Effect of reducing PET injected dose for the assessment of non-lesional epilepsy with PET/MRI

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Introduction

Evaluate the effective dose and image quality obtained with different image reconstruction methods when reducing the injected activity in non-lesional epilepsy patients with [18F]-FDG PET/MRI.

Materials and methods

Healthy Volunteers

- 246±44 MBq
- 3.9±0.2 MBq/kg

Epilepsy patients

- 305±95 MBq
- 4.1±1.0 MBq/kg

Fig. 1 Nine healthy volunteers and nine patients with non-lesional epilepsy underwent dynamic [18F]-FDG PET/MRI examinations in list-mode. For the purpose of the study the last 10 minutes of the acquired data was used.

Fig. 2 The virtual dose reduction was simulated by randomly removing events from the original list mode data. For every event a random number was assigned and based on the applied threshold a new list mode data was generated.

Fig. 3 For each patient four new list mode data sets were generated with reduced counts. The raw data was reconstructed using the standard OSEM, OSEM+PSF and two MAP algorithms (A-MAP and AsymBowsher). All reconstructions were repeated with a 3mm FWHM Gaussian post filter.

Fig. 4 Four volume of interests were delineated: one covering the entire grey matter, four cylindrical VOIs in the white matter, the hypometabolic region and the contralateral part. As figure of merit the contrast, the noise in the white matter and the lesion-to-background ratio (LBR) were evaluated.

Results

Clinical readings of the AsymBowsher and PSF images at different count levels. First column summary of the first reading; second column summary of the second reading; last column inter-reader agreement. Differences of ≥ 1 were considered acceptable, higher deviations were reported. The clinical reader favored the AsymBowsher filter over the PSF reconstruction over the AsymBowsher reconstructions.

Conclusion

PET injected activity could be reduced up to 50% without compromising image quality, when applying the suitable image reconstruction technique.

Fig. 5 Mid-section axial views of the reconstructed PET images (Patient 5, P05) without and with post-filtering for different count levels (100%-10%). A clear degradation of image quality for OSEM and PSF reconstruction can be seen, whereas for AsymBowsher and A-MAP the degradation is less significant.

Fig. 6 Clinical readings of the AsymBowsher and PSF images at different count levels. First column summary of the first reading; second column summary of the second reading; last column inter-reader agreement. Differences of ≥ 1 were considered acceptable, higher deviations were reported. The clinical reader favored the PSF reconstruction over the AsymBowsher reconstructions.

Fig. 7 Figures-of-merit for different image reconstruction methods and count levels: a) Image contrast (Contrast = MEANGM/MEANWM); b) Spatial resolution (PSF filter); c) Noise: standard deviation (Noise=STD); d) lesion-to-background ratio (LBR) (GM, WM, lesion-to-background ratio (LBR)). The highest contrast was achieved with the A-MAP using high weights and no post-filtering.

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