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EDITORIAL

Expanding the long-axial field-of-view PET-CT horizons: unveiling new arrows in our quiver

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Selective internal radiation therapy (SIRT) with yttrium-90 (^{90}Y) has recently emerged as a possible treatment option for several liver malignancies, including intermediate- and advanced-stage hepatocellular carcinoma and intrahepatic cholangiocarcinoma [1–4], allowing to local energy delivery, to induce cancer cell death while sparing peripheral healthy liver tissue and lungs from significant damage [5].

Pre- and post-therapy imaging plays a key role to enable the estimation of absorbed radiation doses in both tumor and non-tumor regions based on the distribution of microspheres. In particular, single-photon emission computed tomography with computed tomography (SPECT/CT), based on technetium99m (^{99m}Tc) macro aggregated albumin (MAA), is the reference imaging for the pre-treatment dosimetry plan [6]. Additionally, ^{90}Y Bremsstrahlung SPECT is commonly employed for post-treatment dosimetry assessment, ensuring the attainment of the intended dose to the target lesion, detecting any unforeseen extrahepatic dose accumulation in remote tissues, and ultimately forecasting treatment efficacy [6]. However, ^{90}Y Bremsstrahlung SPECT imaging, with a wide energy window requirements due to low photopeak, presents certain challenges such as dominant photon scatter, low photon yield, collimator septal penetration, limited spatial resolution and thus, low sensitivity [7]. On the other hand, ^{90}Y positron emission tomography (PET) has become increasingly favored for post-treatment dosimetry assessment, due to greater spatial resolution of scanners, in particular those with novel digital technology, as compared to SPECT [8]. In addition, the introduction of whole-body PET/CT with long-axial-field of view (LAFOV), encompassing comprehensive body coverage in a single scan, allows for evaluation of adsorbed dose to lung and healthy liver tissue that are both are at high dose related risk of complications, such as radiation pneumonitis or liver dysfunction [9].

In this scenario, we read with great interest the article by Zeimpekis et al. [10] focused on the assessment of ^{90}Y liver radioembolization post-treatment findings in 17 patients with different malignancies. Specifically, in addition to measuring the actual absorbed dose using post-treatment LAFOV PET scans and comparing it with the expected dose from the pre-treatment plan, the authors aimed to explore the feasibility of shorter scan durations while preserving comparable image quality to the current standard 20-min scans in clinical practice.

Interestingly, the average predicted and actual mean tumor absorbed dose based on the pre-treatment [^{99m}Tc] MAA SPECT/CT scan and ^{90}Y PET/CT, as calculated with Simplicit90Y™ software, did not significantly differ (median = 304.5 vs. 279.0 Gy, $p = 0.6$). However, differences between predicted and actual mean tumor absorbed dose emerged with HERMIA software. The authors postulated that the underestimation of the measured tumor absorbed dose by HERMIA could stem from misregistration between anatomical and functionally segmented areas, as well as signal spill-over between smaller pixels in PET images and the electron range of ^{90}Y, as demonstrated in a prior investigation [11]. Particularly, the expected and actual average whole liver and lung dose did not significantly differ across all reconstruction times. To note, it becomes clear that the LAFOV PET approach implies a more precise simultaneous whole-body dosimetry. Estimating the precise dose to lung and liver tissues is crucial for administering the optimal activity to the target. This approach enables increased dosage to the lesion while ensuring tissue preservation, thus embodying the dual aims of precision medicine: enhancing therapeutic efficacy while minimizing collateral damage.

Regarding image quality metrics, there was no statistically significant differences between 20- and 5-min reconstructed times for the peak signal to noise ratio (SNR), coefficient of variation, and lesion-to-background ratio. This

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implies that scans lasting only 5 min can achieve comparable image quality to those lasting 20 min, potentially improving patient comfort and streamlining throughput in daily clinical practice. However, it is important to note that these metrics have been presented as averages across all 17 patients, due to significant variations in factors such as injected activity and patient mass.

In conclusion, the authors demonstrated in their exploratory study that simulated 5-min reconstructed images, when compared to the 20-min standard scan, exhibited equivalent image peak SNR and noise behavior, while also performing similarly in post-treatment dosimetry of tumor, whole liver, and lung absorbed doses. However, to solidify these findings, promote standardization and establish broader applicability, further studies with prospective and multicenter design are warranted. Such endeavors would provide a more comprehensive understanding of the efficacy and reliability of whole-body PET/CT in the setting of post-treatment dosimetry assessment.

Declarations

Ethical approval Ethical approval institutional review board approval was not required because the paper is an editorial.

Consent to participate Not applicable.

Conflict of interest The authors declare no conflict of interest.

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