

# 18F-FDG PET/CT features of ureteral metastases from breast cancer: a case report

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## Abstract

Breast cancer metastasis to the ureter is rare. Fluorine-18-fluorodeoxyglucose positron emission tomography (18F-FDG PET)/computed tomography (CT) is widely used to identify primary lesions of metastatic tumours, however, 18F-FDG PET/CT imaging features of ureteral metastasis from breast cancer are rarely reported. Herein, the case of a 46-year-old woman with recurrent left flank pain for 5 months, who was admitted to the Cancer Hospital of Guangxi Medical University and Guangxi Cancer Research Institute, is described. She had undergone right radical mastectomy 5 years previously and had received tamoxifen treatment for 5 years. Assessment by 18F-FDG PET/CT revealed tumours on the ureter presenting as a long segmental lesion, radioactive concentrations, and a low maximum standardized uptake value (SUV<sub>max</sub>), with no radioactive concentrations in the urine and no significant change in the ureteral contour. The severity of the ureteral lesion was not consistent with the severity of hydronephrosis. A tumour biopsy was performed laparoscopically, and postoperative pathological examination confirmed a primary breast cancer tumour. The patient did not consent to treatment and was lost to follow-up.

## Keywords

Breast cancer, ureteral metastatic carcinoma, 18F-FDG PET/CT features, case report, metastasis, mild hydronephrosis

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## Introduction

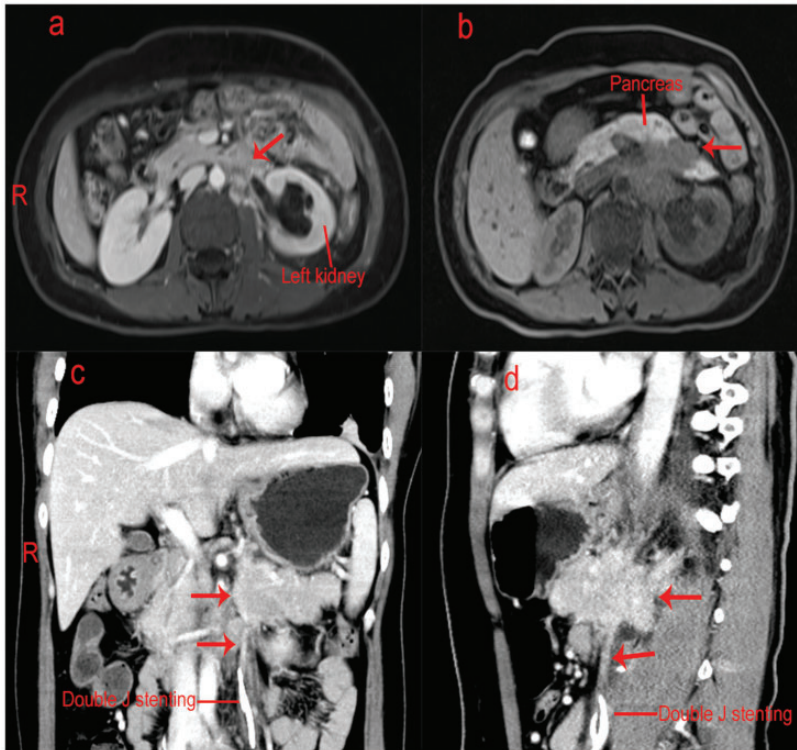
Breast cancer is among the most common malignant tumours in females worldwide and is also the leading cause of cancer-related deaths.<sup>1</sup> Breast cancer can metastasize to any organ; the most common sites being the bone, lung, liver, and pleura.<sup>2</sup> Breast cancer metastasis to the ureter is rare. Abdominal computed tomography (CT) and magnetic resonance imaging (MRI) examinations are necessary but not specific for metastatic ureteral tumours. Fluorine-18-fluorodeoxyglucose positron emission tomography (18F-FDG PET)/CT can help identify the primary lesion of metastatic tumours, however, 18F-FDG PET/CT imaging for metastatic ureteral tumours is rare. Herein, the case of a 46-year-old woman with recurrent left flank pain for 5 months, who was subsequently diagnosed with ureteral metastases from breast cancer, is described.

This study was approved by the Ethics Committee of the Affiliated Cancer Hospital of Guangxi Medical University (No. 20170308-4), and written informed consent to publish the report was obtained from the patient's legal guardian.

## Case report

A 46-year-old woman with recurrent left flank pain for the previous 5 months was admitted to the Cancer Hospital of Guangxi Medical University and Guangxi Cancer Research Institute in October 2020. She presented with the following symptoms: absence of urinary frequency, urinary urgency, painful urination, and haematuria visible to the naked eye. The patient had undergone right radical mastectomy 5 years previously, and pathological examination had confirmed a non-specific type of invasive breast cancer with no vascular or nerve invasion within the slice. Immunohistochemistry results at that time were as follows: E-cadherin (+),

cytokeratin (CK)5/6 (-), epidermal growth factor receptor (-), androgen receptor (+, 90%), oestrogen receptor (ER) (+, 80%), progesterin receptor (PR) (+, 80%), and proliferation marker protein Ki-67 (+, 40%). With human epidermal growth factor receptor (HER)-2 (2+), a diagnosis of invasive breast cancer T1N1M0 stage II was established. Adjuvant chemotherapy after surgery and at least 5 years of endocrine therapy were the treatment modalities advised to this patient, with local radiotherapy as an alternative;<sup>3,4</sup> however, she declined chemotherapy and local radiotherapy and received endocrine therapy with tamoxifen only for 5 years. Physical examination during the latest hospital admittance revealed pressure pain in the left upper middle ureter. Serum tumour marker tests showed the following elevated values: carcinoembryonic antigen: 39.61 ng/ml (normal value,  $\leq 5.0$  ng/ml); cancer antigen 125, 57.2 U/ml (normal value,  $\leq 35.0$  U/ml); carbohydrate antigen 15-3, 258.9 U/ml (normal value,  $\leq 31.3$  U/ml); and CK19 fragment, 4.58 ng/ml (normal value,  $\leq 3.3$  ng/ml). No significant abnormalities were found in other laboratory tests. Ultrasonography revealed that the left renal collecting system was separated by approximately 2.0 cm, indicating that left hydronephrosis was not obvious. Abdominal CT and MRI showed tumours in the pancreas, left adrenal gland, and upper part of the left ureter, and showed folding back of the double J stent at the lesion, suggesting narrowing of the ureter lumen (Figure 1). The wall adjacent to the upper part of the left ureter was slightly thickened. 18F-FDG PET/CT revealed multiple lymph node metastases in the thoracic cavity and abdomen, and larger lymph nodes of approximately  $3.5 \times 2.2$  cm were located next to the abdominal aorta with radioactive concentration. The maximum standardized uptake value (SUVmax) was 10.7. The tumours invaded the pancreas and the transition area between the left ureter and renal pelvis.



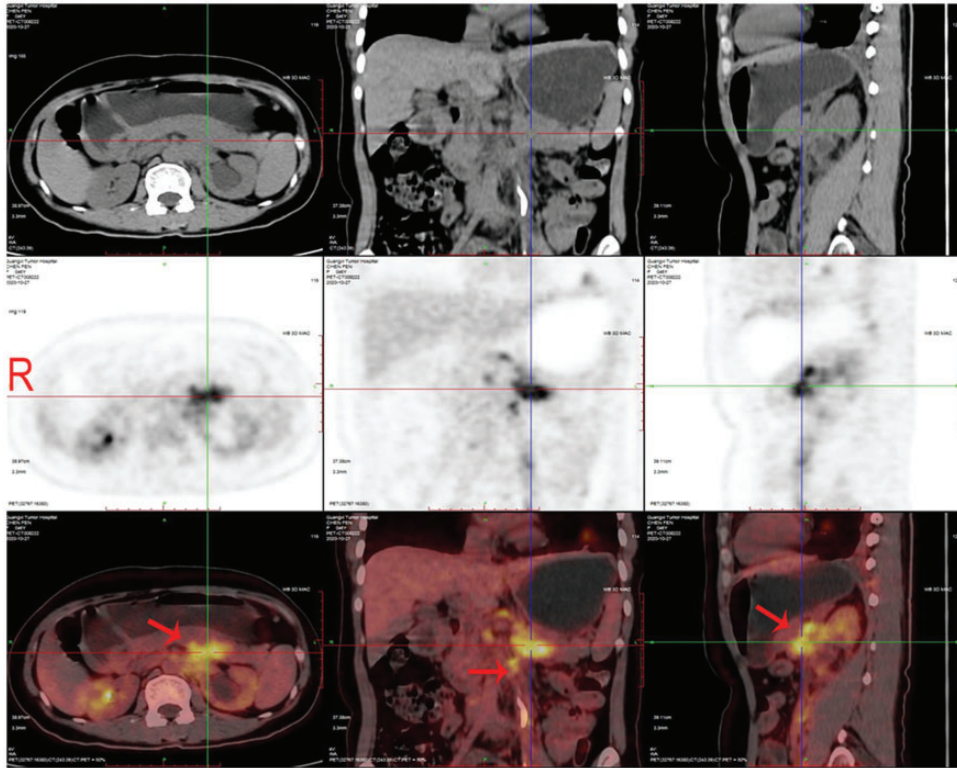
**Figure 1.** Abdominal magnetic resonance images showing: (a) the tumour surrounding the ureter at the junction of the ureter and renal pelvis, and left hydronephrosis, and (b) the tumour invading the tail of the pancreas; and (c and d) abdominal computed tomography images showing double J stenting that has been folded back, and the tumour invading the upper ureter and renal hilum.

Radioactive concentration was observed in the ureteral lesion (Figure 2), but no radioactive concentration was found in the urine of the left dilated renal pelvis. The tumour in the upper ureter and the hilum of the kidney showed increased metabolism; however, the shape, contour, and path of the left upper ureter was not significantly altered (Figure 3). Transurethral ureteroscopy showed a rigid upper and middle ureteral wall, narrow lumen, and no endogenous tumour. Ureteral stenting was challenging to perform, and a viable route for obtaining tumour tissue using fine-needle aspiration could not be found for pathological examination. Thus, tumour tissue was obtained from the hilum of the kidney and the upper

segment of the ureter using laparoscopy. Postoperative immunohistochemistry results were as follows: CK7 (+), CK20 (-), villin (-), GATA-3 (+), ER (+, 80%), PR (+, 90%), HER-2 (-), and Ki-67 (+, 40%), and the primary tumour was confirmed to be breast cancer. Based on the advice of chemotherapists, systemic chemotherapy was recommended to the patient, however, the patient did not return to the hospital for treatment and was lost to follow-up.

## Discussion

Metastasis of a non-urinary system primary tumour to the ureter is a relatively rare clinical phenomenon and often lacks specific



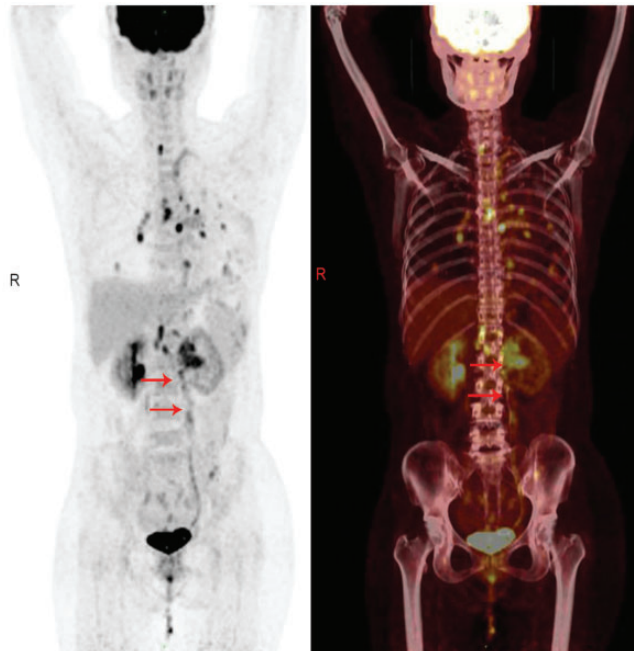
**Figure 2.** Fluorine-18-fluorodeoxyglucose positron emission tomography (PET)/computed tomography (CT) images in transverse, coronal and sagittal planes (left to right), showing the radioactive concentration of the tumour in the renal hilum, the junction of ureter and renal pelvis, and the pancreas, with a maximum standardized uptake value of 10.7. Top images, CT; middle images, PET; bottom images, PET/CT fusion.

characteristic changes.<sup>5</sup> Early diagnosis of the source of the primary tumour is important to achieve a satisfactory outcome due to wide variations in the treatment of urinary and non-urinary system tumours. However, imaging features of urological metastases may be very similar to those of primary urological tumours. Thus, it is challenging to establish a differential diagnosis using conventional imaging alone.<sup>5</sup>

Positron emission tomography/computed tomography is a one-time scan that involves whole-body imaging, and can identify a primary tumour and additional tumours that undergo metastasis. <sup>18</sup>F-FDG PET/CT has been shown to have superior diagnostic accuracy compared

with standard CT,<sup>6</sup> and it can help determine the extent of tumour invasion in the viscera, ureter, mediastinum, and retroperitoneal lymph nodes, where no viable fine-needle puncture routes may be found.

The standardized uptake value (SUV) is a parameter that reflects the uptake of <sup>18</sup>F-FDG by cancer cells. Therefore, both metastatic and primary tumours generate SUVs, however, the SUV of primary tumours tends to be lower than that of metastatic tumours.<sup>7</sup> In the present case, the SUVmax was only 10.7 (normal value, < 2.0), and no radioactive concentration was found in the urine of the left dilated renal pelvis.



**Figure 3.** Whole body fluorine-18-fluorodeoxyglucose positron emission tomography (PET)/computed tomography (CT) images showing the radioactive concentration of the tumour at the junction of the ureter and renal pelvis. The shape and path of the ureter are not significantly altered, the contours are clear, and the urine is not radioactively concentrated. Left image, PET; right image, PET/CT fusion.

The shape, contour, and ureteral formation of the lesion in the upper left ureter were not significantly altered on the  $^{18}\text{F}$ -FDG PET/CT images in the present case. The larger tumour was located in the upper ureter; however, the ureter was not completely obstructed, and only slight hydronephrosis was observed. In the authors' clinical experience, a primary ureteral tumour often causes the ureter wall to undergo serious changes and lose its normal contour. Patients frequently have obvious clinical manifestations associated with hydronephrosis as the chief complaint at the time of hospitalization. In addition, it has been shown that a primary ureteral carcinoma is characterized by limited thickening of the wall at the site of tumour occurrence, with the junction between the tumour and the normal ureter appearing

as 'cupped' and 'rat-tail' or with an irregular mutilated shape.<sup>8</sup> The length of the primary ureteral tumour infiltrating the ureteral segment is usually greater than the diameter of the tumour infiltrating laterally, while secondary tumours commonly involve a shorter ureteral segment.<sup>5</sup> In contrast, most ureteral metastases show only limited thickening of the ureteral wall on CT,<sup>8</sup> which is consistent with the present case.

## Conclusion

Breast cancer metastases to the ureter may appear on  $^{18}\text{F}$ -FDG PET/CT as a ureteral disease with a long segmental lesion, radioactive concentrations, low SUVmax, no radioactive concentrations in the urine, and no significant change in the ureteral

contour. In the present case, the severity of the ureteral lesion was not consistent with the severity of hydronephrosis. Few studies have discussed 18F-FDG PET/CT for the diagnosis of metastatic ureteral tumours, and a large sample size analysis is lacking. However, 18F-FDG PET/CT may be combined with conventional imaging examinations and clinical features to identify tumours in areas where it is challenging to obtain tumour tissue using fine-needle aspiration. Determining the scope of invasion and identifying the source of the primary tumour is beneficial for planning treatment and managing patient prognosis.

### Data accessibility

Additional unpublished data are available upon request to the lead author.

### Author contribution

Yuanbi Huang, Huajie He and Wei Wei are joint first authors and collected the data; images were edited by Qiguang Li, Xian Long, Yongpeng Li, and Rongchao Chen; and Yuanbi Huang and Xianlin Yi drafted the manuscript. All authors read and approved the final manuscript.

### Declaration of conflicting interest


The authors declare that there is no conflict of interest.

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