Towards a robust quantification of brain studies: implementation of MR driven partial volume correction

S.C.Coello, T.Hjørnevik and F.Willoch

Introduction: Scatter, attenuation of photons and limited spatial resolution of the camera are known to be the main sources of bias when estimating physiological parameters from emission tomography images. Whereas the two first can be corrected with vendor packages, we have not identified any commercially available solution satisfactory correcting from partial volume effect. Implementation of partial volume correction (PVC) has a two-fold objective: to reach more accurate estimation of activity [Soret, 2007] and to obtain images with higher spatial resolution. Both these improvements are interesting when it comes to better diagnostic of brain pathologies with dopamine transporter (123I-DATscan) and brain perfusion (99mTc-ECD) SPECT imaging.

Material & Methods: We decided to implement a correction method using maps of the gray matter (GM), white matter (WM) and cerebrospinal fluid (CSF) as a-priori information on where uptake should occur [Melzer, 1996]. These maps are obtained by segmenting anatomical MR images. For each patient, a brain T1 MR image was acquired on a Philips Achieva 3T using a 3D isotropic acquisition (T1W_3D_TFE). Automated segmentation of the GM, WM and CSF was done using FreeSurfer (http://surfer.nmr.mgh.harvard.edu/).Then, the three binary maps were blurred using the previously measured PSF (FWHM=6.9mmx6.0mmx10.9mm) of a dual-headed SPECT camera (GE Infinia). After co-registration of these blurred maps with the SPECT image, the mean activity value in the WM and CSF was calculated in order to estimate and correct the spill-out activity from the GM to the WM and CSF. In addition, to applying the correction on brain perfusion images, we are currently testing the accuracy of this method on phantom images with known concentration distribution.

Results: Figure 1 shows the original ^{99m}Tc-ECD perfusion image and the same image corrected from PVC. Higher anatomical details can be seen, especially in the region of the basal ganglia.

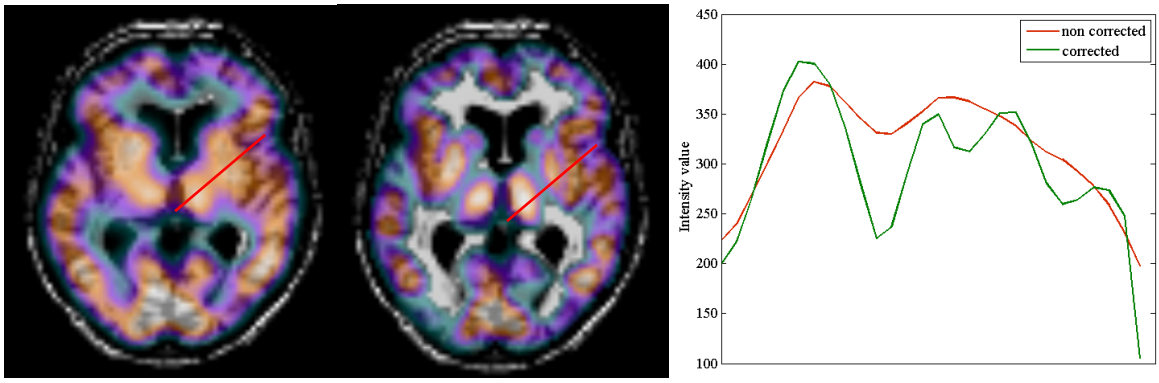

Figure 1. Brain perfusion images before PVC (left) and after PVC (center) overlaying the anatomical MR which has been resliced in the SPECT space. Right: profile along the basal ganglia (red line on the images).

Discussion: The main objective of this method is to quantify the signal in the WM and CSF. Therefore, estimation of these values is critical to obtain accurate correction, Here, mean WM value is considered to be the mean activity in the corpus callosum.

Conclusion: The first qualitative assessment of the corrected images shows promising possibilities of this PVC method, both for research and clinical purposes.