Nuclear Medicine Methods in Idiopathic Parkinsonism: Pre- and Postsynaptic Dopamine SPECT

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Akademisk avhandling

som med vederbörligt tillstånd av Rektor vid Umeå universitet för avläggande av medicine doktorsexamen framläggs till offentligt förvar i Sal 206, byggnad 3A, Norrlands Universitetssjukhus onsdagen den 5 juni, kl. 09:00.
Avhandlingen kommer att förvaras på svenska.

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Background: Single photon emission computed tomography (SPECT) with dopamine transporter (DAT) and dopamine D2 receptor (D2R) ligands can visualise the integrity of the nigrostriatal dopamine system. Parkinson’s disease (PD) and the atypical parkinsonian diseases (APD), progressive supranuclear palsy (PSP) and multiple system atrophy (MSA), have similar symptoms and dopamine depletion, but differ in pharmacological response and prognosis. Clinical differentiation between PD and APD is often difficult in the early stages. The aims of the thesis were to evaluate the differential diagnostic and prognostic value of SPECT in early PD, MSA and PSP, to map the pattern of progression with dopamine SPECT, and map the pattern of dopamine SPECT in non-affected elderly volunteers with a prospective approach. Also, we evaluated the methodological aspects of dopamine SPECT with respect to image evaluation tools, reconstruction parameters, and gamma cameras.

Methods: 172 patients, included in an on-going clinical prospective study on idiopathic parkinsonism, participated in the SPECT study. Also, 31 age-matched healthy controls (HC) were followed within this study. SPECT was done with 123I-FP-Cit (DAT SPECT) and 123I-IBZM (D2R SPECT). Regions of interest (ROI) were used as a standard method for semi-quantitative image analysis.

Results: SPECT uptake ratios from different gamma cameras could be equalised through correction equations derived from images of a brain-like phantom, provided that attenuation correction was applied. The ROI method had high reproducibility. SPECT uptake in HC, measured with the ROI method and a volume based (VOI) method rendered similar trends, but gender and age differences in SPECT uptake were more marked with the VOI method, and less pronounced in DAT SPECT compared to D2R SPECT with both methods. The DAT SPECT uptake was significantly reduced in very early disease stage of PD and APD compared to HC. DAT SPECT uptake was more reduced in PD with postural and gait disturbance (PIGD) compared to tremor-dominant PD. Decline in DAT SPECT uptake during the first year was more pronounced in PD and PSP compared to HC. D2R SPECT uptake overlapped between untreated PD and APD. After initiated treatment, the D2R SPECT uptake was significantly higher in MSA patients compared to PD, PSP and HC. Decline in D2R SPECT uptake during the first year was not significantly different between patients or compared to HC.

Conclusions: 123I-FP-Cit SPECT is a valuable and sensitive method to detect early stage idiopathic parkinsonism. A different level of uptake between PIGD-PD compared to TD-PD indicates a prognostic potential. It is not possible to differ between PD, MSA and PSP in early stage with 123I-FP-Cit SPECT and no differential diagnostic value was found using 123I-IBZM SPECT in the early, untreated stage of PD, MSA and PSP. A different pattern of uptake of this ligand in MSA compared to PD and PSP during the first years of L-dopa treatment may, however, indicate a diagnostic value during the follow-up period.

Keywords: Nuclear medicine, SPECT, 123I-FP-Cit, 123I-IBZM, dopamine, parkinsonism, Parkinson’s disease, multiple system atrophy, progressive supranuclear palsy