

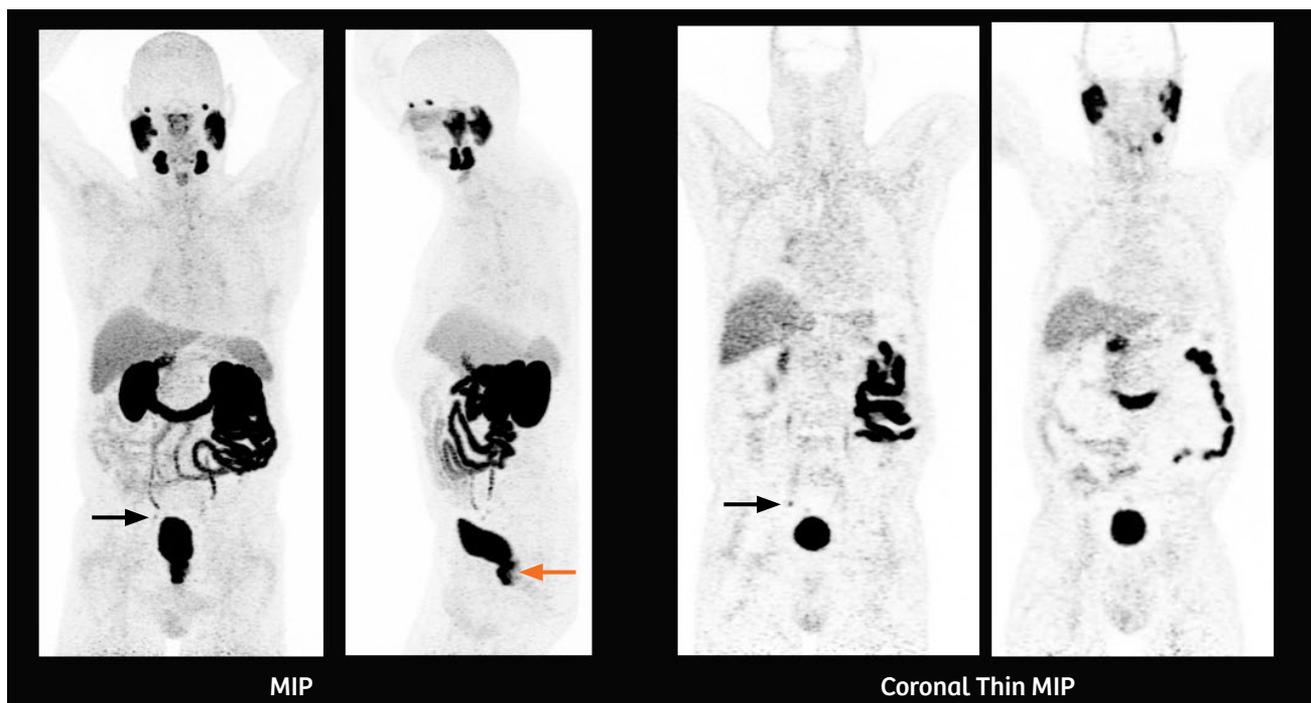
# Detection of solitary pelvic lymph node metastasis in a patient with primary prostate cancer

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Data courtesy of University Medical Center Groningen, Groningen, The Netherlands

## History

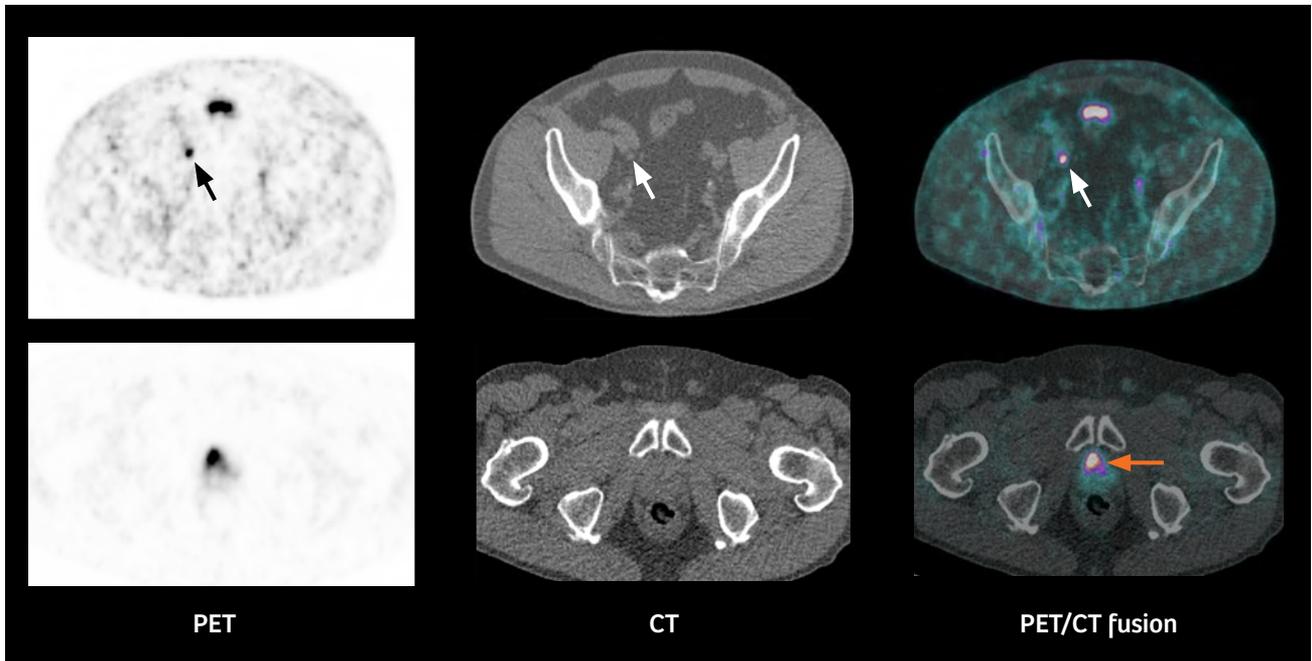
A 78-year-old male with a medical history of lower urinary tract symptoms, referred for primary staging of his newly-diagnosed Gleason 3+4 prostate cancer, underwent a  $^{68}\text{Ga}$  PSMA PET/CT for initial staging on Biograph Vision™. The patient was intravenously injected with 2.7 mCi (100 MBq) of  $^{68}\text{Ga}$  PSMA, and the PET/CT

study was performed 1 hour and 45 minutes post injection. The examination began with an ultra low-dose CT (100 kV, 16 eff mAs, 32 x 1.2 mm collimation) followed by a PET acquisition with continuous bed motion (FlowMotion™ technology) at a constant table speed of 1.0 mm/sec. The PET study was reconstructed with a 220 x 220 matrix using time of flight (ToF) and point spread function (PSF).



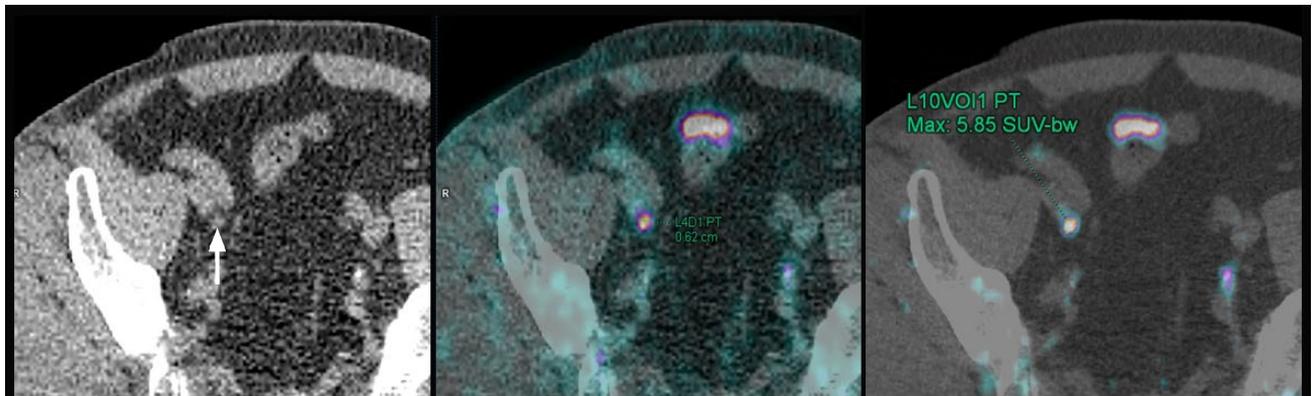
- 1 Left panel: coronal and sagittal  $^{68}\text{Ga}$  PSMA PET maximum intensity projection (MIP) images. Lobulated and intense tracer uptake in the ventral part of the prostate (orange arrow), reflecting the primary tumor. Right panel: coronal thin MIP images show a small focal uptake in the right pelvis (black arrow) that is distinct from the ureter, which is suggestive of a solitary lymph node metastasis. No other tracer-avid lymph nodal lesions are visualized. Salivary and lacrimal glands, liver, kidneys, and intestines show physiological uptake, with physiological excretion through the ureters towards the urine bladder. Additionally, no skeletal lesion is visualized.

Data courtesy of University Medical Center Groningen, Groningen, The Netherlands.



2 Axial slices through PET (left), CT (center), and fused images (right) at the level of the prostate (bottom row) and the pelvic nodal lesion (top row) showing high uptake of  $^{68}\text{Ga}$  PSMA in the primary prostatic tumor (orange arrow) and lymph node metastasis along the right external iliac artery (white and black arrows). The size of this solitary right external iliac lymph node on CT is still within normal range.

Data courtesy of University Medical Center Groningen, Groningen, The Netherlands.



3 Enlarged views of CT (left) and fused PET/CT images (both center and right) highlight the solitary right external iliac lymph node metastasis, which is approximately 6 mm in diameter on CT and has a  $\text{SUV}_{\text{max}}$  of 5.8.

Data courtesy of University Medical Center Groningen, Groningen, The Netherlands.

## Findings

The  $^{68}\text{Ga}$  PSMA PET/CT (Figures 1-3) shows a solitary right external iliac lymph node metastasis along with the PSMA-avid primary prostatic tumor without evidence of any other skeletal, soft tissue, or extrapelvic nodal metastases. The primary prostatic

tumor showed a high-intensity uptake of  $^{68}\text{Ga}$  PSMA with a  $\text{SUV}_{\text{max}}$  of 41.2. The 6 mm solitary pelvic nodal metastasis had a  $\text{SUV}_{\text{max}}$  of 5.8 with with high lesion-to-background ratio seen on the PET images, which helped differentiate the lesion from surrounding uptake in the ureter and intestines. The  $^{68}\text{Ga}$  PSMA PET/CT was

instrumental in detecting a solitary pelvic lymph node metastasis in this patient with primary prostate cancer who otherwise had no clinical or radiological suspicion of metastases. Detection of a single metastatic lymph node puts the patient in stage IV, irrespective of the Gleason score or PSA level.

## Comments

The  $^{68}\text{Ga}$  PSMA PET/CT was instrumental in accurately staging this patient who was otherwise clinically considered free of nodal or distant metastases. Detection of a solitary PSMA-expressing nodal metastasis by the  $^{68}\text{Ga}$  PSMA PET/CT scan places the patient in stage IV; such staging leads to a significant change in therapy approach regarding the use of androgen deprivation therapy (ADT). The detection of a small lymph node metastasis (6 mm in diameter on CT) reflects the high sensitivity of the  $^{68}\text{Ga}$  PSMA PET/CT for detection of nodal metastases. High ToF performance on Biograph Vision demonstrates a possible key relevance for such sharp delineation of a 6 mm lymph node metastasis with high lesion-to-background ratio. Increased contrast to background in any nodal lesion helps distinguish a metastasis from adjacent soft tissue and physiological uptake in the intestines. Excellent ToF performance, high resolution, and count-rate capability available with Biograph Vision should have a positive impact in improving the accuracy of staging since the detectability of small metastatic lesions is a key driver in the staging of prostate cancer.

The primary prostatic tumor in this patient shows high PSMA avidity with a

high  $\text{SUV}_{\text{max}}$  of 41.2. Primary tumors with higher PSMA uptake and SUV have been shown to be associated with higher serum PSA levels and a higher Gleason score.<sup>1</sup> In this case, the 41.2  $\text{SUV}_{\text{max}}$  in the primary tumor probably reflects a higher Gleason score.

$^{68}\text{Ga}$  PSMA PET/CT has shown high sensitivity for detection of nodal metastases, as reflected by a study, which demonstrated detection rates of 57.9% in patients with mild post-surgery PSA increase to the level of 0.2-0.5 ng/mL.<sup>2</sup> In another study involving 50 newly diagnosed prostate cancer patients without any previous treatment history,  $^{68}\text{Ga}$ -PSMA-11 PET/CT detected lymph node metastases in 16% of patients and distant metastases in 10% of patients.<sup>3</sup> In 13 of these 50 patients (26%), there was a change in staging with 11 of the 13 patients (84%) upstaged based on  $^{68}\text{Ga}$  PSMA PET/CT. There was an alteration in the treatment plan in 44% of this patient group.

The present report reflects the sensitivity of  $^{68}\text{Ga}$  PSMA PET/CT for the detection of lymph node metastases and the potential impact on staging and management. Technological improvements in PET/CT, such as the incorporation of Silicon Photomultiplier (SiPM) technology—which leads to an improvement in ToF performance—may potentially prove instrumental

in demonstrating PET/CT's impact in staging and managing prostate cancer.

Biograph Vision, with 214-picosecond timing resolution, enables high lesion contrast to background with standard acquisition time in spite of low injected dose and long post-injection delay. Such a high lesion-to-background ratio improves small metastatic lymph node detectability. Partial volume effect can impact the detection of lymph node metastases as small as 6 mm with low uptake demonstrated by a relatively small  $\text{SUV}_{\text{max}}$  of 5.8, as seen in this case. The 3.2 mm crystals in Biograph Vision provide high spatial resolution, which help minimize partial volume effects thereby providing sharp delineation of such a small lesion along with a high lesion-to-background ratio for excellent small lesion visibility and quantitative accuracy.

## Conclusion

The sharp definition and high lesion-to-background ratio provided by advanced SiPM PET/CT technology, enables the visualization of a solitary 6 mm pelvic lymph node metastasis with relatively low uptake of  $^{68}\text{Ga}$  PSMA in a patient with primary prostate cancer. The ability to visualize a singular lymph nodal metastasis led to a major change in the patient's staging-associated therapy implications. ●

## References

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## Examination protocol

### Scanner: Biograph Vision

<b>PET</b>	
Injected dose	2.7 mCi (100 MBq)
Acquisition	FlowMotion 1.0 mm/sec, 220 x 220 matrix
<b>CT</b>	
Slice collimation	32 x 1.2 mm
Tube voltage	100 kV
Tube current	16 eff mAs
Slice thickness	3 mm

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