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

Akram Al-Ibraheem[1], Rahma M. Doudeen[1], Diyaa Juaidi[1], Alaa Abufara[2], and Stephan Maus[3]

[1]Department of Nuclear Medicine, King Hussein Cancer Center, Amman, Jordan; [2]Department of Internal Medicine, King Hussein Cancer Center, Amman, Jordan; and [3]Department of Nuclear Medicine, Universitätsklinikum des Saarlandes, Homburg, Germany

Terbium-161 is a β-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 post-therapy 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*).

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

The patient received an empiric well-tolerated dose of ^{161}Tb-PSMA-617 (5,550 MBq) without having acute or early adverse events (compassionate use on a named-patient basis under the local regulatory framework and international ethical and radiation safety standards).

Two γ-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 and nontarget potentially dose-limiting organs was obtained by acquiring time-sequential planar and SPECT/CT datasets: 18 h after injection, 69 h after injection, and 90 h after injection. SPECT/CT images were acquired from the lower cervical level to the pelvis at 69 h after injection, aiding in more refined image-derived activity quantification and characterization of tissue kinetics. The obtained images were of

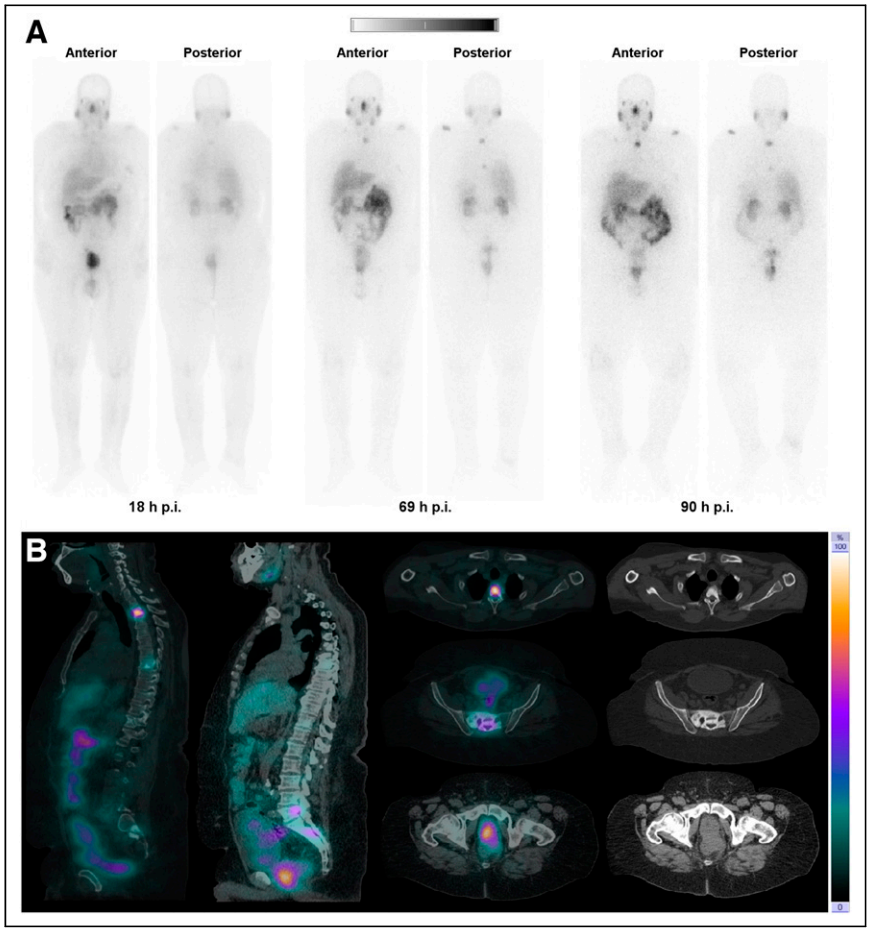

FIGURE 1. (A) Whole-body images at different time points after injection. (B) Representative SPECT/CT sagittal and axial slices and CT axial slices demonstrating physiologic biodistribution of ^{161}Tb-PSMA in lacrimal, parotid, and submandibular glands; nasopharyngeal mucosa; liver; intestinal tract; kidneys; and urinary bladder, as well as pathologic uptake in primary prostate tumor and metastatic bone lesions. p.i. = after injection.

Received Dec. 5, 2022; revision accepted Jan. 31, 2023.
For correspondence or reprints, contact Akram Al-Ibraheem (aibraheem@khcc.jo).
Published online Feb. 9, 2023.

DOI: 10.2967/jnumed.122.265291

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 analog of up to 113 h after injection (*2*). We present here, to the best of our knowledge, the first-in-humans posttherapy ^{161}Tb-PSMA SPECT/CT imaging.

DISCLOSURE

No potential conflict of interest relevant to this article was reported.

REFERENCES

1. Müller C, Umbricht CA, Gracheva N, et al. Terbium-161 for PSMA-targeted radionuclide therapy of prostate cancer. *Eur J Nucl Med Mol Imaging.* 2019;46:1919–1930.
2. Baum RP, Singh A, Kulkarni HR, et al. First-in-humans application of ^{161}Tb: a feasibility study using ^{161}Tb-DOTATOC. *J Nucl Med.* 2021;62:1391–1397.