PET-CT/Clinical Case Study

Prostate-Specific Membrane Antigen PET imaging with Cartesion Prime

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Introduction

It is estimated that 288,300 new cases of prostate cancer will be diagnosed in the United States in 2023.[1] Prostate cancer significantly impacts quality of life and is a leading cause of cancer-related mortality and morbidity. Novel PET imaging tracers, designed to target the Prostate-Specific Membrane Antigen (PSMA) overexpressed in prostate cancer cells,[2] have shown very promising results in the management of prostate cancer patients. F-18 and Ga-68 based PSMA PET imaging agents have recently received FDA clearance for imaging of patients with suspected prostate cancer metastasis who are candidates for therapy or suspected recurrence based on elevated prostate-specific antigen (PSA) level.[3] The National Comprehensive Cancer Network (NCCN) guidelines and Society of Nuclear Medicine and Molecular Imaging (SNMMI) Appropriate Use Criteria (AUC) were recently expanded to allow PSMA PET imaging for screening of patients to determine eligibility for PSMA-targeted radioligand therapy with lutetium Lu-177 vipivotide tetraxetan (PLUVICTO®).

This case study presents images from a PET-CT scan with the recently FDA-approved Flotufolastat F-18 (POSLUMA®) PSMA PET imaging tracer. The images were acquired by Cartesion Prime PET-CT, an air-cooled Premium Digital TOF PET scanner manufactured by Canon Medical Systems.

Patient History

An 81-year-old male, previously diagnosed with prostate cancer that was initially managed with prostatectomy and with radiotherapy after a subsequent relapse, presented with rising PSA of 2.2. The patient underwent PSMA PET-CT imaging with ^{18}F-Flotufolastat to assess recurrence and determine the extent of disease.

Imaging

PET-CT images were acquired using Cartesion Prime PET-CT after a 71-minute post injection delay of 8.4 mCi ^{18}F-Flotufolastat via the left antecubital fossa. The workflow was streamlined using the variable bedtime (vBT) feature on Cartesion Prime PET-CT. VBT enabled acquisitions of the pelvic and proximal regions at three minutes per bed and

Table 1: PET Parameters

Region Covered	BMI	Injected Dose	Acquisition Time	Number of Beds	Uptake Time	PSA level	Reconstruction
Skull-Base to Mid-Thigh	25.8 kg/m^2	8.4 mCi ^{18}F-Flotufolastat	3 min/bed x 3 + 2 min/bed x 3	6	71 min	2.2 ng/ml	TOF Listmode, OSEM

Table 2: CT Parameters

Scan Mode	Collimation	kVp	mAs	HP	Rotation Time	Scan Range	Reconstruction
Helical	0.5 mm x 80	120	196	65	0.5 s	1074 mm	AiCE for CT*

shorter acquisitions of the remaining anatomy at two minutes per bed (Table 1). The bed overlap was set at 40.6%. The PET scan comprised six bed positions and the total PET scan time was 15 minutes. Images were reconstructed using ordered subset expectation maximization (OSEM) with 3 iterations and 12 subsets, point-spread-function and Gaussian postfilter with 6 mm full width at half maximum (FWHM). Acquired non-contrast low-dose CT data (Table 2) were reconstructed with AiCE for CT for attenuation correction and anatomic localization of PET abnormalities.

Findings

There are areas of increased focal radiotracer uptake in the mediastinum suspicious for pathologic mediastinal lymphadenopathy (Figure 1). Additionally, mild uptake is also observed in the upper abdomen associated with curvilinear CT densities likely autonomic ganglia. Low activity in the urinary bladder allows the visualization of focal uptake in the left inferior bladder wall suspicious for recurrent tumor post prostatectomy (Figure 1). As a result, the patient is scheduled to receive PSMA-targeted radiotherapy.

Potential Acquisition Optimizations

The acquired PET data underwent processing that extracted and reconstructed shorter segments of the data, simulating shorter acquisition times. We will refer to this protocol as "time-cut". PET images shown in Figure 2 correspond to the default clinical protocol described above (Table 1) and a "time-cut" protocol of six beds acquired at ninety seconds per bed. All images were reconstructed using OSEM with 3 iterations and 12 subsets, point-spread-function and Gaussian postfilter with 6 mm FWHM. Lesions can be visualized very well in images corresponding to both acquisitions (Figure 2).

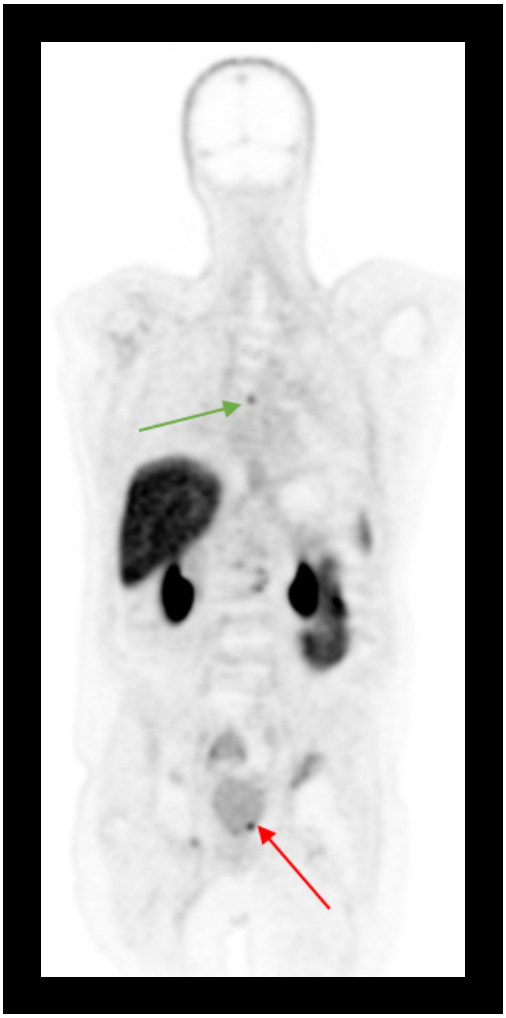

Figure 1: Uptake in bladder (red arrow) and mediastinum (green arrow).

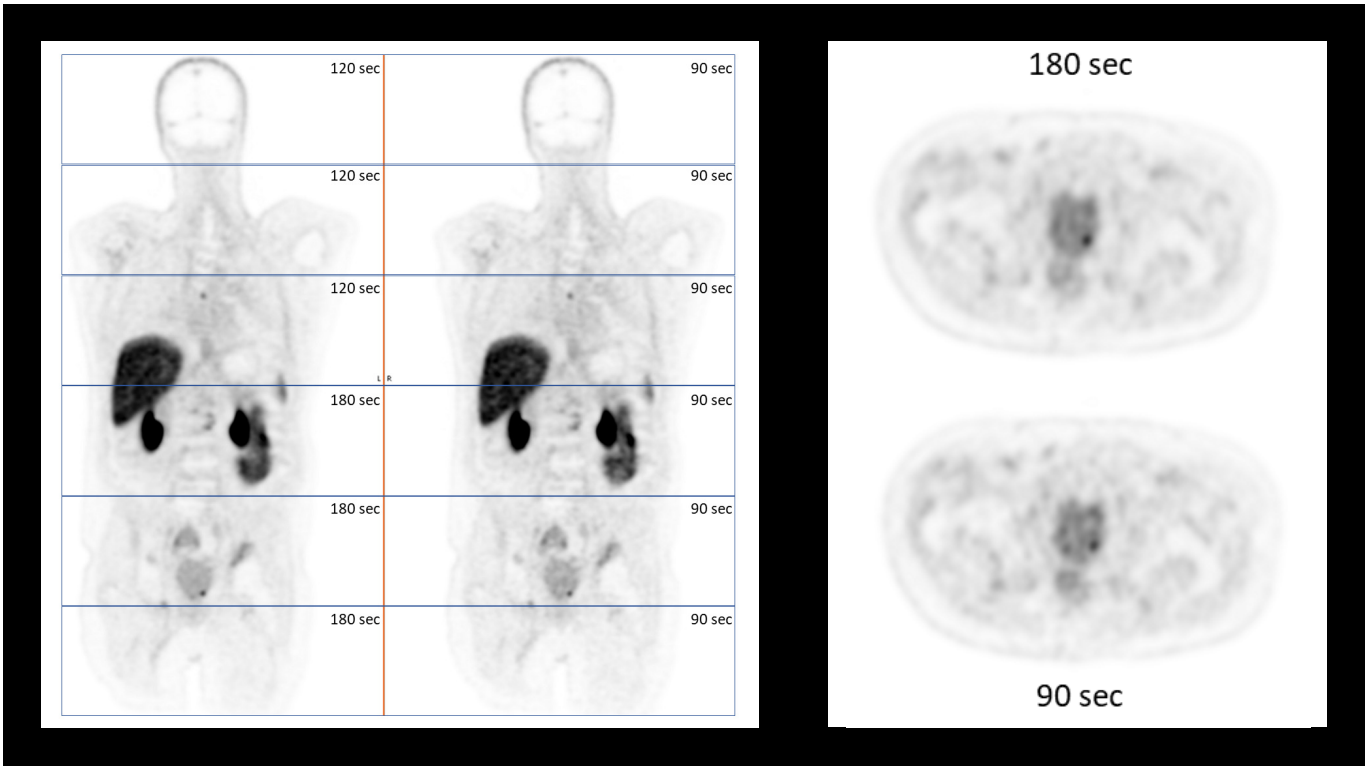

Figure 2: Coronals: Default protocol on the left (3 beds at 3 min/bed and 3 beds at 2 min/bed), and "time-cut" protocol on the right (6 beds at 1.5 min/bed). Axials: Default protocol on top and "time-cut" on bottom.

Conclusions

PSMA PET imaging plays a significant and growing role in cancer patient management with the continuous advances in novel tracers, theranostics, new treatments, and PET technology. In this case, PSMA PET imaging with ^{18}F-Flotufolastat and acquired with Cartesion Prime PET-CT resulted in images of excellent quality that assisted in the visualization of focal uptake in the left inferior bladder wall and guided subsequent patient management. Furthermore, the image quality of "time-cut" reconstructions showcased the possibility of PET acquisition time reduction for further potential workflow improvements with Cartesion Prime PET-CT.

References

1. https://www.cancer.org/cancer/prostate-cancer/about/key-statistics
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3. https://www.medscape.com/viewarticle/959838

* Option

The clinical results, performance and views described in this paper are the experience of the presenter. Actual results and performance of Canon Medical's product may be materially different due to clinical setting, patient presentation, BMI, and other factors.

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