GE Discovery IQ - Acquisition and Reconstruction Optimization of 18F-FDG PET-CT Brain Studies


PET-CT Discovery IQ (GE D-IQ) represents the latest advance in the GE Healthcare (GE) Molecular Imaging. A lower activity and a shorter time of acquisition improves patient comfort and reduces exposure to radiation.

Different image reconstruction produce tomographic images with different characteristics in terms of contrast, resolution and quantification. GE introduced Q.Clear™, which consists in a converging iterative image reconstruction algorithm improving accuracy in quantifying PET images.

Our aim is to study the optimization of acquisition parameters in PET brain studies with 18F-FDG using the iterative method of reconstruction Q.Clear™.

METHODS

A Hoffmann 3D brain phantom was injected with 104.4 MBq of 18F-FDG and scanned with 5 seconds increment in acquisition time from 5 seconds until 72 minutes and 45 seconds - 341 image sets.

The effect of different β values (penalty factor) on the image reconstruction was evaluated. Quantitative analyses were performed by calculating ratios of mean SUV values and mean counts between right and left brain, anterior and posterior brain, caudate nucleus and white matter, putamen and white matter, grey and white matter.

A global quantitative score was calculated by the average ratios obtained in each image set for different values of β. For each value of β was obtained a global quantitative score value, encompassing the different times of acquisitions.

RESULTS:

Graphs 1 represent the ratio values in terms of mean counts/mm³ per voxel for the different structures analyzed. The reconstruction performed with β = 600 have higher values for all ratios obtained while β = 100 reveal the lowest values. It is possible to verify a reduction, as the time increases, for all types of reconstruction when comparing areas with similar intensities.

The variation of SUVmean values along the acquisition time for each ratio is not significant.

Discussion: The fact that reconstruction performed with factor β = 600 have higher values for all ratios and β = 100 reveal the lowest values may be due to a better convergence of the reconstruction algorithm - higher number of events detected as the acquisition time increases leading to a representation of the radiopharmaceutical distribution with greater accuracy. This may be responsible for the increased ratio between grey vs white matter - as the acquisition time increases the contrast increases. For caudate vs nucleus, this might not be so obvious due to the size of the structure leading to operator errors in defining it and loss of detail in the different reconstruction results (image smoothing).

Values of SUVmean appear to remain reproducible for different sets of images. In quantitative terms, the reproducibility of the algorithm is not compromised, with more consistency as β increase. The quantitative score represents an overall assessment of image quality. A smaller score translate greater homogeneity in the image, higher score, greater overall contrast. Highest quantitative scores correspond to the reconstruction with β = 350 and β = 400.

Conclusion: In brain PET-CT performed using the Scanner GE D-IQ and Q.Clear™ reconstruction algorithm, it is possible to maximize quantitatively and qualitatively the quality of images using a reconstruction β value of 350, (1.56x10⁸ prompt events). For individual contrast, different values of β can be used, but for global image contrast we found that β values of 350 or 400 are the most accurate. Higher values of β, lead to a decrease in the contrast of images but the quantitative accuracy of studies is reproducible for a wide variety of image acquisition protocols.

References:

