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Falls in outpatients with Parkinson's disease

Frequency, impact and identifying factors

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Abstract Falls are one of the most serious complications of gait disturbances in patients with Parkinson's disease (PD). Among previous reports, the percentage of patients with PD who fall varies between 38 % to 68 %. We sought to determine the frequency of falls and the factors associated with falls in a group of patients with idiopathic PD who attended an outpatient, tertiary movement disorders clinic. 350 ambulatory, non-demented patients (230 males) were studied. Mean age was 69.7 ± 10.6 years (range: 43–97 yrs) and mean duration of PD symptoms was 8.6 ± 6.2 years (range: 1–33 yrs). Assessments included characterization of demographics, disease duration, disease severity as measured by the Hoehn and Yahr Scale (H&Y), co-morbidities, the presence of depressive symptoms, the presence of urinary incontinence, use of anti-parkinsonian medications, and two performance-based tests of balance and gait (tandem standing and Timed Up & Go). Fall history was determined during three time periods: previous week, previous month, and previous year. Univariate and multivariate logistic regression models were applied to evaluate the relationship between the above-mentioned factors and falls. 46 % of the subjects reported at least one fall in the previous year and 33 % reported 2 or more falls and were classified as Fallers. Fallers had significantly more prolonged and advanced PD compared with Non-fallers ($p = 0.001$ and $p < 0.001$, respectively). Urinary incontinence was the factor most closely associated with falls (crude and adjusted OR were 1.95 and 5.89, respectively). Other factors significantly associated with fall status included increased Timed Up & Go times and increased PD duration. These findings confirm that falls are a common problem among patients with advanced PD and suggest easily measurable features that may be used to prospectively identify those PD patients with the greatest risk of falls.

Key words Parkinson's disease · gait disorders · falls · urinary incontinence

Introduction

Falls are one of the most serious complications of gait disturbances in Parkinson's disease (PD). Together with other cardinal neurological signs of PD, falls may be viewed as a characteristic feature of PD progression, likely the result of decompensated postural instability and gait dysrhythmicity that occurs after the development of continuous and episodic gait disorders [7]. Falls

are a leading cause of physical trauma, fear of falls, restriction of day-to-day activity and nursing home admission in patients with PD [15]. Among previous reports, the percentage of patients with PD who fall varies between 38 % to 68 % [4, 17, 18, 25, 32]. The factors that identify those PD patients with an increased risk of falls also are not clearly understood [8]. We sought, therefore, to determine the frequency of falls and the factors associated with falls status in a relatively large group of patients with idiopathic PD.

Methods

Subjects

We studied 350 consecutive patients with idiopathic PD, as defined by the UK Brain Bank criteria [14], who attended the outpatient clinic of the Movement Disorders Unit of the Tel Aviv Sourasky Medical Center during a four-month period (July – November 2002). The local human studies committee approved the study and all patients provided written informed consent.

With the assistance of a medical secretary, a personal interview, chart review, and interview of family members and/or caregivers were used to obtain information regarding age, duration of PD, medical history, concomitant diseases, co-morbidities, any other relevant medical data, and medication usage. The following were considered as anti-parkinsonian medications: sinemet – levodopa/carbidopa 200/50, dopicar – levodopa/carbidopa 250/25, levopar – levodopa/benserazide 200/50, agonists of the dopamine receptors (pergolide, ropinirole), amantadine, selegiline and trihexiphenidyl. Certificated neurologists trained in movement disorders (Y.B and N.G) examined all of the patients, confirmed the diagnoses of idiopathic PD, and characterized the patients with respect to diagnosis and staging of PD according to the Hoehn and Yahr (H&Y) scale [18], without knowledge of falls status. Following the clinical interview, cognitive function was evaluated using DSM-IV criteria [2]. A focus was placed on peculiarities of dementia due to PD (e. g., cognitive and motor slowing, executive dysfunctions, and problems in words retrieval). Depression symptoms were examined using the short form of the Geriatric Depression Scale [22] and patients were asked to rate their general health state (as "excellent", "very good", "good", "moderate" or "poor"). Activities of daily living (ADL's) were assessed using the Barthel index [23]. Performance-based measures of balance and gait included testing of each subject's ability to stand in a tandem position for up to 30 seconds and the "Timed Up & Go" test, a gross measure of muscle strength and gait that has been strongly associated with falls in the general elderly population [27]. Among patients who experienced motor fluctuations, these tests were performed in an "ON" state.

Special attention was focused on signs of bladder dysfunction. Previous work has shown that urge incontinence is closely and independently associated with increased risk of falls in community dwelling older women [10], but the role of this factor in PD is largely unknown. "The Patient Assessment Tool – Urinary Function Assessment" for men [6] and "The Quality of Life and Symptoms Distress Inventory" for women [30] were used to diagnose urge incontinence (as opposed to stress incontinence).

Exclusion criteria included the diagnosis of dementia (as determined by DSM IV criteria), inability to stand and walk even with help, severe visual disturbances, vestibular disease, and clinically significant neuropathy or leg weakness.

Assessment of falls

A fall was defined as an unintentional change in position resulting in coming to rest on the ground or other lower level [1]. All patients were asked by a medical secretary to report the number of falls they experienced during three time periods: previous week, previous month, and previous year. A patient was classified as a "Faller" if he or she reported a history of two or more falls in any of the above-mentioned periods. Otherwise, the patient was classified as a "Non-Faller". A fall was classified as a "medically intervened fall" (MIF) if it was followed by a call to a doctor or a medical consult in the next few days. These falls were considered to be "injurious" if they caused bruises, skin lacerations, joint dislocations, bone fractures or brain concussion [8].

Statistics

Both univariate and multivariate logistic regression models were applied to evaluate predictors for falls and to estimate odds ratios (OR) and 95 % confidence intervals (CI). The multivariate model was based on those variables that were observed to be significant predictors of falls status in the univariate models. Statistical analyses were performed using SPSS 9.0 program.

Results

Study group

350 PD patients (230 males and 120 females), with a mean age 69.7 ± 10.6 years (range: 43–97 years) and duration of PD symptoms of 8.6 ± 6.2 years (range: 1–33 years) were studied. Average H&Y scale was 2.9 ± 1.1 during "OFF" and 2.4 ± 0.9 during "ON". Motor response fluctuations were experienced by 143 patients (40.9 %).

Number of falls and their impact

161 patients reported 626 falls during the previous year. 115 patients (32.9 %) reported recurrent falls (2 or more) and were classified as Fallers. 189 patients (54 %) reported no falls during the previous week, month or year. 46 participants (13.1 %) reported falling only once during the previous year. Thus, 235 patients (67.1 %) were classified as Non-Fallers.

Thirty-seven patients (10.6 %) reported a "medically intervened fall" (MIF's). Injurious MIF's included skin lacerations (n = 14, 4 %), bone fractures (n = 9, 2.6 %), two pelvic fractures (0.57 %), and a subdural hematoma (n = 1, 0.28 %).

Comparisons between Fallers and Non-Fallers Univariate analysis

Demographic and comorbities

The presence of urinary incontinence was a significant predictor of falls (p = 0.009) (see Table 1). Fallers also

Table 1 Demographic and clinical characteristics of Non-Fallers and Fallers among 350 PD patients[a]

Characteristic	Non-Fallers	Fallers	p-value	Crude Odds ratio	95% CI
Age (years)	69.2 ± 10.5 (n = 235)	70.9 ± 10.8 (n = 115)	0.102	1.02	0.99–1.04
Female gender	32.8% (n = 235)	37.4% (n = 115)	0.39	1.23	0.77–1.95
PD duration (years)	7.8 ± 5.4 (n = 235)	10.5 ± 7.3 (n = 115)	0.001	1.07	1.03–1.11
Presence of urge/urinary incontinence	19.6% (n = 235)	32.2% (n = 115)	0.009	1.95	1.17–3.23
Hypertension	35.7% (n = 235)	28.9% (n = 114)	0.21	0.73	0.45–1.19
Congestive heart failure	6.2% (n = 226)	5.3% (n = 113)	0.75	0.85	0.32–2.23
History of CABG*	7.8% (n = 231)	7.0% (n = 114)	0.79	0.89	0.38–2.11
History of myocardial infarction	10.3% (n = 233)	9.6% (n = 115)	0.85	0.93	0.44–1.97
Peripheral vascular disease	1.8% (n = 222)	1.9% (n = 105)	0.94	1.07	0.19–5.95
Diabetes mellitus	10.7% (n = 234)	8.9% (n = 112)	0.61	0.82	0.38–1.77
Chronic renal disease	2.6% (n = 231)	1.8% (n = 111)	0.64	0.68	0.14–3.42
History of stroke	4.7% (n = 234)	7.0% (n = 114)	0.38	1.52	0.54–3.90
Peripheral neuropathy	2.3% (n = 217)	1.9% (n = 105)	0.82	1.82	0.17–4.32
Osteoporosis	16.0% (n = 225)	18.7% (n = 107)	0.54	1.21	0.17–2.20

[a] Entries are mean ± SD or % of subjects within a given group
* *CABG* coronary artery bypass graft
** Recall that Non-Fallers were subjects reporting 0 or1 falls and Fallers reported 2 or more falls

had significantly longer PD duration ($p = 0.001$). No other predictors of falls were found with respect to demographic variables and co-morbidities.

Characteristics of PD

All PD associated clinical characteristics except for the presence of motor fluctuations were significantly different in Fallers and Non-Fallers (see Table 2). Fallers had more severe disease based on the H&Y scale ($p < 0.001$). Depressive symptoms, as measured by the GDS, were significantly more common in the Fallers ($p = 0.002$). Compared to Non-Fallers, Fallers more frequently rated their health as poor ($p = 0.002$) and had a lower Barthel index of activities of daily living ($p < 0.001$).

Anti-parkinsonian medications

Compared to Non-Fallers, Fallers were more frequently treated with l-dopa, pergolide, and amantadine ($p < 0.05$). Non-Fallers tended to be treated with selegiline more often than Fallers ($p < 0.05$). However, a comparison between Non-Fallers and Fallers, after adjusting for both H&Y staging and duration of PD symptoms, did not reveal any significant differences with respect to treatment by l-dopa, amantadine, pergolide or selegiline ($p > 0.05$). Similarly, the daily dosage of the above-mentioned medications was not associated with fall status.

Performance-based measures of balance and gait

All three measures of balance and gait were significantly different in Fallers and Non-Fallers (see Table 3). The ability to stand in a tandem stance and duration in this position was significantly reduced in Fallers ($p < 0.001$). Timed Up and Go times were significantly shorter in Non-Fallers ($p < 0.001$).

Table 2 PD severity, rating scales, disability level, and depressive symptoms in Non-Fallers and Fallers[a]

Characteristic	Non-Fallers	Fallers	p-value	Crude Odds ratio	95% CI
H&Y at OFF	2.7 ± 1.1 (n = 235)	3.4 ± 1.0 (n = 115)	< 0.001	1.88	1.49–2.37
H&Y at ON	2.2 ± 0.8 (n = 235)	2.8 ± 0.8 (n = 115)	< 0.001	2.28	1.71–3.04
Motor fluctuations	38.7% (n = 235)	43.5% (n = 115)	0.39	1.22	0.75–1.91
GDS score	9.4 ± 7.2 (n = 229)	12.0 ± 7.1 (n = 110)	0.002	1.05	1.02–1.08
Reported poor health	18.1% (n = 227)	29.2% (n = 106)	0.02	1.87	1.10–3.21
Barthel index of ADL	18.0 ± 3.6 (n = 231)	16.3 ± 4.5 (n = 114)	< 0.001	0.9	0.85–0.95

[a] Entries are mean ± SD or % of subjects within a given group
H&Y Hoehn and Yahr; *GDS* Geriatric depression scale; *ADL* Activities of daily living

Table 3 Performance-based measures of balance and gait in PD Non-Fallers and Fallers[a]

Characteristic	Non-Fallers	Fallers	p-value	Crude Odds ratio	95% CI
Ability to stand tandem for 30 sec	67.2% (n = 204)	37.8% (n = 90)	< 0.001	0.28	0.18–0.50
Mean duration of standing tandem (sec)	24.3 ± 8.9 (n = 118)	17.2 ± 10.3 (n = 31)	< 0.001	0.93	0.90–0.97
Timed Up & Go Test (sec)	11.2 ± 5.2 (n = 163)	16.8 ± 10.1 (n = 61)	< 0.001	1.11	1.06–1.16

[a] Entries are mean ± SD or % of subjects within a given group

Multivariate analysis

The results of multivariate analysis showed that urinary incontinence was the factor that most significantly predicted falls status. Its presence increased the probability being a Faller by nearly 6 times (adjusted OR = 5.9, 95% CI: 1.4–24.6). Slow performance on the Timed Up & Go test and longer duration of PD symptoms were also independent risk factors for being a Faller, but to a lesser degree (adjusted OR = 1.18 and 1.16, respectively; 95% CI: 1.03–1.63 and 1.04–1.29, respectively).

Discussion

In a population of 350 ambulatory PD patients, 161 patients reported experiencing 626 falls during a one-year period, while 115 patients reported recurrent falls. To our knowledge, this is the largest study examining fall frequency and the factors that identify PD fallers in the English literature. Based on the retrospective nature of this study, one may assume that the actual frequency of falls might be even higher than the percentage (46%) reported. In the healthy elderly population, studies suggest that about 13–32% falls are not reported [11]. Thus, it is possible that more than 60% of patients with advanced PD experience falls during a one-year period. Indeed, in smaller prospective studies, fall frequency was reported to be from 50.8% to 68.3% [5, 11, 14]. The large number of injurious falls, about 23% among all of the 161 patients who fell, is similar to that observed in other studies [5, 11]. In contrast to other reports [8, 25], however, serious trauma related to falls in the present study was higher than expected.

Based on selected neurological and physical findings, Fallers had more advanced disease than Non-fallers. This was reflected in scales of PD and measures of balance and gait. It follows, therefore, that Fallers were treated more frequently with dopaminergic drugs. This might lead to the impression that pharmacological treatment independently predisposes to falls. However, this impression is probably not accurate since there was no significant contribution of any drug to falls status after adjusting for disease state.

On the other hand, selegiline might have a protective effect on falls, as was observed in univariate analysis. Such an effect could be mediated through its influence on gait speed [19] and freezing of gait [8, 16, 29]. This possibility and the role of freezing of gait should be assessed in future studies. We anticipate that any effect of selegiline is likely to be relatively modest since in this study of 350 patients, its effect was only of borderline significance.

The present study clearly confirms previous investigations that suggest that fall frequency is strongly associated with PD progression [4, 17, 20, 25]. The association between disease progression and falls may be related to progressive loss of postural reflexes and increased postural instability [17]. Interestingly, in contrast to other studies [4, 32], the presence of motor fluctuations did not increase the likelihood of a patient being a Faller.

The main new finding of the present study is the association between urinary incontinence and falls status. This association is well recognized in the general geriatric, non-PD population. Previous studies have shown that urge incontinence is independently associated with an increased risk of falls (OR = 1.26; 95% CI: 1.14–1.40) and non-traumatic (osteoporotic) fractures in older women [9, 10], in community dwelling healthy older persons of both sexes [12, 24, 31], in older adults undergoing rehabilitation after hip fractures [26], and in institutionalized frail elderly [21]. Presence of osteoporosis emphasizes the importance of prevention and treatment of osteopenia in elderly PD patients since the improvement of bone mineral density could reduce hip and other non-vertebral fractures [28]. Similarly, in a large community based study, patients with overactive bladder symptoms were more than twice as likely to be injured as a result of a fall compared with healthy people (OR = 2.26; 95% CI, 1.46–3.51) [31].

Previous studies have shown that detrusor overactivity accounts for 70–88% of urge incontinence in patients with PD [3, 13]. These results support the role of dopaminergic depletion in the pathogenesis of urinary bladder hyper-reflexia and perhaps in falls. To our knowledge, the present study is the first investigation to associate overactive bladder syndrome and falls in patients with PD.

One possible explanation of the association between urinary incontinence and falls is through dysautonomia and orthostatic hypotension, which might lead to falls. However, in the present study we did not evaluate orthostatic hypotension. Future investigations should be aware of the possible contribution of autonomic dysfunction to fall risk in PD.

The present study has a number of limitations. Falls status was retrospectively determined by self-report of the patients, their families and/or caregivers. Thus, the actual fall rate may even be higher than that reported [11]. Because of the retrospective nature of the study, we could not evaluate the influence of fall history on future falls. Fall history may be an important independent predictor of future falls in PD, as it is in other populations. Prospective studies are needed to answer this question, to test which of the measures found to identify Fallers in the present retrospective study are also predictive of fall status, and to better understand the relationship between falls and incontinence in PD. The subdivision of patients into Fallers (two and more) and Non-Fallers (no falls at all, or single fall) is somewhat arbitrary. In addition, our study sample probably has the bias of an outpatient clinic specializing in movement disorders.

In conclusion, we observed that falls are quite frequent among patients with PD and that they are associated with impairment and disability. More than 50 % of PD patients fall at least twice in a given year and 1/5 of these patients experience trauma including bone fractures and intracranial hematomas as a result of a fall. In general, Fallers have more prolonged and advanced PD. They may also be more depressed, have poorer general health and have deficits in their ability to perform activities of daily living, and gait and balance. Finally, the present findings suggest that urinary incontinence may be a powerful measure that can be used to identify patients with the greatest risk of falls.

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