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^{161}Tb-PSMA Radioligand Therapy: First-in-human SPECT/CT Imaging

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^{161}Tb is a beta-emitting radionuclide that resembles ^{177}Lu in terms of its in vivo and in vitro chemical and pharmacokinetic properties, exhibiting similar behavior with regard to radioligand-specific cell uptake and internalization, as well as emitting a modest fraction of photons useful for posttherapy imaging. Unlike ^{177}Lu, a significant amount of conversion and Auger electrons are emitted per decay, making it particularly appealing for targeted radionuclide therapy (*1*).

Herein, we present whole-body scintigraphic and SPECT/CT images acquired with ^{161}Tb-PSMA-617 in a 69-year-old male patient diagnosed with refractory metastatic prostate cancer to hormonal and chemotherapy who was referred for PSMA radioligand therapy (Figure 1).

The patient received an empirical well-tolerated dose of ^{161}Tb-PSMA-617 (5550 MBq) without having acute/early adverse events (compassionate use on a named-patient basis under the local regulatory framework and international ethical and radiation safety standards).

Two gamma energies with high frequencies were identified from the decay scheme of ^{161}Tb: 48.9 keV with a 17% frequency and 74.5 keV with a 10.2% frequency (*1*). As a result, whole-body planar and SPECT/CT scanning protocols have been created. Spatiotemporal distribution of the radionuclide in the target/non-target potentially dose-limiting organs was obtained by acquiring time-sequential planar and SPECT/CT datasets: 18h post-injection (p.i), 69h p.i, and 90h p.i. SPECT/CT images were acquired from the lower cervical level to the pelvis at 69h p.i, aiding in more refined image-derived activity quantification and characterization of tissue kinetics. The obtained images were of good quality, enabling visualization of all previously identified PSMA-avid primary and metastatic bone lesions using a ^{68}Ga-PSMA PET/CT scan.

In-human posttherapy imaging with ^{161}Tb SPECT/CT has been proposed as a predefined clinical protocol using a radiolabeled somatostatin analogue of up to 113h p.i (*2*). We present here, to the best of our knowledge, the first-in-human posttherapy ^{161}Tb-PSMA SPECT/CT imaging.

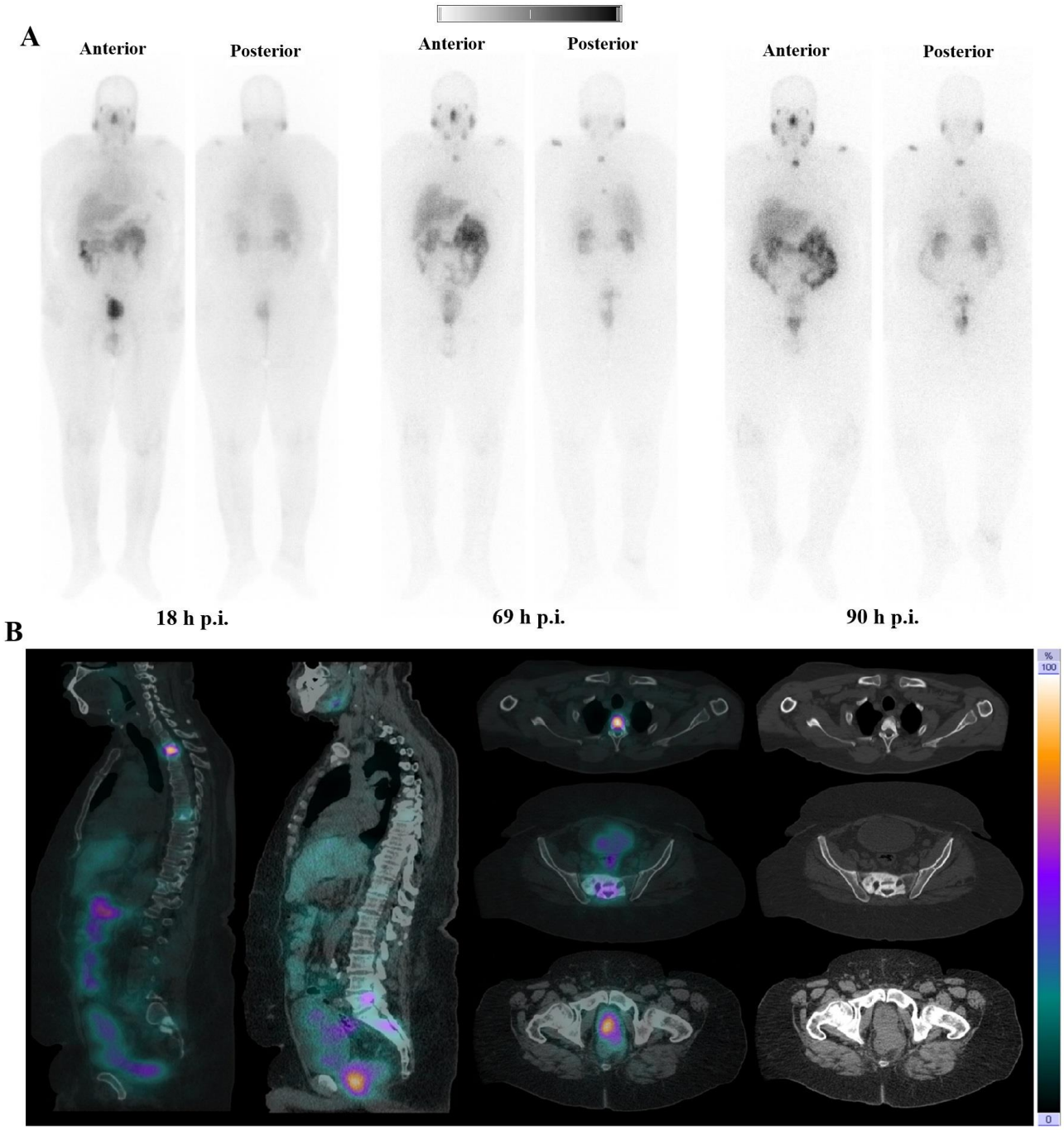

Figure 1: Different time points whole-body images (A) and 69h p.i. SPECT/CT representative fused sagittal, axial, and CT axial slices (B) demonstrating physiologic biodistribution of ^{161}Tb-PSMA in the lacrimal, parotid, and submandibular glands, nasopharyngeal mucosa, liver, intestinal tract, kidneys and urinary bladder, as well as a pathological uptake in the primary prostate tumor and the metastatic bone lesions. p.i. = post-injection.

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