Optimized PET reconstructions: Can they be harmonized as well?

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Aim/Introduction: PET/CT images are extensively utilized for diagnosis, (re)staging and monitoring treatment response. Preferred protocols should have optimal image quality and detectability with accurate quantification, and as such reconstruction protocols should be optimized. There are significant variations in PET quantification due to differences in scanner hardware and reconstruction algorithms. To tackle the challenge of variability in quantitative values between PET images obtained using different scanners, determination of harmonized reconstruction is very important. Materials and Methods: Data acquisition of IQ-NEMA phantom with SBR 4:1, 6:1, 8:1 and 10:1 was performed on a SIEMENS Biograph6 TrueV PET/CT scanner. Raw PET data were reconstructed using 6 different iterations (x subsets) and Gaussian post-smoothing filters with FWHM 2, 4, 6, 8 and 10 mm. In addition, image reconstruction was performed with/without PSF modeling (HD and 3D mode). CNR, COV, percentage difference of CNR, RCmax, RCAS50% and RCpeak were evaluated for standardization, and were compared with EARL specification reference values. Results: CNR and COV improved using smoother filters and fewer iterations. COV was less than cutoff (15%) for all reconstructions of frames >3mm. Percentage difference of CNR between FWHM 4 and 6mm for all reconstructions was more than other sequential filter pairs. Though in SBR4:1, the maximum value of CNR of the smallest sphere was 8, it was barely visible, but in SBR6:1, CNR increased to 15. Iterations 30-60 with suitable post-smoothing Gaussian filters harmonized quantitative PET data. There were no difference in RC curves between 3D and HD mode in SBR 4:1. In HD mode, RCmax and RCAS50% were overestimated in higher SBRs and higher iterations. Positive bias in RCmax and RCAS50% was observed for 13, 17, 22mm spheres caused by PSF-modeled reconstruction, creating edge artifact. However, applying 6mm Gaussian filter and/or using RCpeak reduced this bias. Furthermore using CNR as a surrogate for image quality demonstrated that 6 mm Gaussian filter can be appropriate towards optimized as well as harmonized imaging. Conclusion: Image quality and detectability in PET images strongly depends on activity to background ratios, reconstruction parameters and post-smoothing filter. The optimized post-reconstruction filter was found to minimize variations of RC in comparison to EARL references. In addition, accurate quantification is feasible utilizing PSF modeling when utilizing appropriate filters. References: None.

Regularized Reconstruction Improves Signal-to-noise and Quantification for 18F-PSMA PET/CT Imaging

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Aim/Introduction: The popular 18F-labeled PSMA-targeting PET tracer, 18F-DCFPyL, has shown to be significantly superior in detecting metastatic prostate cancer than 18F-FDG. Accurate quantification of 18F-DCFPyL images can enable evaluation of therapeutic efficacy, comparison between centres, and the potential to build outcome predictive models. Ordered subsets expectation maximization (OSEM) is commonly used to generate PET images, but noise is amplified at high number of iterations. As such, limited iterations are used in practice to maintain adequate image quality; however, this may not be sufficient to achieve convergence and leads to lower standardized uptake values (SUV). The block sequential regularized expectation maximization (BSREM) algorithm, also called Q.Clear (GE Healthcare), allows convergence while avoiding noise amplification at higher number of iterations. In