

## Psychometric Findings in Clinical Subtypes of Parkinson's Disease

G. Ransmayr, W. Poewe, S. Ploerer, G. Birbamer, and F. Gerstenbrand

*University Clinic of Neurology, A-6020 Innsbruck, Austria*

Based on differences in expression of the cardinal symptoms, idiopathic Parkinson's disease can be subdivided into akineto-rigid (RA type) and tremor-dominant (T type) varieties that differ in several clinical aspects from the classical variety with equal expression of akinesia, rigidity, and tremor (RAT type, equivalence type) (4,5,11). Predominantly tremulous forms of Parkinson's disease often follow a benign course, whereas akineto-rigid types of the disease may be associated with a more unfavorable prognosis.

Deficits of various cognitive and visuospatial functions in Parkinson's disease have been shown to be correlated with rigidity and akinesia, whereas no such correlation was found for tremor (6,8-10). In the present study, patients with idiopathic Parkinson's disease underwent a series of psychometric tests to detect possible neuropsychological differences among patients belonging to the RA, T, and RAT types of Parkinson's disease, as briefly outlined above.

### MATERIAL AND METHODS

Forty-four consecutive right-handed patients with idiopathic Parkinson's disease (22 males, 22 females, mean age  $63.0 \pm 9.2$  years, mean duration of disease  $6.3 \pm 3.5$  years) and no evidence of concomitant cerebrovascular disease entered the study. All patients except one had been receiving sustained levodopa therapy (Madopar) with mean a daily dosage of  $572 \pm 309$  mg for a mean of  $3.7 \pm 3.2$  years. Ten patients were additionally treated with small doses of different dopaminergic drugs and 13 with anticholinergics. Nineteen patients were clinically classified as RA type, 12 as T type, and 13 as RAT type. Stage of Parkinson's disease was assessed according to Hoehn and Yahr. Tremor, rigidity, and akinesia, as well as abnormal involuntary movements (AIMs) and overall disability, were rated on a clinical scale ranging from 0 to 4 for each

item. A history of drug-induced psychosis was recorded, and the episodes were rated from 0 to 3.

The battery of neuropsychological tests consisted of two parts. In part 1 the subtests for general information, similarities, picture completion, and block design without time limit of the Wechsler Adult Intelligence Scale (WAIS), the subtests number 4 (logical memory), number 5 (digit span forward and backward), and number 7 (paired associates) of the Wechsler Memory Scale, and the Benton Visual Retention Test (visual memory), multiple-choice form, the Bender Gestalt Test (visuomotor functions), Digit Symbol Test of the WAIS (visual discrimination, scanning, and visuomotor function), and the Zung Self-Rating Scale of Depression were employed. These tests are widely used and control values for different ages are available in the literature.

Thirty-three of the 41 patients tested in part 1 went through a second session (part 2) consisting of the Line Cancellation Test of K. deS. Hamsher [visual scanning with regard to inattention or neglect phenomena (7)], the Figure Test of Rybakoff [visuospatial thinking (12)], the Cube Task of the Intelligence-Structure Test (IST) of R. Amthauer (1) (visual discrimination and visuospatial thinking), and a self-designed test for visual estimation of various distances (black, straight lines of 7, 11, 12, 14, 20, 21, and 25 cm). All tests of part 2 were untimed. Thirteen age-matched normal right-handed subjects with identical intelligence quotients (IQs) were examined as controls.

### RESULTS

Comparing clinical parameters of the three subgroups of patients, no differences were found for age, duration of disease, duration of levodopa treatment and latest mean levodopa dosage, as well as severity of drug-induced AIMs ( $0.3 \pm 0.5$ ). Significant differences were only found in overall disability

ity and stage of disease as well as history of drug-induced psychotic episodes (Table 1; Kruskal Wallis one-way ANOVA; U-test of Mann and Whitney).

In comparing the results of the neuropsychological tests of part 1, no significant differences were found among the three groups. The mean scores in the administered subtests of the WAIS of all patients did not differ from normal control scores, except for the Digit Symbol Test (Table 2). In the subtest for logical memory of the Wechsler Memory Scale, the Benton Visual Retention (multiple-choice form), and the Bender Gestalt Test, the patients produced more errors than indicated for normal controls. The mean score of the Zung Scale revealed moderate depression in the parkinsonian group. For the subtests numbers 5 and 7 of the Wechsler Memory Scale, no differences were found between patients and controls according to digit retention and associated memory.

Spearman rank correlation of the scores of tremor, rigidity, and akinesia with the neuropsychological test scores revealed a positive correlation of akinesia with number of errors in the Bender Gestalt Test ( $p = 0.007$ ) and of rigidity with depression score ( $p = 0.029$ ). History of drug-induced psychosis correlated negatively with tremor ( $p = 0.012$ ) and positively with akinesia ( $p = 0.001$ ).

The results of the neuropsychological tests of part 2 (33 patients; RA type: 13 patients, RAT type: 1 patient, T type: 8 patients) did not reveal significant differences between patients and normal controls (Table 3). A trend toward impairment of visual scanning and visuospatial thinking can only be assumed for the Cube Task of the IST test. Also, no differences were found among the three subgroups of patients, except for the Distance Estimation Test in which the patients with T type scored significantly lower than those with RA type. The Spearman rank correlation of the motor symptoms tremor, rigidity, and akinesia with the tests of part 2 revealed significant positive correlations of tremor score with the total score of omissions ( $p = 0.015$ ) and differences of omissions between the right and left sector ( $p = 0.014$ ) in the Line Cancellation Test. A negative correlation of tremor score with the pass scores of the Figure Test of Rybakoff ( $p = 0.033$ ) and a positive correlation of tremor

TABLE 1. Comparison of clinical parameters of the three Parkinson subgroups

Subgroup	N	Motor disability <sup>a</sup> (0-4)	Stage of disease (Hoehn and Yahr) <sup>b</sup> (I-V)	History of drug-induced psychosis <sup>c</sup> (0-3)
RA type	19	2.2 ± 0.9	3.0 ± 0.9	0.84 ± 0.83
RAT type	13	1.5 ± 0.7	2.4 ± 0.8	0.22 ± 0.59
T type	12	0.9 ± 0.8	1.9 ± 0.6	0.17 ± 0.39

<sup>a</sup>Difference between RA type and T type:  $p = 0.001$  difference between RAT type and T type:  $p = 0.047$ .

<sup>b</sup>Difference between RA type and T type:  $p = 0.0003$ .

<sup>c</sup>Difference between RA type and RAT type:  $p = 0.02$ ; difference between RA type and T type:  $p = 0.9172$ ; for the other assessed clinical parameters, no significant differences were found.

score with sum score of overestimation and underestimation in the Distance Estimation Test ( $p = 0.001$ ) were also observed. No further correlations were found in the Spearman correlation matrix of part 2.

A correlation of laterality of Parkinson's disease (predominant left-sided versus bilateral versus predominant right-sided symptoms) to the results of the administered visual tests (all tests of part 2, and Benton Visual Retention Test, Bender Gestalt Test, and Block Design Test of part 1) did not reveal any significances.

## DISCUSSION

In this study no consistent differences in the results of the neuropsychological tests employed could be detected between patients with idiopathic Parkinson's disease and normal controls. Although the patient group scored higher on the Zung Scale for depression and also exhibited deficits in some cognitive and visuospatial tests in part 1 of this study, no significant differences were found between patients and controls for most of the subtests of the WAIS (block design without time limit) and for the visuospatial tests of part 2.

In particular, neglect phenomena and uni- or bilateral inattention in visual scanning were not appar-

TABLE 2. Tests of part 1 with scores worse than normal controls

WAIS (digit symbol test)	Wechsler Memory Scale (logical memory)	Benton Visual Retention Test (multiple choice)	Bender Gestalt Test	Zung Scale
19.3 ± 11.1 >25 <sup>a</sup>	5.4 ± 2.4 >17.0 <sup>a</sup>	10.6 ± 1.9 >12.0 <sup>a</sup>	39.6 ± 19.2 <32.0 <sup>a</sup>	33.4 ± 15.6 <30 <sup>a</sup>

<sup>a</sup>Normal value.

TABLE 3. Results of the tests of part 2\*

Subgroup	Hamsher Line Cancellation Test		Rybakoff Figure Test (passed score)	Amthauer IST Test Cube Task (passed score)	Distance Estimation Test [sum score of error <sup>2</sup> (cm)]
	Total score of cancellation	Difference right/left sector			
RA type (N = 13)	89.2 ± 1.2	0.85 ± 1.34	5.5 ± 3.3	6.8 ± 2.4	11.8 ± 11.3
RAT type (N = 11)	87.9 ± 4.7	1.36 ± 2.33	3.4 ± 2.0	6.2 ± 2.4	30.2 ± 31.9
T type (N = 8)	89.1 ± 1.5	0.88 ± 1.46	6.4 ± 10.9	4.9 ± 3.3	30.8 ± 18.0
Normal controls (N = 13)	89.0 ± 2.0	0.70 ± 1.33	5.1 ± 2.6	8.3 ± 2.4	19.0 ± 17.4

\*Mean values + SD of patients and normal controls. No significances among subgroups of patients, except for Distance Estimation Test ( $p = 0.02$ ). No differences between patient group ( $N = 33$ ) and normal controls (Kruskal-Wallis one-way ANOVA; Mann and Whitney U-test).

ent in this sample of patients, contrary to the findings of Villardita et al. (13). Unlike Direnfeld et al. (3), we did not find severer deficits in visual tests in predominantly left-sided, compared to bilateral and right-sided, Parkinson's disease. Furthermore, no consistent pattern of neuropsychological differences emerged among the three subgroups of idiopathic Parkinson's disease distinguished in this study. In the Bender Gestalt Test, visuomotor deficits correlated with akinesia, whereas impairment of visuospatial thinking as assessed by the Figure Test of Rybakoff, visual scanning as assessed by the Line Cancellation Test, and visual estimation were found to be correlated with tremor. In this respect our results differ from those reported by Mortimer et al. (9), although direct comparison is difficult due to differences in the tests and methods of evaluation. Further correlations observed in this investigation include correlations of rigidity with depression and akinesia with drug-induced psychosis.

In summary, the present study fails to detect a specific association of akineto-rigid Parkinson's disease (AR type) with cognitive and visuospatial deficits as has been suggested by several reports (6, 8-10) and critically discussed by other authors (2).

Of particular importance among the factors responsible for such differences in neuropsychological investigations of Parkinson's disease are preselection of patients, influence of antiparkinsonian therapy, and selection of tests. With respect to the subtypes of Parkinson's disease described in this investigation, further studies of possible neuropsychological differences—especially in untreated patients—are needed.

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