First-in-Human $^{212}$Pb-PSMA–Targeted $\alpha$-Therapy SPECT/CT Imaging in a Patient with Metastatic Castration-Resistant Prostate Cancer

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There is significant interest in the development of $^{212}$Pb-PSMA–based targeted $\alpha$-therapy for patients with metastatic castration-resistant prostate cancer. A previous phantom study has shown that $^{212}$Pb SPECT is feasible by imaging the 238.6 keV and 75 to 91 keV $\gamma$-emissions produced after the $\beta$-decay of $^{212}$Pb to its $\alpha$-emitting progeny (1).

Here we present—to the best of our knowledge—the first human $^{212}$Pb SPECT/CT images published to date. They were acquired after administration of 60 MBq of $^{212}$Pb-ADVC001 to a 73-yr-old man with metastatic castration-resistant prostate cancer. This study was approved by the local institutional review board. Imaging was at 1.5, 5, 20, and 28 h after infusion. Two simultaneous triple-energy window acquisitions (78 keV $\pm$ 20% with 20% scatter [31% abundance] and 239 keV $\pm$ 10% with 10% scatter [43% abundance]) were obtained using a Siemens Intevo Bold (high-energy collimators at 30 s per view for 120 views per rotation at 2 bed positions with noncircular orbits; total time, 60 min). Each energy window was reconstructed independently, and the resulting images were summed with removal of Compton-based orbit artifacts.

Representative $^{212}$Pb SPECT/CT images (Fig. 1) showed rapid tumor uptake of $^{212}$Pb-ADVC001 highly concordant with tumor burden delineated on the pretreatment $^{18}$F-DCFPyl PET/CT images. Images acquired after 20 h showed persistent tumor uptake despite low counts due to $^{212}$Pb decay (10.6 h half-life).

$^{212}$Pb is a challenging isotope to image because of the high-energy $\gamma$-rays from the lead progeny generating Compton scatter from the patient and collimator (1). Our approach of summing images reconstructed from both energy windows shows the feasibility and benefit of $^{212}$Pb SPECT/CT imaging in providing postinfusion radio-pharmaceutical biodistribution and patient-specific dosimetry for clinical development of $^{212}$Pb-targeted $\alpha$-therapy.

DISCLOSURE

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REFERENCE