Article published online: 2022-05-21

Editorial

The Conundrum of PET/MR

The concept of hybrid imaging holds an important value in the modern day medical care as a single scan provides combined functional and anatomical information. Single procedure multimodality acquisition and processing shortens the investigation time, adds the value of different diagnostic systems, and increases the clinical efficiency. Positron Emission Tomography/Computed Tomography (PET/CT) scan has become the hallmark of fusion imaging by combining additional metabolic information of PET to the anatomic detail of CT, and has become the imaging modality of choice in oncology.

The enormous success of PET/CT in clinical practice stimulated the need and research of further hi-tech hybrid medical technologies including PET/MR. Initially, PET and MR data were fused retrospectively with limited success, mainly restricted to brain PET/MR fusion. Subsequently, spatially separated PET and MR scanners connected by moving patient table were used. But the long examination time and misalignment complicated the earlier fusion technologies.

The feasibility of the concept of integration of PET and magnetic resonance imaging (MRI) technology was made possible by replacement of the conventional photomultipliers with avalanche photodiodes which are compatible in strong magnetic fields of 3-T MRI scanner. The new MR Dixon sequence that estimates distribution of four tissue types (fat, soft tissue, lungs, and background/air) was used for calculation of attenuation correction by derivation of presumed radiodensity, and at the same time was used for anatomical allocation also because of short acquisition time. The whole body coils as well as other equipments have been redesigned for PET/MR in order to minimize their attenuation. These technological advances helped in incorporating a fully functional PET scanner inside the MRI gantry and fixing the fully functional PET scanner inside the MRI gantry and contemporaneous scanning.

Access this article online	
Quick Response Code:	Website: www.wjnm.org
	DOI: 10.4103/1450-1147.98717

There are only few hi-tech, new breed, fully integrated PET/MR scanners in the world. Recently, we read an interesting article regarding the clinical experience with Integrated Whole Body PET/MR (installed in November 2010) in comparison to the established PET/CT in oncologic diagnoses based on a study conducted in Technische Universitat Munchen, Munich, Germany.[1] The main aim of the study was to evaluate the clinical acceptability of PET/MR by correlating the quality and quantity parameters such as lesion detection, quality of images, alignment in hybrid imaging, and SUV measurements.

There was no additional dose of radioactivity as the PET/MR (~140 min after injection) was done after the PET/CT scan (~86 min after injection) with single injection of tracer (~401 MBq of 18F-FDG). It was a prospective study that included 32 patients consecutively, having variable oncologic diagnoses with a clinical indication of PET/CT scan, excluding pregnancy, patients below 18 years, and those with contraindications for MRI. The study was well designed with formation of two reporting teams, each containing one nuclear medicine physician and one radiologist. Every team studied only PET/CT or PET/MRI of any patient to avoid the potential bias, and concordant conclusions regarding the lesions were made followed by qualitative and quantitative analyses.

According to the study, overall, the detectability of the lesions and subjective rating of quality of images are comparable between PET/CT and PET/MR with no statistical difference. The image quality, contrast, and alignment between PET/CT and PET/MR are comparable with a significant correlation in the ratings of lesion contrast. Thus, MR Dixon sequence proved its utility for both attenuation correction and anatomical allocation. These results allay the fear in our mind about the performance of PET/MR.[2-4]

But there was significant difference in the SUV-based evaluation between two modalities. The SUV values (mean and maximum) of PET/CT are higher than those of PET/MR for both lesions (by ~9.4%) and background (by ~22.6%). In PET/MR, there is more decrease in SUV of background in relation to SUV of lesion, hence the lesion–background ratio is higher, which means higher quantitative lesion contrast compared to PET/CT. Despite the absolute difference between SUVs, there is strong correlation between uptake values in PET/CT and PET/MR in suspicious lesions, so PET/MR is suitable for quantitative evaluation in longitudinal studies.

For unknown reasons, there is variable correlation of SUV of organs between both modalities. Also, direct comparison between the radiodensity of low-dose CT and presumed radiodensity derived from MR Dixon sequence was not discussed in the article. With our limited experience and knowledge in this direction, we should be very careful or refrain from comparing SUV of PET/MR and PET/CT till we reach our confidence level.

The advantages of hybrid PET/MRI imaging are substantial: high resolution and sensitivity, better soft tissue contrast, simultaneous acquisition eliminating misalignment, and most importantly, less radiation dose compared to PET/CT. The study also predicts the likely positive impact of PET/MR in near future. The nuclear medicine community should be well prepared to adapt to this challenging PET/MR hybrid imaging that expands imaging frontiers.

Anbalagan Kannivelu, Tian Yue Kok,
Ajit Kumar Padhy

Department of Nuclear Medicine, Singapore General Hospital, Singapore 169608
E-mail: ajit.kumar.padhy@sgh.com.sg

References

1. Drzezga A, Souvatzoglou M, Eiber M, Beer AJ, Fürst S, Martinez-Möller A, *et al*. First clinical experience with integrated whole-body PET/MR: Comparison to PET/CT in patients with oncologic diagnosis. J Nucl Med 2012;53:845-55.
2. Eiber M, Martinez-Moller A, Souvatzoglou M, Holzapfel K, Pickhard A, Löffelbein D, *et al*. Value of a Dixon-based MR/PET attenuation correction sequence for the localization and evaluation of PET-positive lesions. Eur J Nucl Med Mol Imaging 2011;38:1691-701.
3. Beyer T, Freudenberg LS, Czernin J, Townsend DW. The future of hybrid imaging-part3: PET/MR, small animal imaging and beyond. Insights Imaging 2011;2:235-46.
4. Keereman V, Fierens Y, Broux T, De Deene Y, Lonneux M, Vandenberghe S. MRI-based attenuation correction for PET/MRI using ultrashort echo time sequences. J Nucl Med 2010;51:812-8.

How to cite this article: Kannivelu A, Kok TY, Padhy AK. The Conundrum of PET/MR. World J Nucl Med 2012;11:1-2.