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Short communication

How precise are activities of daily living scales for the diagnosis of Parkinson's disease dementia? A pilot study

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ABSTRACT

Background: Beside the presence of cognitive deficits, impaired activities of daily living (ADL) are crucial for the diagnosis of dementia in Parkinson's disease (PD). Several scales can be used to evaluate PD patients' ADL (dys)function. However, only a few of them sufficiently discriminate between demented and non-demented PD patients. It is well-known that the diagnostic accuracy of ADL scales for Parkinson's disease dementia (PDD) is influenced by confounding variables such as motor worsening.
Objective: To evaluate the diagnostic accuracy of ADL scales for PDD.
Methods: In a cohort of 106 patients (21 with dementia), we evaluated observer-based activities of daily living rating scales (e.g. Pill Questionnaire, Schwab & England Scale), caregiver assessments, and patient questionnaires (e.g. Lawton Instrumental Activities of Daily Living Scale).
Results: Each inventory showed moderate or even high specificity for dementia (>75.3%). Sensitivity was highest for the Pill Questionnaire (90.5%). Interestingly, the ratings of caregivers and trained clinical observers overestimated the presence of dementia.
Conclusions: Standardized activities of daily living assessments like the Pill Questionnaire accompanied by neuropsychological testing can be a helpful tool for the diagnosis of PDD. Further studies are needed to verify these first results in larger cohorts.

1. Introduction

Parkinson's disease dementia (PDD) is an important predictor for nursing home placement and mortality. Inventories with a high diagnostic accuracy for PDD are gaining increasing importance as therapeutic interventions can delay cognitive decline.

PDD is characterized by cognitive deterioration affecting daily life. However, activities of daily living (ADL) dysfunction in Parkinson's disease (PD) can result from different causes including motor, cognitive, or autonomic deficits. As a result, impaired ADL abilities have been detected even at early stages of the disease when the prevalence of PDD is rather low [1].

ADL dysfunction associated with PDD should be caused by cognitive worsening but should not primarily reflect motor impairment [2]. This differentiation can often be difficult as PD is, first of all, a motor disorder accompanied by several other non-motor symptoms. Moreover, ADL inventories are known to at least partly reflect motor disabilities [3,4]. Since PDD patients should be treated as early as possible, it is important to know whether ADL inventories are helpful to diagnose PDD.

The objective of this study was to evaluate the diagnostic accuracy of ADL scales for PDD. To date, several ADL assessments are used [5], but little is known about their contribution to the diagnosis of PDD. Only a few of them sufficiently discriminate between demented and non-demented PD patients [6,7]. We here provide a comparative analysis of different observer-based, caregivers' and patients' ADL assessments to verify their accuracy for the diagnosis of PDD.

2. Methods

2.1. Patients

We investigated a sample of idiopathic PD patients [8] who were recruited from our outpatient clinic, the Parkinson Clinic Leun-Biskirchen or a former study [9] according to the following criteria: age ≥50 years, onset of dementia >2 years

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after diagnosis of PD, normal or corrected hearing/visual abilities, German as first language and written informed consent for study participation. Exclusion criteria were: other neurological diseases affecting the central nervous system, deep brain stimulation, history of drug or alcohol addiction, intake of medication interfering with cognition (i.e. hypnotics or tranquilizers) or a Mini Mental State Examination (MMSE) score <18 (testing not feasible). Patients were tested while taking their optimized medication. Only those caregivers who reported to be involved in patients' care and who were willing to take part in the study were included (77 spouses, 20 adult children, 6 other family members, and 3 non-family members). The study was approved by the local ethical committee.

2.2. Diagnosis of Parkinson's disease dementia (PDD)

Diagnosis of PDD was made according to the Diagnostic and Statistical Manual of Mental Disorders Fourth edition (DSM-IV) criteria based on both (i) the results of a comprehensive neuropsychological examination [9] (see supplementary Table 1 for details) indicating cognitive impairment in at least two domains including memory dysfunction and (ii) the clinically rated impact on ADL function. A neuropsychologist and a physician performed the clinical ADL rating in a personalized interview. Both interviewers did not have access to the results of the standardized ADL scales. The clinical rating was based either on patients'/caregivers' reports of a marked ADL dysfunction primarily caused by cognitive worsening in the domestic environment or on the interviewers' impression of the patients' behavior.

We did not exclude PD patients with major depression as we are particularly interested in how ADL scales can be used to assess patients' performance given this confounding variable.

2.3. Assessments

Patient demographics, medical history, and medication (specified as levodopa equivalent dose LEDD) were recorded. The Unified Parkinson's Disease Rating Scale part III (UPDRS-III) and the Hoehn & Yahr (H&Y) scale were applied to evaluate motor function. The Beck Depression Inventory was used to account for depression.

The UPDRS-II as well as the Schwab and England Activities of Daily Living Scale (S&E-ADL) were applied by a neurologist blinded to both, PDD diagnosis and results in all other scales. The Pill Questionnaire [2] was adapted to evaluate whether patients were able to manage their anti-parkinsonian treatment independently or whether they depended on caregivers' help. Starting with an open question, a trained physician asked the patients about their anti-parkinsonian medication (see supplementary Table 2, Part A). If the patients were able to describe name, color of tablet, dose, and schedule of intake (at least three out of these four descriptions must be correct), the medication management was estimated to be independent (score = 0). Otherwise, the examiner gave three standardized questions to help the patients remember the medication (see supplementary Table 2, Part B1). If two of these three questions were answered correctly – with dose or schedule being one of them – a score of 0 (zero) was achieved. If these previous parts could not be answered satisfactorily by the patients, the caregivers were consulted to certify whether the patients could safely and reliably take the pills without supervision (see supplementary Table 2, Part B2, score = 0). Only if the patients were not able to report the medication – neither spontaneously nor with standardized questions nor according to the caregivers' rating–, the patients were judged to be impaired in ADL function (score = 1).

Two subscales of the Nurses' Observation Scale for Geriatric Patients (NOSGER) assessing the caregivers' complaints about the patients' instrumental activities of daily living (IADL) and ADL function were applied (max. score 25 points each, higher scores indicated more complaints of ADL problems).

The Lawton Instrumental Activities of Daily Living (Lawton-IADL) Scale (max. 24 points) and the NAB-IADL Inventory (Nuernberger-Alters-Inventar Beobachtungsskala, max. 45 points) were also completed by the caregiver. In correspondence to the caregivers' ratings, the Lawton-IADL Scale as well as the Nuernberger-Alters-Inventar Aktivitaeten-Skala (NAA-IADL) were used for the patients' ADL self-assessments.

2.4. Statistical analyses

Parametric statistics are reported (e.g. mean). Mean group differences between non-demented (PDND) and demented (PDD) PD patients were calculated either by chi-square tests, *t*-tests, regression, or covariance analyses ($p < 0.05$, two-sided). Diagnostic accuracy parameters (e.g. sensitivity, positive predictive value) were evaluated by receiver operating characteristic (ROC) curve analyses. Data were analyzed using SPSS 19.0 for Windows (IBM® SPSS® Corporation, New York USA).

3. Results

The total of 106 PD patients comprises 21 with PDD (Table 1). PDD patients were older ($p < 0.001$), had less years of education ($p = 0.04$), more severe motor impairment (UPDRS-III $p < 0.001$), a longer disease duration ($p = 0.02$) and reported more severe depressive symptoms (BDI $p = 0.018$). Patients' disease duration and motor performance were supposed to be highly correlated in this study. Thus, mean group comparisons referring to ADL assessments were corrected for age, years of education, the UPDRS-III and the BDI score.

In the Pill Questionnaire, PDD patients were more often judged to need assistance with their medication management than patients with PDND (3.5% in PDND vs. 90.5% in PDD, $p = 0.001$). However, ADL performance in other observer-based assessments did not differ between the groups (UPDRS-II or S&E $p > 0.05$).

Based on caregivers' information, PDD patients had more severe ADL impairments than patients with PDND when they were assessed by the Lawton-IADL ($p = 0.01$), the NOSGER-IADL ($p < 0.001$), and the NAB-IADL ($p = 0.02$). However, results of the NOSGER-ADL scale did not differ between study groups ($p = 0.10$). PDD patients themselves stated more ADL problems than patients with PDND if they were assessed with the Lawton-IADL ($p = 0.03$) and the NAA-IADL ($p = 0.001$) scale.

The specificity of all ADL assessments was greater than 75.3%. The negative predictive value was greater than 88.9% (Table 2). The sensitivity (SE) of our ADL inventories, particularly of the self-rating Lawton-IADL scale (57.1%), was lower than the SE of the Pill Questionnaire (90.5%) and of the NAB-IADL (81.0%). The positive predictive value of most assessments was below 57.1%, except for the Pill Questionnaire with 86.4%.

4. Discussion

We here evaluated the diagnostic accuracy of different ADL assessments for PDD. To the best of our knowledge, this is the first comparative analysis of various ADL scales regarding their ability to differentiate between PDND and PDD patients. As ADL impairment caused by cognitive worsening is a core criterion for the diagnosis of PDD [2,6], it is essential to know if ADL inventories in addition to cognitive testing could be a helpful diagnostic tool. In fact, an early and valid PDD diagnosis is mandatory as therapeutic intervention can reduce cognitive decline. Thus, an early detection of dementia by means of standardized ADL assessments could be important for early treatment. Moreover, ADL scales might be beneficial to serve as screening tools to define further clinical options such as a comprehensive neuropsychological examination.

In our cohort, the diagnostic accuracy of the Pill Questionnaire was superior to other ADL ratings. This semi-quantitative test assesses the patient's situation at home, is easy to apply and economical in time. One might consider that particularly the complexity of medication could have affected the performance in the Pill Questionnaire. However, the dopaminomimetics intake as calculated by the Levodopa equivalence daily dose did not differ between demented and non-demented PD patients in the present study. Based on our results, this test seems to be a promising tool for the assessment of daily living dysfunction indicative of PDD.

The assessment of objective medication handling might be preferable to the patients' subjective self-rating regarding their ability of medication management [10]. Even at early stages, PD patients tend to overestimate their competence to organize medication intake. In demented patients, loss of decisional abilities is primarily associated with memory and executive function [11]. Cognitive deterioration was also more prominent in the present PDD group, supporting an association between cognitive worsening and the inability to manage medication intake. However, this assumption has to be verified by further analyses.

Empirical studies suggest that ADL function is impaired in the preclinical phase (phase of mild cognitive impairment) of Alzheimer's disease dementia [12]. Interestingly, PD patients with mild