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Correlations of apathy and depression with postural instability in Parkinson disease

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ABSTRACT

Background: Postural instability (PI) in Parkinson's disease (PD) is associated with depression and apathy based on UPDRS scores. We sought to examine the link using more objective PI measures.
Methods: Demographic, clinical, depression and apathy data were recorded for PD patients prospectively recruited from an outpatient university movement disorders clinic. PI was objectively evaluated using the standing center of pressure sway area.
Results: Thirty-seven PD patients participated in the study. Bivariate analysis revealed that PI was significantly correlated to both apathy ($p = 0.018$) and depression ($p = 0.014$). Hierarchical regression revealed that apathy significantly predicted PI but depression did not significantly add to the prediction. Also, depression did not significantly predict PI and the addition of apathy did not increase this prediction.
Conclusion: Apathy and depression are both associated with objective measures of PI, and apathy appears a stronger predictor of PI than depression. Concomitant improvement in PI may be important to consider when measuring apathy or depression interventions in PD.

1. Introduction

Parkinson's disease (PD) is characterized by both non-motor and motor features which impact quality of life [1–3]. The non-motor symptoms of apathy and depression have been associated with the cardinal motor finding of postural instability (PI) [4]. Apathy is defined as a deficit of motivation, goal-directed behavior, and emotion [5]. It is a distinct entity to depression, reliably distinguished by validated scales [6,7]. Prior studies have utilized the simple UPDRS motor subscale axial items to assess the presence of PI in apathetic and depressed PD patients [7–9]. Objective laboratory measures of PI have not been employed despite their validated use in PD populations [10,11]. This study sought to confirm and to better characterize the relationship between PI, depression and apathy in PD through the use of objective laboratory measures of PI.

2. Methods

2.1. Patients

PD patients with and without apathy were recruited from our Movement Disorders Center to participate in two separate prospective intervention studies aimed at improving apathy ($n = 17$) or postural control ($n = 20$). All subjects provided written informed consent, and the studies were approved by the Institution Review Board. This is a post-hoc analysis, and the data presented here are from the baseline evaluations of these studies. Inclusion criteria for both studies were: patients with PD confirmed by a movement disorder neurologist and aged 30 or older. Exclusion criteria were: atypical parkinsonism or other neurodegenerative diseases; brain insult including stroke, mass lesions or major head trauma; prior deep brain stimulation or other brain surgeries; dementia based on the Mini-Mental State Examination (MMSE) score ≤26 and the Dementia Rating Scale (DRS) score ≤130; or unstable medical illnesses.

Demographic variables obtained included: gender, age, PD duration, and UPDRS motor subscale scores. Apathy was measured using the Starkstein Apathy Scale (AS), a modification of the Marin Apathy Scale [7]. This is a validated measure for apathy in the PD population. In general, an AS score of >14 represents significant apathy symptoms.

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Depressive symptoms were evaluated using the Beck Depression Inventory I or -II (BDI) [12] one of the most commonly used screening scales for depression in PD. In general, patients with a BDI score of ≥14 represent significant depressive symptoms. The BDI contains four items that relate to apathy, and this was not corrected for.

2.2. Postural instability assessment

Ground reaction forces were recorded (360 Hz) from two force platforms (type 4060-10, Bertec Corp., Columbus, OH) embedded level with the floor. During three quiet stance trials, participants stood still for 20 s with their feet in a self-selected, comfortable stance width with one foot on each platform. Patients were tested in a levodopa on-state. Ground reaction forces and moments from the two force platforms were used to calculate the location of the net center of pressure (COP). The net COP displacement is reflective of the output of the central nervous system as it attempts to manage the body position to keep the center of mass within the base of support. COP sway area (cm^2) was then calculated as the product of the maximum displacement in the mediolateral and anteroposterior directions.

2.3. Statistical analysis

Standard descriptive statistics were used (mean, standard deviation) to describe our cohort. The primary response variable in this analysis was the mean sway area. Using Spearman's correlation we evaluated the measures of apathy and depression (AS and BDI-II) to the mean sway area. Using two-sided *t*-test, we compared the demographic characteristics and AS, BDI, and PI scores between those with and without apathy and depression. Using chi square, categorical variables were compared between those with and without apathy and depression. We then explored the association of PI (using the mean sway area) with measures of depression and apathy using hierarchical regression models.

These models were used to determine how well apathy and depression could predict PI among PD. The collinearity statistics indicated a high tolerance value of 0.662 between depression and apathy predictors suggesting that both these scores were not covariates and could be used in the regression model. No other predictors were used in the model. The alpha-value was set at 0.05.

3. Results

Thirty-seven PD subjects (24 male; 65%) participated with a mean age of 67 ± 9 years and a mean disease duration of 95 ± 51 months (Table 1). They were median Hoehn and Yahr (H&Y) stage 2 (interquartile range 1). The mean apathy score was 15 ± 7 (range 5–29) (n = 36) and the mean depression score was BDI 12 ± 9 (range 0–34). Eleven of 37 (30%) PD patients had a BDI score >14, representing significant depression in our cohort, whereas a higher proportion, 23 of the 37 (62%) PD patients, had an AS score of >, representing significant apathy. The subjects with apathy had significantly greater mean UPDRS total scores (31.7 vs. 23.7, p = 0.012), similar UPDRS posture scores (0.7 vs. 0.9, p = 0.513) and greater mean BDI scores (15.1 vs. 7.6, p = 0.009) compared to the non-apathetic subjects. The subjects with significant depression had significantly greater mean UPDRS total scores (34.0 vs. 25.9, p = 0.022), lower mean UPDRS posture scores (0.2 vs. 1.0, p = 0.002), and greater mean AS scores (19.3 vs. 13.2, p = 0.010) compared to the subjects without significant depressive symptoms (Table 2).

The mean sway area was 4.2 (±2.7) cm^2. The mean sway area significantly correlated with AS score (rho = .393, p = 0.018) and BDI score (rho = .401, p = 0.014). The AS explained 12% of the variance (represented by R^2 in Table 3) in sway area [F(1,35) = 4.641; p = 0.038]. When BDI was added to the model, only an additional 2% of variance was explained [F(2,35) = 2.644; p = 0.086]. The BDI explained 10% of the variance in sway area [F(1,35) = 3.63; p = 0.065]. When AS was added to the model, only an additional 4% of variance was explained (Table 3).

Table 1
Demographic and clinical data for PD patients.

Variables	Patients (n = 37)
Age (years), mean (±SD; range)	67 (±9; 45–82)
Gender (male)	24 (65%)
Hoehn and Yahr (H&Y) stage[a], median (±interquartile range)	2 (±1)
Disease duration (months), mean (±SD, range)	95 (±51; 7–192)
UPDRS-III score[b], mean (±SD; range)	28 (±10; 13–52)
UPDRS posture subscore[b], mean (±SD; range)	1 (±1; 0–3)
UPDRS gait subscore, mean (±SD; range)	1 (±1; 0–3)
UPDRS balance subscore, mean (±SD; range)	1 (±1; 0–2)
Apathy scale, mean (±SD; range)	15 (±7; 5–29)
BDI score, mean (±SD; range)	12 (±9; 0–34)

[a] Data for 32 subjects.
[b] Data for 36 subjects.

4. Discussion

This study showed that objective measurements of PI significantly correlated with either apathy or depression in our PD cohort. This confirms previous observations which utilized only UPDRS motor subscores as an indirect measure of PI [4,6,8]. Importantly, objective PI measures were more reliable than UPDRS subscores in our study. The apathy and non-apathy groups had similar UPDRS subscores, while the depressed group appeared to have better stability than non-depressed subjects using UPDRS subscores.

Notably, the frequencies of apathy and depression in patients in this cohort were representative of those found in other populations of PD patients [6,9]. Apathy and depression may occur individually or co-exist in PD patients, similar to our cohort [13]. Apathetic or depressed PD patients appeared more parkinsonian, by approximately 8 or 9 points on the UPDRS scale, in our study. In depressed patients, this observation has been previously explained by the overlap of physical embodiment of mood disturbance with parkinsonian signs. Apathetic patients are not considered to have more severe parkinsonism, apart from correlations found in one study, and may relate to coexistent depression [8,14].

Table 2
Mean (SD) and statistical comparisons between the two groups differentiated by AS scores and BDI scores.

	Group 1	n	Group 2	n	t-Statistic	p
	AS > 14		AS ≤ 14			
Age (years)	68.6 (8.3)	20	63.2 (9.0)	16	1.86	0.071
Disease duration (months)	97.1 (45.5)	20	96.3 (57.7)	16	0.04	0.966
UPDRS						
Total	*31.7 (8.8)*	*20*	*23.7 (8.9)*	*15*	*2.65*	0.012*
Posture	0.7 (0.8)	20	0.9 (0.6)	15	−0.66	0.513
Gait	0.8 (0.6)	20	0.6 (0.8)	16	1.00	0.326
Balance	0.7 (0.7)	20	0.6 (0.8)	16	0.10	0.924
H&Y score[a]	2.4 (0.5)	19	2.4 (0.6)	12	−0.11	0.914
BDI	*15.1 (9.7)*	*20*	*7.6 (6.4)*	*16*	*2.77*	0.009*
	BDI ≥ 14		BDI < 14			
Age (years)	68.8 (8.1)	10	65.7 (9.4)	27	0.92	0.362
Disease duration (months)	95.5 (37.7)	10	94.5 (55.9)	27	0.05	0.960
UPDRS						
Total	*34.0 (8.6)*	*10*	*25.9 (8.9)*	*26*	*2.47*	0.019*
Posture	*0.2 (0.4)*	*10*	*1.0 (0.7)*	*26*	*−3.44*	0.002*
Gait	0.9 (0.9)	10	0.6 (0.6)	27	1.18	0.247
Balance	0.9 (0.9)	10	0.5 (0.7)	27	1.38	0.178
H&Y score[a]	2.6 (0.6)	10	2.3 (0.5)	22	1.14	0.262
AS score	*19.3 (5.5)*	*10*	*13.2 (6.1)*	*26*	*2.75*	0.010*

[a] H&Y reported as median (interquartile range).
* significant correlation (p ≤ 0.05).