A quantitative comparison of HMPAO-SPECT and DSC perfusion MRI in suspected dementia

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Introduction

Single Photon Emssion Tomography (SPECT) shows typical changes in regional cerebral blood flow in patients with Alzheimer's disease. Hypoperfusion is usually prominent in temporo-parietal association cortex and very early changes, preceeding the clinical diagnosis, can be found in posterior cingular gyri. Dynamic susceptibility contrast MRI has been applied in the evaluation of stroke with great success. MRI also has the potential of providing high resolution imaging of rCBF in AD without radiation exposure. Sofar, only a few studies have examined DSC MRI in AD, although with promising results. One study compared SPECT and MRI in a small sample of AD-patients using manual ROI tracing and found comparable results. However, a more direct comparison of the brain perfusion distribution using SPECT and MRI is lacking.

Aims

The aims of the present study were to perform a quantitative voxel-based comparison between SPECT and MRI in a sample of patients examined for suspected dementia. We also wanted to perform a automated ROI analysis to compare regional changes between patients without objective cognitive impairment and patients with AD.

Methods

MRI was performed using a Siemens 1.5 Tesla Magnetom with DSC EPI-FID with TE = 54 ms, Slices = 10, SL = 8 mm, FOV=250, Matrix= 128x128, Meas= 50, Time res.= 1.65sec

SPECT imaging: Injection of 1000 Mbq Tc-99m-HMPAO (Ceretec, Amersham Ltd). 64 projections through 360 degrees with a 3-headed rotating gamma camera (Philips). Tomographic slices were reconstructed using an iterative algorithm (Hosem, Nuclear Diagnostics AB, Sweden) The reconstructed SPECT data sets as well as the MR-images were post-filtered with a Butterworth filter, cutoff 1.0 cm^{-1}. MRI and SPECT images were then co-registered using normalized mutual information as a similarity measure. SPECT images were also corrected for flow-underestimation using the Lassen algorithm. Images were normalized to whole brain mean. ROI-analyis was performed using BRASS (Nuclear Diagnostics AB, Sweden), which is an automated software for SPECT analysis.

Materials

54 patients consequtively examined for suspected dementia at the memory clinic at Karolinska University Hospital, Huddinge, were included in the study. Diagnostic groups: 8 AD, 6 SMI (Subjective Memory Impairment), 10 MCI (Mild Cognitive Impairment), 30 other diagnoses (including depression, VaD, FTD, PPA). The extreme groups SMI (without any objective cognitive decline) and AD were compared to detect changes related to AD.

Results

Voxel-based correlation between co-registered SPECT and MRI of all subjects showed a high correlation, the mean correlation coeffcient being 0.92 without SPECT correction and 0.94 with SPECT correction.

ROI analysis showed significant differences between SMI and AD, especially in subcortical regions and temporoparietal cortex using both SPECT and MRI, although more regions were significantly changed using SPECT. (mean group images; fig 1 and fig. 2)

Conclusions

Voxel-level distribution of CBF-values using DSC.MRI was highly correlated to that of SPECT in a sample of patients investigated for suspected dementia. Both MRI and SPECT showed regions of reduced perfusion in AD compared to SMI, although SPECT changes were more widespread.Susceptibility artefacts in MRI, in frontal and temporal regions, might contribute to this, but there is also a need for development of an automated ROI-analysis specifically adopted for DSC-MRI that e.g. would take advantage of the higher resolution.

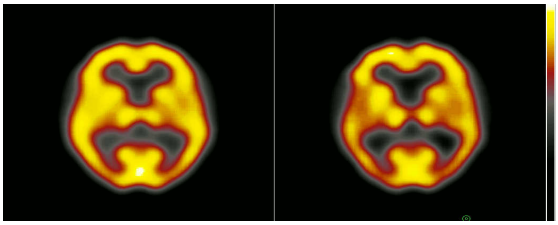

Fig.1 Mean SPECT images of 6 SMI patients (left) and 8 AD patients (right).

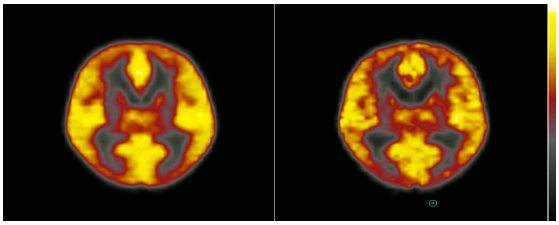

Fig. 2 Mean MR images of 6 SMI patients (left) and 8 AD patients (right).