

Feasible Method to Successfully Uncover a Urothelial Carcinoma in the Urinary Bladder on the FDG PET/CT Scan Masked by Physiological Urine Radioactivity

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Abstract: A 71-year-old man asked for a F-18 fluorodeoxyglucose positron emission tomography/computed tomography (FDG PET/CT) scan for follow-up of the renal cell carcinoma of right kidney after nephrectomy 2 years ago. Except for normal radioactivity outside the urinary system, however, a CT abnormality in the urinary bladder was noted but its character of metabolic activity was interfered with by the abundant physiological urine FDG radioactivity. After a simple procedure with intravenous administration of diuretics and asking the patient to hold his urine, the lesion emerged as an area of focal intense radioactivity after the dilute effect of the urine. The subsequent histologic examination via the cystoscopic biopsy revealed papillary urothelial carcinoma.

Key Words: FDG PET, urothelial carcinoma, diuresis, hold urine, dilution

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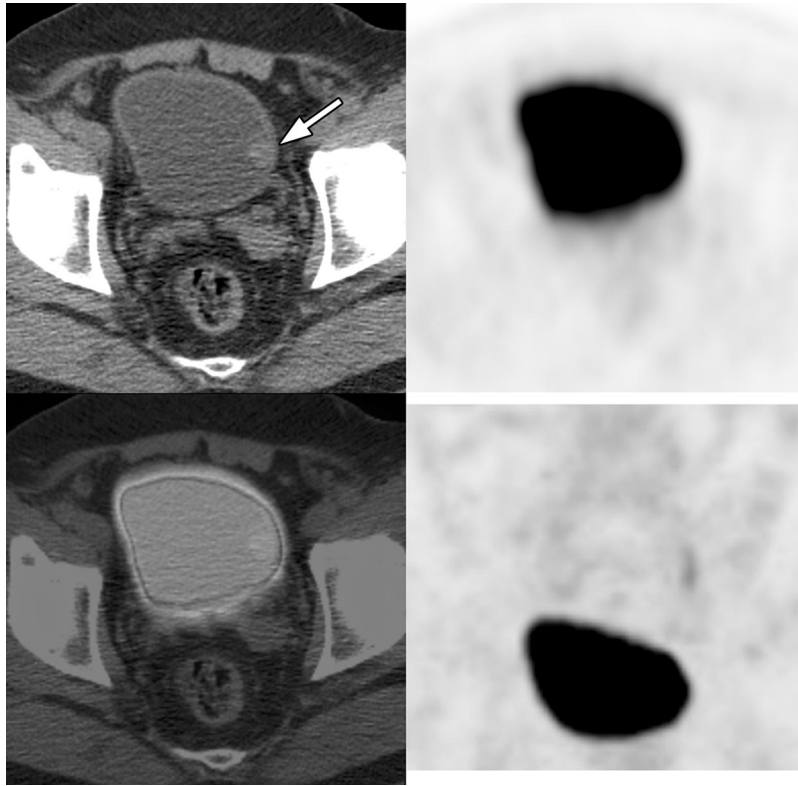


FIGURE 1. A 71-year-old man had undergone right nephrectomy for renal cell carcinoma about 2 years ago without symptoms and signs suggestive of recurrence during the regular follow-up. Recently, he asked for a FDG PET/CT scan for a comprehensive survey and follow-up of the post-treatment condition of malignancy. The FDG PET/CT was performed 60 minutes after intravenous administration of FDG to the patient with a low radiation dose, freely breathing, noncontrast enhanced CT acquisition protocol. The whole body images revealed absence of the right kidney and no significant FDG-avid abnormality outside the urinary system. At first glance, the FDG radioactivity in the urinary bladder was intense and homogeneous (maximum standardized uptake value, SUVmax = 13), revealing a usual physiological pattern of urinary excretion. However, the CT component of the FDG PET/CT scan disclosed a focal hypodense (Hounsfield unit, HU = 53) protuberance from the left inner wall of the urinary bladder (arrow), which was easily distinguished from the adjacent urine density (HU was about 0–5). (The arrangement of the panels in Figures 1 and 2 are the same as follows: left upper panel indicates representative transaxial slice of CT scan; right upper panel, representative transaxial slice of FDG PET scan; left lower panel, representative transaxial slice of fused FDG PET/CT scan; right lower panel, maximum intensity projection of FDG PET scan).

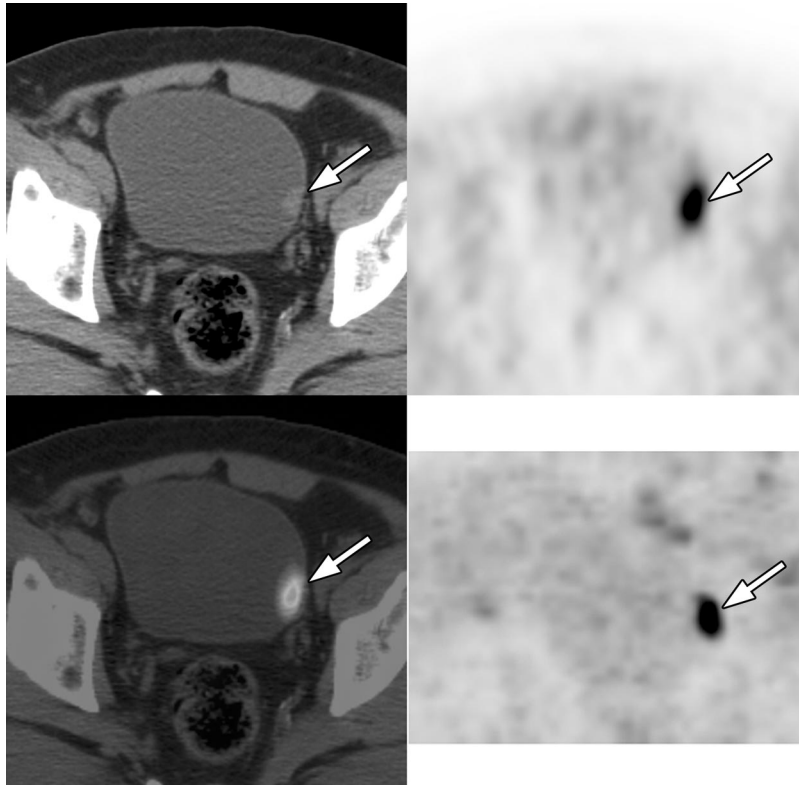


FIGURE 2. For further discrimination of the CT finding with the assistance of reliable FDG metabolic activity, a delayed scan was obtained 60 minutes after the bolus intravenous administration of the diuretic (20-mg furosemide). The time interval between the initial and delayed scans was 75 minutes. No additional fluid was given either via the intravenous infusion or oral intake after the administration of the diuretics. The patient was also asked to void immediately after the initial scan and then hold the urine until the delayed scan was finished. The delayed scan showed much lowered intensity of the urine radioactivity (SUVmax = 1.6) in contrast to the highlighted left bladder wall lesion (arrows; SUVmax = 8.0). The high FDG uptake strongly suggested its malignant origin. Further histologic examination of the lesion via cystoscopic biopsy proved a low-grade papillary urothelial carcinoma.

To correctly measure the actual metabolic activity of the intravesical or perivesical lesion is important for the differential diagnosis and depends on the capability of removing the influence of abundant physiological urinary FDG radioactivity. For this purpose, several methods have been advocated, including retrograde saline irrigation of the urinary bladder,^{1,2} combined use of diuretics, intravenous saline infusion and bladder catheters,³⁻⁵ combined use of furosemide forced diuresis and parenteral hydration,⁶ and combined use of furosemide forced diuresis, oral hydration and frequent voiding.^{7,8} On the contrary, it seems less problematic for anuric patients such as those with end-stage renal disease because of the better contrast of the tumor uptake and background radioactivity.⁹ Although several methods to decrease the interference of urine radioactivity have been proposed, they are either too invasive or labor intensive for the combination of multiple procedures to be routinely applied. On the other hand, our patient only received additional diuretics after voiding immediately after the initial scan for eliminating the high concentrated radiopharmaceuticals, and then diluted the urine radioactivity with the subsequently physiologically produced low radioactive urine. The additional 1-step procedure is feasible and noninvasive, and may be more practical for routine use of detecting an intravesical or perivesical lesion, especially in a busy nuclear medicine department. This case also highlights the need to carefully review the CT component of FDG PET/CT scan in case omission of morphologically evident lesions is masked by the abundant physiological FDG radioactivity.