasia.

After two months of neoadjuvant chemotherapy, the restaging CECT revealed a partial reduction of the bladder lesion and persistence of two areas of slight wall thickening in the left ureter, which is still equivocal malignancy (Fig. 1).

During surgical planning because of the suspicion that the tumor might be multifocal with extension to the ureter, an 18F-FDG PET/CT was performed. The whole-body images did not reveal FDG-avid lesions, only physiologic tracer accumulation/excretion from the kidneys, ureters, and bladder. However, delayed images after hyperhydration, administration of diuretics, and voiding identified three focal areas of hypermetabolism consistent with bladder tumors. These focal areas were a vegetative lesion in the left anterolateral wall of the bladder (SUV max = 25.9) and posterior bladder wall thickenings (SUV max = 6.6). The staging CECT did not identify these focal areas.

Moreover, 18F-FDG PET/CT identified two hypermetabolic foci in the proximal portion of the left ureter (SUV max = 12.5), consistent with

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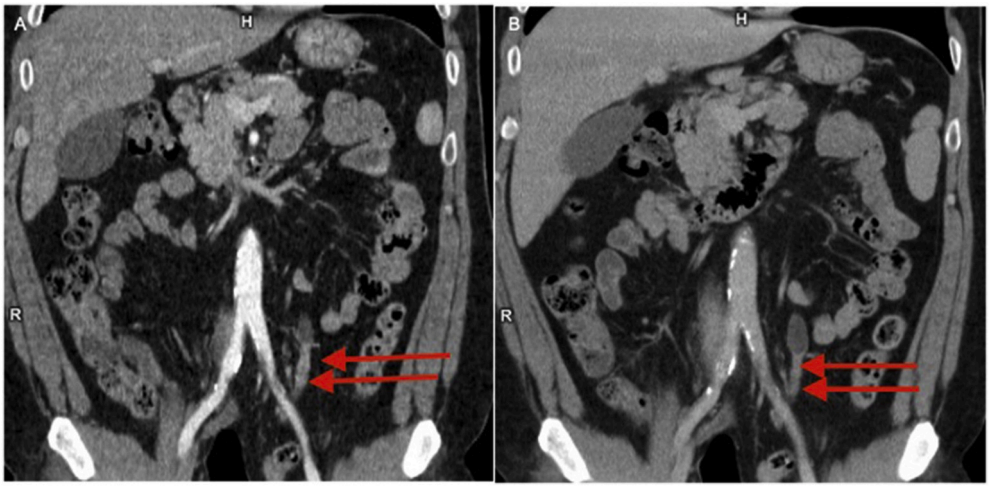

Fig. 1. Restaging contrast-enhanced CT coronal images performed after two months of neoadjuvant chemotherapy for a urothelial bladder cancer revealed a partial reduction of the bladder lesion. However, the A) angiographic and B) nephrographic phases of the scan reveal two areas of slight wall thickening in the left ureter (arrows). These regions of slight wall thickening were unaltered compared to the staging CT scan and deemed equivocal for malignancy.

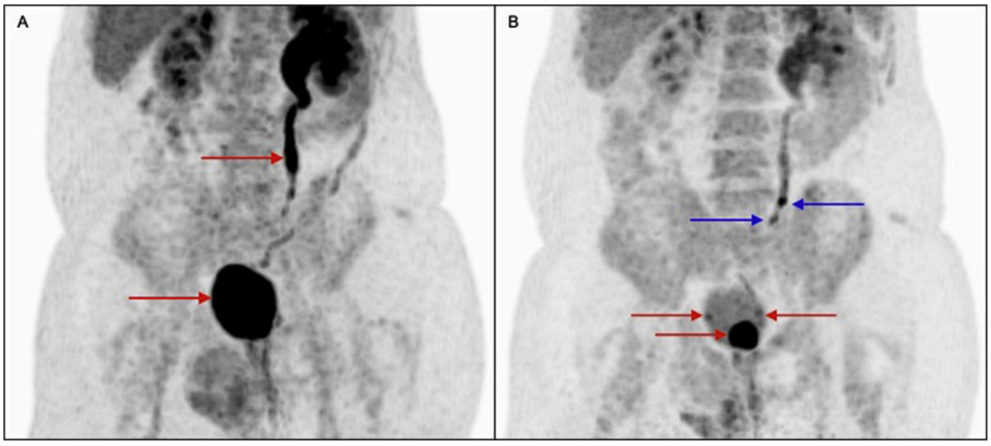

Fig. 2. The adequate surgical planning required investigation of a possible multifocal tumor with extension to the ureter; therefore, an 18F-FDG PET/CT was performed. A) The routine 18F-FDG PET/CT coronal image shows only intense physiologic radiotracer elimination in the left dilated ureter and the bladder (arrows). B) However, the delayed 18F-FDG PET/CT images performed after the adequate protocol composed of hyperhydration, diuretics, and voiding identified three focal areas of hypermetabolism in the bladder. These regions corresponded to one vegetative lesion in the left anterolateral wall (SUV max = 25.9); and two in the posterior bladder wall (SUV max = 6.6) (arrows). The latter two lesions in the posterior bladder wall were not identified previously in the CT scan. Furthermore, delayed 18F-FDG PET/CT images also revealed two foci of increased uptake (arrows) consistent with metastatic spread in the proximal portion of the left ureter (SUV max = 12.5). 18F-FDG PET/CT did not detect signs of locoregional or distant metastases.

the regions of ureter wall thickening noted on the CECT scan. No signs of locoregional or distant metastasis were detected. These findings on 18F-FDG PET/CT were staged as multifocal urothelial carcinoma in the bladder and ureter without locoregional lymph nodes or distant metastases (Fig. 2).

The patient underwent left nephroureterectomy, radical cystoprostatectomy, and iliac and obturator fossa lymphadenectomy, followed by a urinary transit reconstruction. Histopathology confirmed the left ureter and bladder lesions as high-grade urothelial carcinoma. The lymph nodes were all benign (Fig. 3).

Discussion

18F-FDG PET/CT has been considered limited in the investigation of UCC because of the renal excretion and accumulation of 18F-FDG in the urinary tract. To overcome the interference of urinary radiation, removing the excreted 18F-FDG and techniques such as delayed images after administration of furosemide were developed.[3] Several studies have shown that 18F-FDG PET/CT is equal to or even superior to CT in the evaluation of UCC. A meta-analysis revealed 82% sensitivity, 89% specificity, and 92% accuracy for staging/restaging UCC.[4] 18F-FDG PET/CT performs even better than contrast-enhanced CT to detect bone metastasis, with sensitivities, specificities and accuracies ranging from 73 to 95%, 60–100% and 70–94%.[5] Furthermore, especially in patients with low risk of disease spread, 18F-FDG PET/CT imaging is still more accurate and beneficial than CT as it detects unsuspected metastases.

In conclusion, we demonstrated the benefit of performing 18F-FDG PET/CT in UCC, as these cancers are incredibly FDG-avid. When a proper 18F-FDG PET/CT protocol is applied with delayed images after hyperhydration, administration of diuretics, and voiding, multifocal lesions can be detected to stage and improve surgical and oncological patient management adequately.

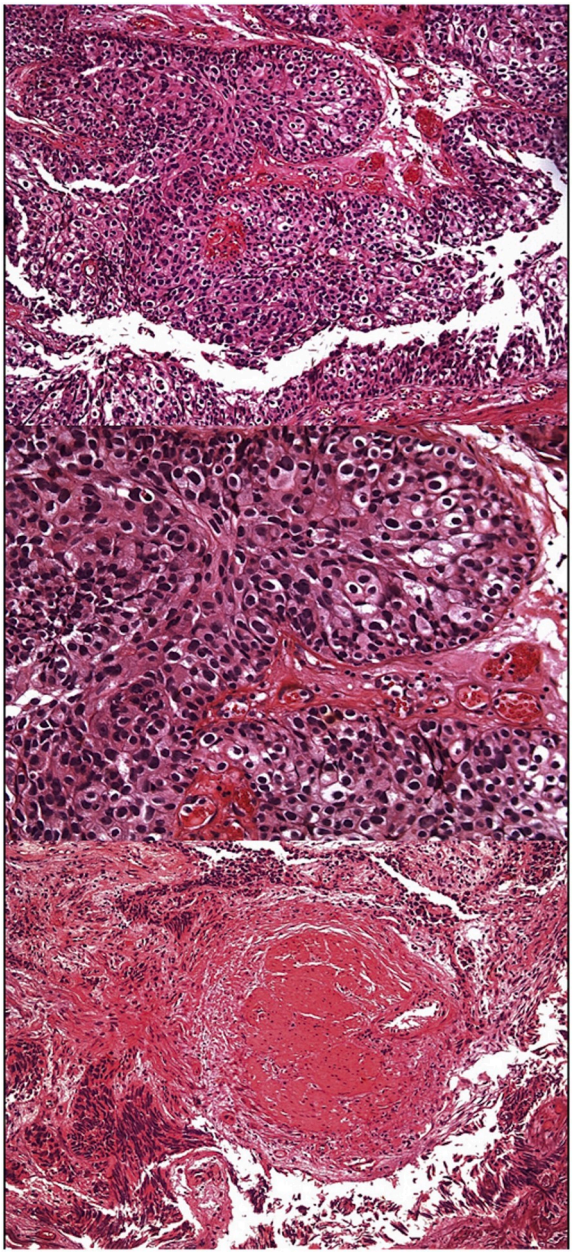

Fig. 3. Histopathology confirmed that all 18F-FDG-avid foci (two in the left ureter and three in the bladder) were high-grade urothelial carcinoma. There were no metastatic lymph nodes (also consistent with the 18F-FDG PET/CT findings).

Declaration of competing interest

The authors declare they have no financial interests.

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