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Single-photon emission computed tomography in the differential diagnosis of dementia with Lewy Bodies

Tomografia emisyjna pojedynczego fotonu w diagnostyce różnicowej otępienia z ciałami Lewy'ego

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ABSTRACT

Background: The study is aimed at assessing the usefulness of ^{99m}Tc-ECD SPECT in distinguishing patients with: Dementia with Lewy Bodies (DLB), Alzheimer's disease (AD) and Parkinson's disease with dementia (PD-D). **Methods:** Fifty patients participated in the study: 13 patients with DLB (aged 74 ± 4 years), 19 patients with AD (aged 75 ± 7 years), 18 patients with PD-D (aged 72 ± 3 years) and 14 healthy individuals (aged 70 ± 6 years). A neuropsychological examination was conducted on all patients. Motor function of DLB and PD-D patients was assessed using the Hoehn-Yahr scale, Unified Parkinson's Disease Rating Scale and Schwab and England Activities of Daily Living Scale. ^{99m}Tc-ECD SPECT was performed on all subjects. Statistical analysis of radiotracer uptake was performed for 16 regions of interest. To differentiate patients with DLB, PD-D and AD discriminate analysis was conducted. **Results:** SPECT showed global hypoperfusion in all patient groups when compared to control group. In DLB perfusion was significantly lower within the left temporal region as compared to AD and within the right parietal region, left temporo-occipital junction and left thalamus as compared to PD-D. A significant decrease of perfusion in both thalami was found in PD-D in comparison to AD. Discriminate analysis allowed for the proper classification in 68% of all patients: PD-D

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was classified the most accurately (83%) and DLB with least precision (46%). **Conclusions:** ^{99m}Tc-ECD SPECT did not allow us to differentiate precisely among DLB, PD-D and AD. Overlapping neuropathological features of DLB, PD-D and AD may account for this pattern of perfusion.

Introduction

The core features of Dementia with Lewy bodies (DLB) include a progressive and fluctuating cognitive impairment and visual hallucinations along with Parkinsonian symptoms. In some cases making a distinction between patients with DLB and those with Alzheimer's disease (AD) or Parkinson's disease with dementia (PD-D) may be difficult because of overlapping cognitive and psychiatric features [1–4]. Some authors regard DLB and PD-D as two phenotypes of Lewy body disease [5]. DLB patients have overlapping neuropathological features both with PD-D (Lewy Bodies) and Alzheimer's disease (AD) (amyloid plaques, neurofibrillary tangles) [5–8]. Clinical criteria do not allow us to make an early and specific diagnosis in many patients. Early diagnosis in DLB is important to avoid rapid disease progression after the implementation of classical neuroleptics (which increase the mortality rate and the risk of nursing home placement).

Occipital hypoperfusion is now used as a supportive feature for the clinical diagnosis of DLB [1]. However, functional neuroimaging studies with the use of single photon emission tomography (SPECT) or positron emission tomography (PET) reveal inconsistent patterns of perfusion deficits in patients with DLB, AD and PD-D. In DLB bilateral parieto-temporal hypoperfusion (with a similar pattern to that described in AD), symmetric occipital and frontal hypoperfusion were described [9–13]. Similarly, the temporo-parietal pattern of hypoperfusion characteristic of AD is most often described in PD-D patients [14–18].

Functional imaging studies with ^{123}J-FP-CIT (DaTscan, iod ^{123}-2β-carboxymethoxy-3β-[4-jodophentyl] tropan) or PET study with ^{18}F-DOPA, which show the affinity to the dopamine transporter, are also mentioned in the diagnostic criteria for DLB [1, 19] as a suggestive feature. However, those methods are less available than brain perfusion SPECT.

The aim of our study was to assess the pattern of regional cerebral blood flow (rCBF) deficits in 3 groups of patients, i.e. those with DLB, AD and PD-D, and to investigate the diagnostic utility of a SPECT study in the differential diagnosis.

Methods

Fifty consecutive patients referred to the Regional Outpatient Movement Disorders Center and Neurology Department in Gdansk participated in the study: 13 patients with DLB, 19 patients with AD and 18 patients with PD-D. Additionally, 14 healthy age–matched individuals served as a control group. The DLB patients met the criteria for probable DLB [1]. AD was diagnosed based on the diagnostic criteria of dementia of the American Psychiatric Association (DSM-IV) [20]. PD was diagnosed according to the Parkinson's Disease United Kingdom Brain Bank criteria [21]. At the time of recruitment formal criteria of PD-D [22] were not available, therefore the diagnosis of PD-D was based on PD diagnosis and DSM-IV criteria of dementia and neuropsychological examination. In all patients magnetic resonance imaging (MRI, $n = 47$) or computerized tomography study (CT, $n = 3$, due to contraindications to perform MRI) was performed to exclude the alternative causes of dementia, e.g. tumor, stroke or hydrocephalus. The Hachinski ischemic score was computed to exclude mixed or vascular dementia and was lower than 4 in all patients [23].

All patients were examined by a neurologist specialized in movement disorders (JS). In all PD-D and DLB patients the assessment of motor function was performed using the Hoehn-Yahr scale (H-Y), the Unified Parkinson's Disease Rating Scale (UPDRS) and the Schwab and England Activities of Daily Living Scale. The group of PD-D patients differed significantly in term of disease duration and mean age at disease onset as compared to the DLB and AD groups, as dementia is a late feature in PD and an early feature in AD and DLB. The clinical characteristics of the patient groups are presented in Table I. A neuropsychological examination was performed on all patients (Tab. II). In all participants SPECT examination was performed.

Regional cerebral blood flow (rCBF) was assessed semi-quantitatively on transverse slices using the cerebellum as a reference region. Focal perfusion deficits were assessed with the use of an asymmetry index (AI): $AI = R - L/(R + L)/2 \times 100\%$, where R and L are mean counts/pixel values in the respective regions of interest (ROIs) of the right and left hemispheres. Statistical analysis of radiotracer uptake was estimated for 16 ROIs (8 for each hemisphere) in 3 transverse slices: prefrontal and frontal inferior area, striatum, thalamus, middle and upper frontal region, temporal, parietal, occipital areas and the parieto-occipital junction. The ROIs are shown in Fig. 1.

Clinical groups were matched in terms of age and general cognitive status (Tab. I). The study was approved by the Bioethics Committee at the Medical University of Gdansk.

Methodology of SPECT study

Scanning was performed approximately 30 min after intravenous injection of 20 mCi (740 MBq) ^{99m}Tc-ECD (FAM, Lodz,