Improved Scatter Correction to Eliminate Halo Artifacts for ^{68}Ga-Labeled Radiopharmaceuticals in PET Imaging

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TO THE EDITOR: We read with interest the article by Lindemann et al. titled "Improving 68-Ga-PSMA PET/MR Hybrid Imaging of the Prostate with Un-renormalized Absolute Scatter Correction" (*1*). The authors present a modified PET scatter-correction algorithm to improve halo artifacts sometimes seen around the bladder and kidneys in ^{68}Ga-PSMA PET images. The scatter estimation for these tracers is challenging due to 2 reasons. The first is the extremely high signal-to-background ratio in the bladder and kidneys, which is difficult to capture in traditional scatter-estimation algorithms that assume the spatial distribution of scatter to be low frequency. The second is due to prompt γ-ray coincidence events that cannot be distinguished from positron emission coincidence events.

Scatter-estimation algorithms are most commonly based on single scatter simulation with either relative or absolute scaling. This study introduces un-renormalized absolute scatter correction, which omits the last scaling step of the standard scatter correction. This modification was found to significantly reduce the halo artifact around the bladder and improves PET/MR hybrid imaging of the prostate.

Previously published work cited by the authors includes suppression of the halo artifact through absolute scatter scaling and reduction of the maximum allowed scatter fraction. The authors also cite the potential for double scatter simulation to improve total scatter estimation, which may further improve ^{68}Ga-PSMA PET imaging.

However, the paper fails to mention another published method that demonstrated significant reduction of the halo artifacts. Wangerin et al. showed that improvements to the PET scatter algorithm significantly decreased or completely eliminated halo artifacts for ^{68}Ga-PSMA-11 and also for ^{68}Ga-RM2 in the kidneys and bladder regions (*2*).

There were 2 significant modifications to the scatter algorithm that helped to account for the highly targeted uptake and prompt γ-emission of these ^{68}Ga-labeled radiopharmaceuticals. The first improved the single scatter estimation through optimization of the subsampling methodology that is used to limit the computation time. The second improved the scatter scaling step by adding an additive offset factor to the model. The conclusions were that image reconstruction with the improved scatter-correction algorithm mitigated washout artifacts and recovered diagnostic image quality in ^{68}Ga-PSMA-11 studies, indicating that the use of diuretics may be avoided.

We think that *The Journal of Nuclear Medicine* readership will benefit from increased awareness of this alternative approach to improved scatter correction when using ^{68}Ga-labeled radiopharmaceuticals.

REFERENCES

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2. Wangerin KA, Baratto L, Khalighi MM, et al. Clinical evaluation of ^{68}Ga-PSMA-II and ^{68}Ga-RM2 PET images reconstructed with an improved scatter correction algorithm. *AJR.* 2018;211:655–660.

Reply to: Improved Scatter Correction to Eliminate Halo Artifacts for ^{68}Ga-Labeled Radiopharmaceuticals in PET Imaging

REPLY: After reading our ahead-of-print article (*1*), Wangerin et al. pointed out that their paper (*2*) might be interesting for *The Journal of Nuclear Medicine* readership with regard to the subject matter of un-renormalized absolute scatter correction on ^{68}Ga-PSMA PET quantification in PET/MRI of the prostate. Therefore, we will reference their paper in the final published version of our article (*1*). We thank Dr. Wangerin for informing us of their publication and its relevance to our article.

REFERENCES

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2. Wangerin KA, Baratto L, Khalighi MM, et al. Clinical evaluation of ^{68}Ga-PSMA-II and ^{68}Ga-RM2 PET images reconstructed with an improved scatter correction algorithm. *AJR.* 2018;211:655–660.

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The Martinique Principles

TO THE EDITOR: Recently, the Martinique Working Group (MWG), composed of representatives from the American Thyroid Association (ATA), the European Association of Nuclear Medicine (EANM), the European Thyroid Association (ETA), and the Society of Nuclear Medicine and Molecular Imaging (SNMMI), published a white paper referred to as "The Martinique Principles" (*1*).

As defined by Wikipedia (*2*), ". . . a white paper is an authoritative report or guide that informs readers concisely about a complex issue and presents the issuing body's philosophy on the