

Chapter 2

Executive Dysfunction in Parkinson's Disease

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ABSTRACT

Executive dysfunction (ExD) constitutes a core feature of the cognitive impairment in Parkinson's disease (PD). ExD in non-demented PD was evaluated using the Behavioral Assessment of the Dysexecutive Syndrome (BADs), which provided for the first time a broad assessment of ExD in PD patients. ExD in non-demented PD patients are predisposed to a greater severity of PD, particularly in impairments in activities of daily living. Patients with non-demented PD exhibited a wide range of ExD symptoms. All components of ExD were correlated with severity of PD, but correlation patterns differed across components. The first quantitative EEG evaluation of the differences between PD with and without ExD was also described. PD with ExD exhibited an increase in slow wave activity and a decrease in alpha and fast wave activities in frontal pole and frontal locations. These findings suggest that the ExD in PD is caused by frontal dysfunction.

BACKGROUND

According to the original description of Parkinson's disease (PD), the "senses and the intellect remain uninjured" (Parkinson J., 1955). However, many observations reported in the past three decades suggest that dementia and cognitive impairment are also recognizable non-motor symptoms in PD. It has recently been suggested that executive dysfunction (ExD) constitutes a core feature of the

cognitive impairment in PD. ExD in PD presents as impairments in set elaboration and planning, set shifting, and set maintaining, based on results of many previous studies (Pillion, B. et al., 2001). ExD in PD also includes impairments in concept formation and rule finding, problem solving, set elaboration and planning, set shifting, and set maintenance (Emre, M., 2003).

The Wisconsin Card Sorting Test (WCST), a widely used test for ExD, was mainly designed to detect problems with set shifting, and Tower

DOI: 10.4018/978-1-4666-2113-8.ch002

tasks such as Tower of London task (TOL) also primarily assay set elaboration and planning (Pillion, B. et al., 2001). In view of the weakness of traditional tests for the assessment of ExD, Wilson et al. developed a new test battery which assesses a wider range of ExD, the Behavioural Assessment of the Dysexecutive Syndrome (BADS) (Wilson, B.A. et al., 1996). Lezak et al. recently provided evidence that the BADS is an effective and broad assessment for ExD in daily life (Lezak, M.D. et al., 2004). BADS has been administered to neurologically intact adults and patients with a variety of neurological and psychological disorders.

The BADS consists of 6 different subtests: the Rule Shift Cards Test, the Action Program Test, the Key Search Test, the Temporal Judgment Test, the Zoo Map Test, and the Modified Six Elements Test. The BADS offers a more comprehensive assessment of ExD than other test types in that it involves not only set shifting (e.g., the Rule Shift Cards Test), but also the planning of behavior with exposure to novel situations (e.g., the Action Program Test), problem solving (e.g., the Key Search Test and the Zoo Map Test), judgment of time periods (the Temporal Judgment Test), and problem solving when faced with several competing tasks simultaneously (e.g., the Modified Six Elements Test). In contrast to traditional executive tests, the BADS is considered to be a more integrated battery with better “ecological validity,” based on the fact that it simulates problem-solving situations that patients may confront in their daily lives (Burgess, P.W. et al., 1998; Moriyama, Y. et al., 2002; Krabbendam, L. et al., 1999).

Performance on each of the 6 subtests in the BADS is scored according to the BADS manual. These scores are summed to derive a composite total “profile” score, providing an overall measure of ExD. The total profile score is then converted into a standardized score with a mean of 100 and a standard deviation of 15 based on data obtained from 216 normal control subjects, in the same way that the IQ scores are standardized on the Wechsler Adult Intelligence Scale-Revised.

In this article, recent clinical studies of ExD in non-demented PD using BADS (Kamei, S. et al., 2008) and the quantitative EEG (qEEG) evaluation of ExD in PD (Kamei, S. et al., 2010) are reviewed.

METHODS

Definition of Participants

Of 146 patients consecutively diagnosed with sporadic form PD at the neurology clinic of our hospital, 96 gave informed written consent to participate in this study. The clinical diagnosis of sporadic PD was made according to the UK PD Brain Bank criteria (Gibb, W. R. & Lees, A. J., 1988). Based on clinical features and neuroradiological findings from brain computed tomography (CT) and magnetic resonance imaging (MRI) at later than 12 months post-onset, we excluded other forms of parkinsonism, which included (1) dementia with Lewy bodies (DLB) (Geser, F. et al., 2005; McKeith, I. G. et al., 1996), (2) drug-induced parkinsonism, (3) vascular parkinsonism, and (4) atypical parkinsonism with absent or minimal responses to anti-parkinsonian drugs. The subjects included in the study had thus exhibited good responses to anti-parkinsonian drugs and did not have a history of visual hallucinations or fluctuations in cognitive ability suggestive of the clinical diagnosis of DLB at 12 months post-onset.

Assessment of ExD Using BADS

All 96 registered patients underwent the same assessments, including a detailed PD history, family history of neurological diseases, assessment of educational background, drug history, Hohen & Yahr (H&Y) stage and Unified Parkinson's Disease Rating Scale (UPDRS) score (Fahn, S. et al., 1987) evaluations for the severity of PD, and a Mini-Mental State Examination (MMSE) of mental state. The UPDRS, H&Y stage and MMSE

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