

Comparison of Dementia With Lewy Bodies to Alzheimer's Disease and Parkinson's Disease With Dementia

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Abstract: We compared the clinical and neuropsychological pattern of dementia with Lewy bodies (DLB) to Alzheimer's disease (AD) and Parkinson's disease with dementia (PD-d). Sixteen patients clinically diagnosed with DLB were compared with two groups of patients with PD-d ($n = 15$) and AD ($n = 16$) matched for level of dementia. Isolated cognitive impairment was the most common form of presentation in AD (93.8%) and DLB (31.3%) groups, while parkinsonism was in 100% of PD-d subjects. Psychoses associated with cognitive impairment at the beginning of the disease were more frequent in DLB patients (31.3%) than in AD (6.3%) and PD-d (0%) groups. There were no significant differences in Unified Parkinson Disease Rating Scale motor-subscale scores between DLB and PD-d patients. DLB and PD-d patients performed significantly worse on attentional functions and better on mem-

ory tests than AD. DLB patients also showed lower scores than AD subjects on visual memory, visuo-perceptive, and visuo-constructive tests. No significant differences were found between PD-d group and DLB subjects on any neuropsychological test. We were unable to find any differences in cognitive tasks between PD-d and DLB subjects. Clinical features and neuropsychological deficiencies of DLB (attentional, visuo-perceptive, and visuo-constructive deficits) and PD (attentional deficits) compared to AD (amnesic syndrome) can contribute to accurate identification of these entities and to the understanding of the neuropathological and neurochemical substrate underlying these diseases. © 2003 Movement Disorder Society

Key words: Dementia with Lewy bodies; Parkinson's disease; Alzheimer's disease; Neuropsychology

Dementia, particularly Alzheimer's disease (AD), and parkinsonism, mainly Parkinson's disease (PD), are two of the most common age-related neurodegenerative disorders. Although AD and PD have been traditionally considered as separate clinical entities, the recognition of extrapyramidal features in up to 30 to 70% of clinically diagnosed AD patients¹ and the increasing number of studies demonstrating the presence of dementia in patients with PD² have changed this strict dichotomy. Also, dementia with Lewy bodies, which is characterized by a

progressive and fluctuating cognitive impairment associated with psychoses and extrapyramidal features, has emerged during this decade as one of the most common types of degenerative dementia.^{3,4}

Many studies have demonstrated different neuropsychological presentations in AD compared to PD dementia (PD-d).^{5,6} Dementia in AD is characterized by an early and progressive memory impairment accompanied by an increasing disorder of perception, language, praxis, and calculation. On the other hand, a prominent impairment of executive functions associated with a slowing of thought processes and a relative sparing of memory and other cortical functions has been described in PD-d. The characterization of DLB, which shows a mixed cortico-subcortical neuropsychological pattern, has linked these extremes but at the same time has opened a debate about whether or not DLB it is a distinct entity of PD, a variant form of AD, or a separate individual condition. This

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nosological puzzle is highlighted by recently recognized overlapping neuropathological findings.^{4,7-9}

Because there are no known clinical markers for these neurodegenerative diseases, diagnosis is based on detailed clinical history, careful physical examination, and neuropsychological evaluation. Several studies suggest the use of cognitive assessment in differentiating patients with DLB from those with AD. According to these studies, DLB patients exhibit equivalent deficits in many cognitive abilities affected by AD but have disproportionately severe deficits in executive, attentional, and visuospatial processing. Conversely, DLB patients show better scores than AD patients on most of the tests designed to assess verbal memory.¹⁰⁻¹⁹ Although two previous cognitive comparisons have been made between DLB and PD, to our knowledge these studies have not included a specific group of PD demented patients.^{15,20}

In the present study, we compared a group of patients with clinical diagnosis of "probable" DLB to AD and PD-d patients matched for overall intellectual function. Our aim was to delineate a distinctive cognitive profile among these entities to assist the physician in the differential diagnosis of the patient with dementia and parkinsonism.

PATIENTS AND METHODS

Patients

Sixteen patients, evaluated in the Alzheimer's Disease Research Center at Columbia University, with the clinical diagnosis of probable DLB were identified based on their initial diagnosis. The 1996 Consensus Guidelines for DLB were not operational during part of this study,³ so all clinical data were retrospectively reviewed and a final diagnosis was made according with these criteria, independent of the neuropsychological data. Two carefully matched groups of patients with probable Alzheimer's disease without parkinsonism (AD, $n = 16$) and Parkinson's disease with dementia (PD-d, $n = 15$), were sampled according to the following inclusion criteria.

Parkinsonism.

A modified form of the Unified Parkinson Disease Rating Scale (mUPDRS) was administered to all patients in *off* state at the initial visit.²¹ Based on the United Kingdom Parkinson's Disease Society Brain Bank criteria, parkinsonism was defined as the presence of bradykinesia (score ≥ 1), associated with one or more (score ≥ 1) of these three features: tremor at rest, rigidity, or axial symptoms.²² We defined lack of parkinsonism as those patients scoring "0" on the mUPDRS.

Following these criteria, 633 AD patients without parkinsonism were identified.

Matching Procedures.

To ensure that any differences in group test profiles could be attributed to differences in the underlying nature of the disorders rather than to differences in global level of dementia, members of the three groups were matched *one-by-one* for level of dementia (Clinical Dementia Rating).²³ DLB and AD patients were also matched individually for age and global cognitive impairment, as assessed by a modified form of the Mini-Mental State Examination (MMSE).²⁴

Clinical Diagnosis Criteria

All patients received a structured medical, neurological, and functional assessment by physicians. A brief neuropsychiatric scale, focused on the presence or absence of delusions and hallucinations, was completed in all cases.²⁵ Laboratory tests to exclude treatable causes of dementia were performed. All patients received neuroimaging (computed tomography or magnetic resonance imaging) to exclude the presence of focal brain lesions. Care was taken to ensure that DLB patients were not tested during a period of marked confusion.

The neuropsychological battery has been described previously.⁶ It was designed to assess a broad range of cognitive functions, including *orientation* (the 10 orientation items from the MMSE),²⁶ *verbal memory* (total recall, delayed recall, and delayed recognition subscores of the Buschke Selective Reminding Test),²⁷ *nonverbal memory* (a multiple-choice version of the Benton Visual Retention Test),²⁸ *verbal reasoning* (the Similarities subtest of the Wechsler Adult Intelligence Scale, Revised [WAIS-R]),²⁹ *nonverbal reasoning* (the Identities and Oddities subtest of the Mattis Dementia Rating Scale),³⁰ *naming* (a 15-item version of the Boston Naming Test),³¹ *verbal fluency* (letter and category fluency tasks),³² *auditory comprehension* (the first six items version of the Complex Ideational Material subtest of the Boston Diagnostic Aphasia Examination),³³ *repetition* (the high-frequency phrases from the Boston Diagnostic Aphasia Examination Repetition of Phrases subtest),³³ *attention* (two cancellation tasks involving the detection of a shape form (Δ) and a consonant trigram (TMX) from an array of shape and phonemic distractors, respectively),³⁴ *visuo-constructional skills* (a five-item version of the Rosen Drawing Test),³⁵ and *visuoperceptual skills* (a four-choice matching version of the Benton Visual Retention Test).²⁸

Data from all these evaluations were presented at a consensus conference of neurologists and neuropsych-

chologists, and a diagnosis was made. Alzheimer's disease and DLB were diagnosed according to the National Institute of Neurological Communicative Disorders and Alzheimer Disease and Related Disorder Association (NINCDS-ADRDA) criteria, and the Consensus Guidelines for DLB, respectively.^{3,36} Because methodological difficulties led to "fluctuations in attention"³⁷ not being recorded in most patients, DLB diagnosis was made based on the presence of dementia accompanied by hallucinations and/or parkinsonism. The patients with PD and dementia met the DSM-IV criteria for dementia due to PD. In accordance with the Consensus Guidelines for the Clinical Diagnosis of PD with dementia, the diagnosis of PD had always preceded the development of dementia by 1 year at least.³

Data Management

Clinical records were independently reviewed, and demographic, psychiatric, motor, and cognitive data, were obtained for this analysis. "Presenting symptom" was defined as any combination of cognitive impairment, parkinsonism, or psychotic features (hallucinations and/or delusions) first noted by the nearest caregiver. The "first cognitive complaint" was classified according to one of the following categories: memory, performance, language, disorientation, and personality change. The "duration" of these symptoms was defined as the time from caregivers' initial awareness of the patient's abnormality to the initial patient assessment.

Statistical Procedure

For group comparisons, parametric data were analyzed by Student's *t* test and one-way analysis of variance (ANOVA) with Tukey's post hoc test.³⁸ A parametric correlation between mUPDRS total score and the scores in visuocognitive (Rosen Drawing Test) and atten-

tional (Cancellation) tests was used to detect whether motor disability was affecting the overall cognitive tests performance of DLB and PD-d groups. Nominal and qualitative data were analyzed using chi-square tests with Yates correction when necessary. A significance level of $P < 0.05$ was used in all comparisons.

RESULTS

Demographic Characteristics and Level of Dementia

There were no significant differences in age, gender, years of education, and ethnicity between groups (Table 1). As would be expected because of our matching procedure, there were no significant between-group differences in Clinical Dementia Rating (CDR). There were also no significant differences in duration of cognitive symptoms and mMMSE scores. Duration of parkinsonism was longer in PD-d than DLB patients (Table 2).

Neurological Findings

Presenting Symptoms and Cognitive Complaints.

Of the 16 patients with DLB, 15 (93.7%) presented with isolated or combined cognitive impairment as their first symptom. Only 1 patient from this group presented initially with isolated psychotic episodes followed by cognitive symptoms and parkinsonism several years later. Cognitive deficit was the sole presenting symptom in 5 patients of the DLB group, 15 patients (93.8%) of the AD group, and none of the PD-d patients ($\chi^2 = 67.5$, $P < 0.001$). As the presenting symptom, cognitive impairment was associated with parkinsonism and psychosis in 4 and 5 patients of the DLB group, respectively (Table 2).

"Memory changes" were considered as the first cognitive complaint in 15 patients with DLB, and only 1

TABLE 1. Demographical data

	DLB (n = 16)	PD-d (n = 15)	AD (n = 16)	P
Age at intake (yr)	72.7 (6.9)	73.5 (5.7)	71.5 (9.7)	NS
Gender (male), n (%)	8 (50%)	11 (73.3%)	6 (37.5%)	NS
Education (yr)	12.9 (4.5)	15.2 (4)	14.1 (3.8)	NS
Ethnicity, n (%)				
White	15 (93.7%)	14 (93.3%)	11 (68.8%)	NS
Hispanic	1 (6.3%)	1 (6.7%)	3 (18.8%)	
African American	—	—	2 (12.4%)	
m-MMSE (0–57)	35.9 (9.3)	40.8 (11.2)	35.7 (9.4)	NS
CDR (CDR1: CDR2)	13:3	13:2	13:3	NS

Values are expressed as mean (SD), unless otherwise indicated.

One-way ANOVA with Tukey's later, except for Gender, CDR, and Ethnicity (χ^2 test). AD, Alzheimer's disease; DLB, Dementia with Lewy bodies; CDR, Clinical Dementia Rating; PD-d, Parkinson's disease and dementia; mMMSE, modified Mini-Mental State Examination; NS, not significant; ANOVA, analysis of variance.

TABLE 2. Clinical data

	DLB (n = 16)	PD-d (n = 15)	AD (n = 16)	P
Duration of dementia (mo.), mean (SD)	35.25 (23.88)	31.6 (21.2)	30.75 (17.91)	NS
Duration of parkinsonism (mo.), mean (SD)	17.87 (22.23)	64.4 (34.2)	—	<0.001
First symptom, n (%)				
Cognitive	5 (31.3%)	0	15 (93.8%)	<0.001
Psychoses	1 (6.3%)	0	0	
EPS	0	15 (100%)	0	
Cognitive + EPS	4 (25%)	0	0	
Cognitive + psychoses	5 (31.3%)	0	1 (6.3%)	
Cognitive + psychoses + EPS	1 (6.5%)	0	0	
Psychotic symptoms at intake, n (%)				
Delusions	11 (68.8%)	1 (6.7%)	3 (18.8%)	<0.001
Hallucinations	14 (87.5%)	3 (20%)	0	<0.001
Both	9 (56.3%)	0	0	<0.001
First cognitive complaint, n (%)				
Memory change	15 (93.8%)	10 (66.7%)	16 (100%)	NS
Other	1 (6.3%)	5 (33.3%)	0	
Treatment, n (%)				
Levodopa	4 (25%)	9 (60%)	—	<0.001
ACE inhibitors	2 (12.5%)	2 (13.3%)	1 (6.3%)	NS

χ^2 test (Fisher's test) and one-way ANOVA with Tukey's for duration of dementia and parkinsonism). ACE inhibitors, cholinesterase inhibitor; EPS, extrapyramidal symptoms; DLB, dementia with Lewy bodies; PD-d, Parkinson's disease and dementia; AD, Alzheimer's disease; NS, not significant.

patient presented with "disorientation" as the first cognitive complaint (see Table 2). Similar to that in the DLB group, "memory changes" were considered the first cognitive deficit in all the patients with AD and all but 5 from the PD-d group (2 patients with "performance changes," 1 patient with "language difficulties," and 2 patients with "disorientation"; $\chi^2 = 12.5$, $P < 0.25$).

Psychiatric Symptoms.

At the time of their first visit, all the patients with DLB had psychiatric symptoms. Fourteen patients had hallucinations (visual in 13 and visual-auditory hallucinations in one). Of these 14 patients, 9 also had delusions, usually of paranoid content, while 2 more presented delusions in the absence of clear hallucinations (see Table 2).

Only 3 patients in the AD group and 1 patient in the PD-d group presented delusions, usually paranoid, at the time of their intake ($\chi^2 = 15.6$, $P < 0.01$). Also, 3 PD-d patients reported sporadic visual hallucinations. None of the subjects in these groups had both delusions and hallucinations, compared with 9 of the 16 (56.3%) patients with DLB who had both ($\chi^2 = 21.5$, $P < 0.01$).

Parkinsonism.

All but 2 patients in the DLB group had parkinsonism at the time of their intake. There were no significant differences between DLB and PD-d patients in the mean mUPDRS score (9.7 ± 6 and 12.7 ± 5.3 , respectively) nor in the proportion of patients who presented with

tremor, rigidity, bradykinesia, axial symptoms, hypomimia, or hypophonia (see Table 3).

Treatment.

Motor scores should be interpreted carefully, because 4 patients with DLB and 9 patients of the PD-d group were receiving levodopa treatment ($\chi^2 = 14$, $P < 0.01$). Finally, there were no significant differences in the proportion of patients with DLB, AD, or PD-d on cholinesterase inhibitor medication (12.5%, 6.3%, and 13.3%, respectively; see Table 2). Three PD subjects were treated with antidepressants. No other psychotropic medication was used before inclusion. No other psychotropic drugs were used.

Neuropsychological Findings

The mean test scores achieved by the three groups of patients are presented in Table 4. Although the three groups were matched for overall severity of dementia, their patterns of performance on the neuropsychological tests differed.

AD vs. DLB.

In general, the patients with AD were more impaired than the DLB group on verbal memory tasks. Although there was no significant difference in the immediate total recall score of the Selective Reminding Test (measure of encoding/acquisition), the AD group scored significantly lower than the DLB group on the delayed recall ($F = 5.3$,

TABLE 3. *Extrapyramidal features (mean and SD) noted at the time of examination*

	DLB (n = 16)	PD-d (n = 15)	P value
Total mUPDRS (range), 0–44	9.7 (6)	12.7 (5.3)	NS
Speech (range), 0–4	.75 (.93)	.73 (.7)	NS
Patients affected, n (%)	8 (50%)	9 (60%)	NS
Facial expression (range), 0–4	.87 (.81)	1.4 (.83)	NS
Patients affected, n (%)	10 (62.5%)	13 (86.7%)	NS
Tremor at rest (range), 0–4	.75 (.86)	.87 (.9)	NS
Patients affected, n (%)	8 (50%)	8 (53.3%)	NS
Rigidity (range), 0–20	4 (3.12)	5.4 (3.3)	NS
Patients affected, n (%)	14 (87.5%)	13 (86.7%)	NS
Bradykinesia (range), 0–4	1.3 (1)	1.53 (.92)	NS
Patients affected, n (%)	12 (75%)	13 (86.7%)	NS
Axial (range), 0–8	2 (1.3)	2.7 (1.2)	NS
Patients affected, n (%)	12 (75%)	15 (100%)	NS

χ^2 test (Fisher's exact test when necessary) and Student's *t* test in all comparisons. DLB, dementia with Lewy bodies; mUPDRS, modified version of the Unified Parkinson's Disease Rating Scale; NS, not significant; PD-d, Parkinson disease and dementia.

$P < 0.01$) and delayed recognition (measure of retention/forgetfulness; $F = 6.1$, $P < 0.01$).

Conversely, the DLB subjects exhibited a greater degree of visuoperceptual, visual memory, constructional, and attentional impairment than the AD. The DLB group performed significantly worse than the AD patients on the matching ($F = 3.6$, $P < 0.05$) and recognition ($F = 3.8$, $P < 0.05$) subtests of the Benton Visual Retention Test and on the Rosen Drawing Test ($F = 3.9$, $P < 0.05$). Patients with DLB performed significantly slower than AD-P on

both (Shape and TMX) forms of the Cancellation Test ($F = 4.5$ and 5.6 , $P < 0.05$ and $P < 0.01$, respectively) and showed a greater number of omission errors on the Shape version of this test ($F = 3.4$, $P < 0.05$).

The DLB and AD groups exhibited similar degrees of language impairment on the naming, comprehension, and repetition subtests of the Boston Diagnostic Aphasia Examination as well as on verbal fluency tasks. These two groups were also equally impaired on the Orientation subtest of the mMMSE, the Similarities subtest of

TABLE 4. *Neuropsychological data (mean and SD)*

Test (range)	DLB (n = 16)	PD-d (n = 15)	AD (n = 16)	ANOVA
SRT Total recall (0–72)	19.25 (7.9)	20 (11.1)	17.62 (7.1)	NS
SRT Delayed recall (0–12)	1.63 (1.7) ^{a,*}	1.47 (1.6) ^{a,*}	.19 (4)	$P < 0.01$
SRT Recognition (0–12)	8.13 (2.75) ^{a,*}	8.3 (3.3) ^{a,*}	5 (2.9)	$P < 0.01$
BVRT Matching (0–10)	6.27 (3.4) ^{a,*}	6.7 (2.9)	8.7 (1.6)	$P < 0.05$
BVRT Recognition (0–10)	4.27 (2.6) ^{a,*}	4.87 (2.3)	6.6 (2.4)	$P < 0.05$
MMSE Orientation (0–10)	5.88 (2.9)	7.3 (2.6)	5.8 (2.6)	NS
WAIS-R Similarities (0–28)	8.6 (7.8)	10.9 (6.7)	8.8 (5.7)	NS
Identities and Oddities (0–18)	13 (2.9)	12.7 (2.7)	14.6 (1.2)	NS
Boston Naming Test (0–15)	11.6 (4)	11.3 (3.5)	10.9 (4.5)	NS
Letter fluency (≥ 0)	5.3 (4.4)	5.9 (4.6)	7.8 (2.6)	NS
Category fluency (≥ 0)	8.6 (3.9)	7.5 (4.5)	9.2 (4.5)	NS
BDAE Repetition (0–8)	6.9 (1.5)	6.7 (1.6)	7.2 (1.4)	NS
BDAE Comprehension (0–6)	3.9 (1.8)	3.9 (2.2)	4.4 (1.4)	NS
Rosen Drawing Test (0–5)	1.7 (1) ^{a,*}	2.7 (1.1)	2.9 (1.4)	$P < 0.05$
Cancellation Shape time	149.1 (77.3) ^{a,*}	146 (64) ^{a,*}	89 (43)	$P < 0.05$
Cancellation Shape omits	10.6 (6) ^{a,*}	7 (4.8)	5.6 (5)	$P < 0.05$
Cancellation Shape commits	8.2 (13.2)	6.62 (16.8)	.5 (9)	NS
Cancellation TMX time	166.6 (67.7) ^{a,**}	139.9 (62.7)	97.6 (38.2)	$P < 0.01$
Cancellation TMX omits	5.5 (5.6)	3.15 (4.2)	3.2 (5.3)	NS
Cancellation TMX commits	1.5 (1.7)	.15 (.4) ^{a,*}	3.2 (5.2)	$P = 0.05$

^aStatistical differences versus AD (Tukey's test): * $P < 0.05$; ** $P < 0.01$.

DLB, dementia with Lewy bodies; PD-d, Parkinson's disease and dementia; AD, Alzheimer's disease; ANOVA, analysis of variance; BVRT, Benton Visual Retention Test; BDAE, Boston Diagnostic Aphasia Examination; SRT, Selective Reminding Test; NS, not significant; MMSE, Mini-Mental State Examination; WAIS-R, Wechsler Adult Intelligence Scale, Revised.

the WAIS-R, and the Identities and Oddities of the Mattis Dementia Rating Scale.

PD-d versus AD.

Similar to previous comparisons, the patients with AD were more impaired than the PD-d group on verbal memory tasks. The AD group scored significantly lower than the PD-d group on the delayed recall ($F = 5.3, P < 0.01$) and delayed recognition ($F = 6.1, P < 0.01$) components of this test. Patients with PD-d performed significantly slower than AD on Shape form of the Cancellation Test ($F = 4.5, P < 0.05$) and showed a lower number of omission errors on the TMX version of this test ($F = 3.4, P < 0.05$).

PD-d versus DLB.

No significant differences were found when comparing the performance of the PD-d group on any neuropsychological test with the DLB group. There was no significant correlation between the total mUPDRS score in the three groups and their performance on the Rosen Drawing Test ($r = -0.07, P = 0.6$). However, a low but significant correlation was found between total mUPDRS and TMX time cancellation tasks ($r = 0.35, P = 0.017$) or Shape time cancellation task ($r = 0.34, P = 0.02$).

DISCUSSION

Our findings are consistent with previous studies that compared neuropsychological performance of patients with either clinically or pathologically DLB to those with AD.¹⁰⁻¹⁹ The patients with DLB scored better on verbal memory tests, and worse on attentional, visuo-perceptual, visuoconstructive, and visual memory tests. The group differences were noted in this study even though these groups were matched on age, global severity of dementia (CDR), and were also comparable in all other clinical and demographical variables. Previous neuropsychological studies have shown that moderately DLB-demented patients perform similar or slightly better on memory tests than AD subjects^{11,13,17-19} but show more severe deficits on tests of visual tracking and visual attention shifting,^{14,18} visuo-perceptual integration,³⁹ and visuospatial praxis.^{14,16,18,19,40}

Of interest, PD-d patients showed better memory function and worse attentional resources than AD patients, but no other significant differences emerge on comparison. Previous studies comparing demented PD patients to AD subjects have shown that the former perform worse on verbal fluency tasks, have a more rapid decline in naming, show better recognition memory (despite

equally impaired recall), and show a slower rate of forgetting from immediate to delayed recall.^{5,6}

No significant differences were found when comparing the performance of the PD-d group on any neuropsychological test with the DLB group. Two previous studies have established a direct comparison of cognitive function in PD and DLB. Gnanalingham and colleagues¹⁵ found a greater dysfunction on attention, verbal fluency, motor sequencing tasks and visuoconstructive tests in DLB. However, that study included only nondemented PD patients and, thus, did not compare the two dementia syndromes. Downes and coworkers²⁰ compared the neuropsychological performance of 10 patients with DLB to 10 patients with early-PD and 10 patients with advanced PD. DLB patients showed executive deficits compared to advanced PD even though these groups were matched in terms of global intellectual deterioration. However, it is not clearly defined in the study if all advanced PD patients were demented. In fact, verbal WAIS-II IQ was definitely normal in this group of patients, and a lower MMSE cut off score of 16 was used to exclude severely demented patients.

The distinctive patterns of neuropsychological impairment in these diseases probably represent a different distribution of pathological changes. The neuropathological substrate of AD affects preferentially the entorhinal cortex and the neocortical association areas, which explains the preferential dysfunction with encoding and storing information. On the other hand, the neuropathological basis of Lewy body dementia includes neuronal loss and the presence of Lewy bodies in subcortical nucleus, and frontal, temporal, and parietal lobes, which explains the predominantly attentional, executive, and visuospatial dysfunction found in this disease.⁴¹

Despite differences, AD, DLB, and PD-d patients shared similar deficits on encoding/acquisition, orientation, naming, verbal fluency, language comprehension and repetition, and verbal-visual reasoning. This "neuropsychological overlapping" might be due to methodological factors such as the advanced stage of the disease in some of our patients, the reduced samples size, or the characteristics of the neuropsychological battery. Our battery was used as a screening tool to detect "global cognitive deficits" so it could be of limited value to detect differences between entities with prominent executive difficulties such as PD and DLB. Other nongraphomotor executive tests would be more sensitive to detect changes in those cases. Another possibility for cognitive overlap might be the logical consequence of the neuropathological overlap between these three entities. The neuropathological evaluation of cases with impaired cognition associated with parkinsonism has frequently re-

vealed a degeneration of multiple cortico-subcortical neuronal systems within the presence of cortical Alzheimer and Lewy body pathological conditions.^{7,13,42,43} The conclusion of this nosological puzzle is that dementia in parkinsonism, or parkinsonism in dementia, may be the expression of different and individual combinations of lesions, including degeneration of subcortical ascending systems associated with neuronal loss and synapse destruction caused by Alzheimer and Lewy body pathological conditions.

Parkinsonism is a recognized feature of DLB, although its prevalence is controversial.^{15,42-44} In this study, parkinsonism was reported in 6 (37.5%) patients with DLB at presentation and in 8 (50%) more patients with the evolution of the disease. In accordance with previous studies, rigidity, bradykinesia, and axial symptoms are commonly found in DLB and are present with approximately the same frequency as in PD.^{15,42-44} Also, we did not find differences in the percentage of DLB or PD-d patients presenting with rest tremor (50% and 53%, respectively). Prevalence of rest tremor in DLB is not clear, with percentages ranging from 47% to 87%. Louis and associates⁴³ found that rest tremor was more common in PD (85%) than DLB (55%). Conversely, Gnanalingham and colleagues¹⁵ did not find differences in the percentage of PD and DLB patients presenting with rest tremor (82% vs. 67%, respectively). Differences in findings may be explained by different stages of the disease examined. None of the PD patients assessed in the study by Gnanalingham and coworkers¹⁵ and only 6 of the 34 PD patients assessed in the study by Louis and associates⁴³ were demented, and it is commonly accepted that the proportion of PD patients who have rest tremor may decrease if only PD-demented patients are included, because their parkinsonism is more likely to consist of rigidity, bradykinesia, and postural instability instead of tremor.^{2,45,46}

DLB and PD-d patients may be related by the presence of motor disabilities. In fact, a significant correlation was found between scores on time cancellation tests and the total mUPDRS score in DLB and PD-d patients. However, DLB patients performed poorly not only in the timed aspect of the tasks but also had increased omission errors, which probably reflects a difficulty in processing visuospatial information. Our results are in agreement with previous reports showing similar deficits in DLB compared with AD patients after controlling for the severity of motor symptoms.¹⁵

Some limitations of our study should be pointed out. At the time of writing, we have histopathological confirmation of DLB in only one case. We took care to avoid misdiagnosis with PD by including only DLB patients

with a "probable" diagnosis according to Consensus Criteria and with onset of dementia at least 1 year before parkinsonism.³ To avoid misdiagnosis with AD, we include for comparison only cases with AD in the absence of parkinsonism. Also, The sample size was relatively small, which limits our power to detect group differences. However, most previous published studies included a similar number of patients, most of them were not one-to-one matched, and none of them consider PD-d patients as an independent group. We used DSM-IV criteria for the diagnosis of dementia in PD. Limitations of using DSM-IV criteria in the diagnosis of PD dementia are well known. As recent publications demonstrate, it still remains useful, especially in large study populations.^{2,45,46} Finally, our subject pool was assembled in an institution specializing in dementia, which may show bias against including DLB cases that present initially with motor features.

In summary, although we were unable to detect cognitive differences between DLB and PD-d, our data confirm the different clinical and neuropsychological profile of AD compared to PD-d and DLB subjects. Further studies comparing DLB and AD patients with and without parkinsonism, to PD patients with and without dementia are needed. The diagnostic utility of the clinical and neuropsychological patterns noted here must be validated in future studies that include larger samples of autopsy-verified patients.

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