A home environment test battery for status assessment in patients with advanced Parkinson's disease

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Determining treatment outcome and follow-up of patients with fluctuations in motor performance, such as in advanced Parkinson's disease (PD), is difficult in practice. A test battery for assessing patient state in advanced PD consisting of self assessments and motor tests (tapping and spiral drawing) was developed for a hand computer with touch screen in a telemmedicine setting. Assessments and tests were carried out 4 times per day in a group of 65 patients with advanced PD (Duodopa® treated or candidates) during 1-6 weekly test periods each. For most test periods, Unified PD Rating Scale (UPDRS) ratings were available.

In a web interface, two PD specialists rated drawing impairment in 3 spiral drawings from 3 random test occasions per patient using the Bain & Findley 10-category scale. A computer method, using wavelet transforms and principal component analysis of a dataset with the 10% worst and 10% best tapping results, processed the same spirals to generate a ‘spiral score’. According to a PD specialist, the information content of a test period with the test battery could be described by six dimensions: ‘off’, ‘dyskinesia’, ‘walking’, ‘satisfaction’, ‘spiral’, and ‘tapping’. Each dimension was defined as the first principal component of the level (mean), and fluctuation (standard deviation) for the questions or tests that this dimension is based on. Tapping test results were based on both speed and accuracy. To obtain weights for an overall test score, linear regression of the component dimensions vs. simultaneous UPDRS ratings was performed. To assess the internal consistency of the test battery, Cronbach’s Alpha for the six dimensions was calculated.

A validation study was performed, with objective to assess patient compliance, test-retest reliability, correlations to other assessment methods and ability to detect differences between patient groups at different disease stages. Data from another 30 patients, both in stable and fluctuating conditions, in age and gender matched pairs were analysed. Patients used the test battery for one week, and were assessed with UPDRS and PDQ-39 (PD related Quality of Life) at the end of the test period. This procedure was repeated one week later without allowing treatment changes. Reliability and validity were assessed by Spearman rank correlations. The Mann-Whitney statistical test was used to test if the overall score was different between stable and fluctuating groups.

For drawing impairment in spirals, 95 % confidence interval for prediction errors was below ± 2, which is similar to the differences of opinion between human raters. Weights in overall test score were (%): spirals, 41, tapping, 24, satisfied, 19, dyskinetic, 10, walking, 5.4 and off, 0.1. Internal consistency for the dimensions was 0.81.

Median compliance in the validation study was 93%. Test-retest reliability was 0.71 in the stable group and 0.84 in the fluctuating group. The correlation (combined group) to UPDRS was -0.60 and to PDQ-39, -0.66. Median overall score differed 18% between the two groups (p<0.0001).

In conclusion, the computer method could successfully assess PD-related drawing impairments, well comparable to trained raters. Spirals were assigned highest weight in overall score, reflecting the high weight of motor function in total UPDRS. Internal consistency among the dimensions in the overall score was strong, implying they are all measuring aspects of a common characteristic. In the validation study, compliance and reliability of the test battery were good overall, with better reliability in fluctuating patients. Correlations to UPDRS and PDQ-39 were adequate and difference in test score between stable and fluctuating patient groups was detected.