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IMAGE OF THE MONTH

Image-based dosimetry for ^{225}Ac-PSMA-I&T therapy using quantitative SPECT

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Targeted alpha therapy (TAT) using ^{225}Ac-PSMA ligands is a promising therapy option for advanced metastatic castration-resistant prostate cancer (mCRPC) [1]. The ^{225}Ac decay chain shows a noticeable gamma emission (440 keV, 25.9%; 218 keV, 11.4%). However, recommended low therapeutic activities (4–8 MBq) limit the clinical applicability of SPECT [2], although initial attempts for ^{225}Ac imaging exist [3, 4]. Particularly quantitative SPECT is a vital tool to assess dosimetry and therapy response. While the 218-keV-peak is characterized by a lower branching ratio and a higher scatter fraction, SPECT imaging of high-energy gammas such as 440 keV causes a complex detector point spread function (PSF) [5].

In this study, we would like to demonstrate the general feasibility of image-based dosimetry for ^{225}Ac radionuclide therapy using quantitative ^{225}Ac SPECT. For a mCRPC patient (65 years), imaging of the abdomen was performed 24 h p. i. of 8.1 MBq ^{225}Ac-PSMA-I&T on a Siemens Symbia Intevo T16 SPECT/CT (440 keV (width, 20%), lower adjacent window (width, 10%), HEGP collimator, 16 projections/head, 128 × 128 pixel, 210 s/projection). Reconstruction was carried out via a MAP algorithm (30i1s) [6], including CT-based attenuation and dual-energy-window scatter correction and a simulated distance-dependent 2D PSF model (SIMIND). Final absorbed dose assessment was performed by combining the single ^{225}Ac image with the effective half-life information determined from a previous ^{177}Lu-PSMA-I&T imaging sequence [7]. This resulted in an absorbed dose of 0.18 and 0.17 $Sv_{RBE=5}$/MBq for the left and right kidney, respectively, compared with 0.27 and 0.24 Gy/GBq for the preceding ^{177}Lu cycle (6.2 GBq). A comparison with the pre-therapy ^{18}F-PSMA-I&T PET/CT demonstrates that ^{225}Ac SPECT imaging for this patient was able to locate a small lesion in the right hip. The ^{225}Ac-absorbed dose was determined as 0.26 $Sv_{RBE=5}$/MBq, compared with 0.35 Gy/GBq for ^{177}Lu-PSMA-I&T.

Our analysis demonstrates the feasibility of dosimetry for ^{225}Ac-PSMA-I&T, which provides further insights into theranostic approaches using TAT in mCRPC patients.

This article is part of the Topical Collection on Image of the month.

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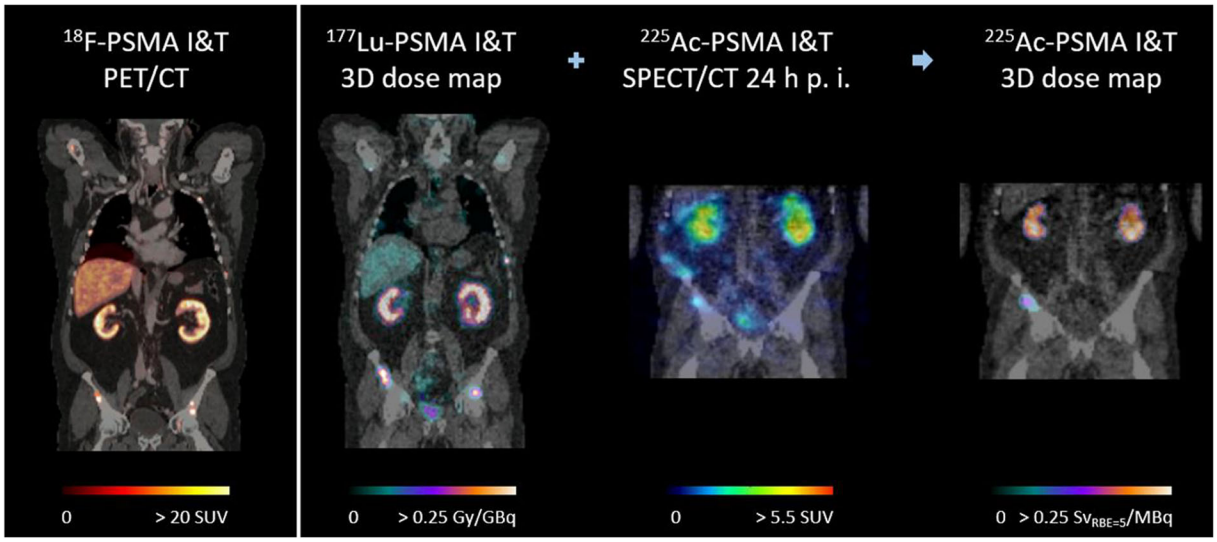

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Compliance with ethical standards

All procedures performed in this study involving human participants were in accordance with ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. The retrospective evaluation was approved by the local ethic committee (20-178). Written informed consent was obtained prior to the exam.

Conflict of interest The authors declare that they have no conflict of interest.

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