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Usefulness of a blood flow analyzing program 3DSRT to detect occipital hypoperfusion in dementia with Lewy bodies

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ABSTRACT

In the latest criteria for the clinical diagnosis of dementia with Lewy bodies (DLB), supportive features include generalized low uptake on SPECT/PET perfusion scan with reduced occipital activity. In this study, we investigated the usefulness of a cerebral blood flow (CBF) quantification program '3DSRT' in detecting occipital hypoperfusion in DLB. Twenty two patients with probable DLB, 38 patients with probable Alzheimer's disease (AD) and 16 normal controls underwent brain perfusion SPECT. Compared with AD, DLB patients had a bilateral lower CBF in the posterior cerebral segments. The correlation of clinical symptoms and brain blood perfusion was examined by dividing the subjects into subgroups. DLB patients with Parkinsonism, when compared to non-Parkinsonism subgroup, had a lower CBF throughout the cerebrum with statistical significance in the posterior cerebral segments. The quantitative analysis of brain perfusion SPECT by 3DSRT could be a useful supportive measurement in the diagnosis of DLB.

1. Introduction

Dementia with Lewy bodies (DLB) is characterized by progressive cognitive decline with fluctuations in cognition, recurrent hallucinations and Parkinsonism (McKeith et al., 2005). Because the clinical symptoms of DLB and Alzheimer's disease (AD) overlap in the early disease stages, the initial diagnostic criteria proved to be insufficiently sensitive for reliable DLB recognition (McKeith et al., 2004). To increase the accuracy of the clinical diagnosis of DLB, the latest diagnostic criteria incorporate findings on single photon emission computed tomography (SPECT) or positron emission tomography (PET) and include reduced occipital perfusion as a supportive feature (McKeith et al., 2005). In this study, we evaluated the usefulness of a fully automated regional cerebral blood flow (rCBF) quantification program '3DSRT' for the detection of occipital hypoperfusion in DLB. We also compared the blood perfusion pattern in DLB patients with and without Parkinsonism to determine the relation between rCBF and the clinical features.

2. Materials and methods

2.1. Subjects

The subjects of this study were 22 patients with probable DLB (McKeith et al., 2005), 38 patients with probable AD (McKhann et al., 1984) and 16 normal controls. The clinical diagnosis of DLB and AD was based on the latest diagnostic criteria and determined by a multidisciplinary discussion which included four psychiatrists, a neurologist, a neurosurgeon and a clinical psychiatrist. All of whom have extensive clinical experience with diagnosing dementia and are nationally certified specialists in their respective fields. All subjects were followed-up for at least 9 months and their diagnosis was re-evaluated before any data analysis was done. Most AD and normal control subjects were involved in our previous study (Kobayashi et al., 2007). The mean ages for each group were DLB 77.1±6.9, AD 79.0±5.3 and controls 75.8±5.6; gender ratios (M/F) were 11/11, 12/26, 4/12; mean MMSE scores were 18.7±6.4, 20.6±4.2, 28.3±2.2 and mean clinical dementia rating (CDR) was 1.7±0.5, 1.5±0.5 and 0, respectively. Statistical analysis revealed no significant difference in age among the three groups ($p=0.147$, ANOVA), and in the mean MMSE score ($p=0.223$, Student's t-test) and CDR ($p=0.082$) between the two

Abbreviations: DLB, Dementia with Lewy bodies; AD, Alzheimer's disease; SPECT, single photon emission computed tomography; PET, positron emission tomography; rCBF, regional cerebral blood flow; CDR, clinical dementia rating; ECD, 99mTc-ethylcysteinate dimmer; PD, Parkinson's disease; HMPAO, 99mTc-hexamethylpropylene amine oxime; IMP, I-123 iodoamphetamine; ROIs, regions of interest.

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dementia groups. All subjects were right-handed. Exclusion criteria included patients with severe dementia who scored 3 on CDR, patients receiving donepezil which could affect blood perfusion and subjects whose onset was earlier than 65 years old. The control subjects scored at least 24 on the MMSE and were rated 0 on CDR (non-dementia); they underwent full clinical assessment similar to patients with dementia. The institutional review board of Sunagawa City Medical Center approved the study which was conducted in accordance with the Declaration of Helsinki. All subjects or their relatives provided informed consent.

2.2. Image acquisition and quantification of CBF

All subjects were placed in a comfortable supine position with eyes closed in quiet surroundings. After an injection of 600 MBq of 99mTc-ethylcysteinate dimer (ECD), the passage from the heart to the brain was monitored with a rectangular large field gamma camera (E. Cam Signature, Toshiba Medical, Japan). Ten minutes after the angiography, SPECT images were obtained using a rotating, dual-head gamma camera. The data acquisition time was 20 min (5 min/cycle, four times). All images were reconstructed using ramp-filtered back-projection and then three-dimensionally smoothed with a Butterworth filter. The reconstructed images were corrected for gamma ray attenuation using the Chang method. We quantified CBF by the Patlak plot method (Matsuda et al., 1993; Matsuda et al., 1995). Quantitative flow-mapping images were obtained from the qualitative perfusion images by using Patlak plot graphical analysis and Lassen's correction (Friberg et al., 1994; Lassen et al., 1988). Regional CBF was quantified using 3DSRT (Kobayashi et al., 2007; Takeuchi et al., 2003; Takeuchi et al., 2004).

3. Results

The quantified CBF are expressed as graphs in Fig. 1(A) except for cerebellar segments in which blood flow was preserved until the late

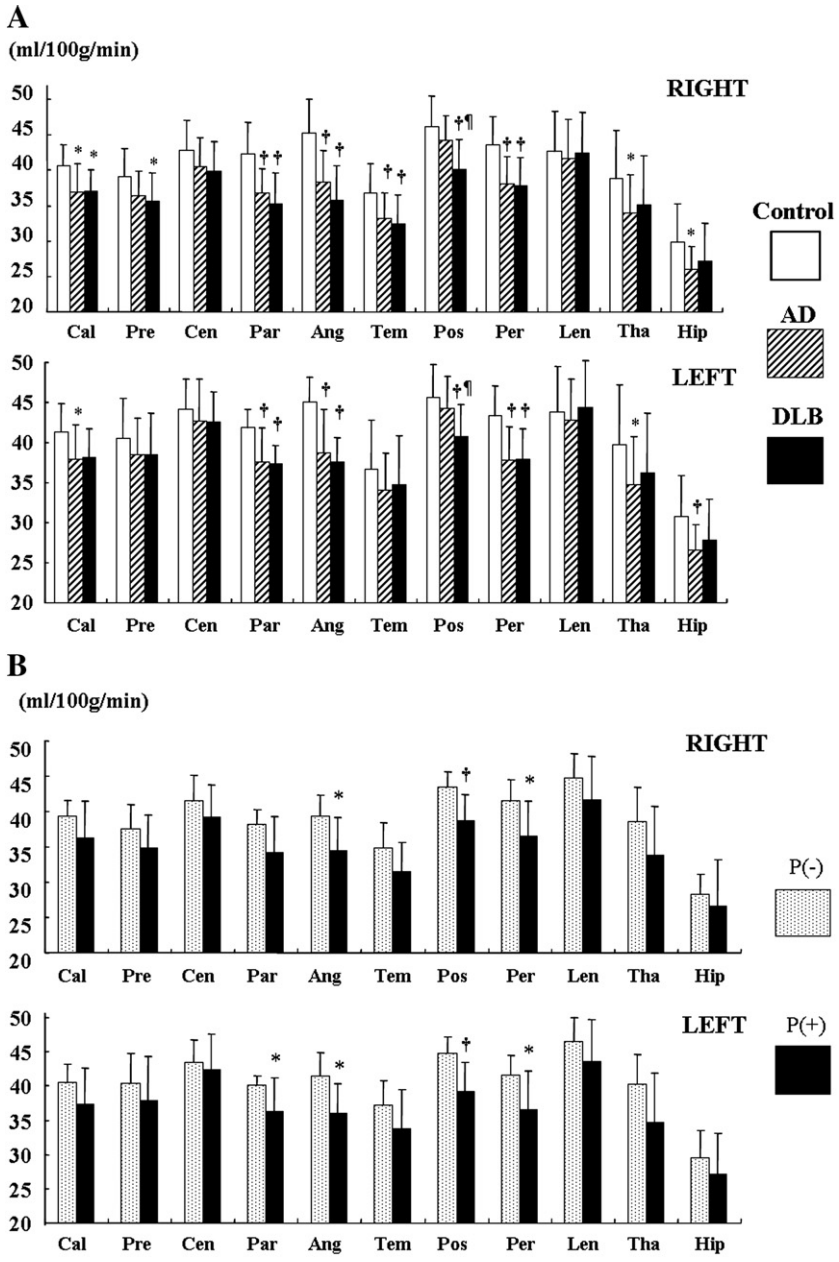

Fig. 1. (A) rCBF in DLB, AD and control. Cal: callosomarginal, Pre: precentral, Cen: central, Par: parietal, Ang: angular, Tem: temporal, Pos: posterior cerebral, Per: pericallosal, Len: lenticular nucleus, Tha: thalamus, Hip: hippocampus. *$p<0.05$, †$p<0.01$ (vs. control), ¶ $p<0.01$ (vs. AD). (B) rCBF in DLB with and without Parkinsonism. *$p<0.05$, †$p<0.01$.