ELSEVIER

Parkinsonism and Related Disorders 6 (2000) 165–170

Parkinsonism & Related Disorders

www.elsevier.com/locate/parkreldis

Construction of freezing of gait questionnaire for patients with Parkinsonism

N. Giladi[a,*], H. Shabtai[a], E.S. Simon[a], S. Biran[b], J. Tal[c], A.D. Korczyn[a]

[a]*Movement Disorders Unit, Department of Neurology, Tel-Aviv Sourasky Medical Center, Sackler School of Medicine, Tel Aviv University, Tel Aviv, Israel*
[b]*TechnoStat Ltd, 14 Habanim St., Hod Hasharon, Israel*
[c]*The Technion, Israel Institute of Technology, Haifa, Israel*

Received 30 September 1999; received in revised form 5 December 1999; accepted 17 December 1999

Abstract

Background: Freezing of gait (FOG) is a common, poorly understood, parkinsonian symptom interfering with daily functioning and quality of life. Assessment of FOG is complex because of the episodic nature of this symptom, and the influence of mental and environmental factors on it.

Objective: To design a self-reportable reliable questionnaire for FOG.

Method: A questionnaire consisting of 16 items regarding gait and falls was administered together with the Unified Parkinson's Disease Rating Scale (UPDRS) to 40 Parkinson's disease (PD) patients (26 males) with a mean age of 72.3 ± 9.3 years and mean Hoehn and Yahr (H&Y) stage at "Off" of 2.85 ± 0.84. A principal component analysis with Varimax rotation was conducted on the results. Item analyses were performed and reliability computed for an abbreviated FOG questionnaire.

Results: Based on these analyses, a short (six item) FOG questionnaire was constructed, which was found to be highly reliable (Cronbach alpha = 0.94) for assessment of FOG and with moderate correlation with the activity of daily living (ADL) and motor parts of the UPDRS (0.43 and 0.40, respectively). Moderate correlation was also found with the FOG item at the ADL part of the UPDRS (alpha = 0.66 for the "Off" and 0.77 for the "On" state).

Conclusion: The FOG questionnaire that was constructed is highly reliable in assessing freezing of gait, unrelated to falls, in patients with PD.

Keywords: Parkinson's disease; Freezing of gait; Scale; Questionnaire

1. Introduction

Freezing of gait (FOG) is a prevalent and disabling symptom in Parkinson's disease (PD) [1] and may be even more common in other parkinsonian syndromes [2]. Assessing FOG is difficult due to the great variability of its manifestations within each patient. This variability is the result of FOG being affected by numerous parameters including: severity of the disease and the motor state ("On"/"Off"), visual input, tight alleys, response to variable tricks, and relation to specific gait patterns such as gait initiation or turns, cognitive factors such as attention, anxiety and stress [3]. Seventy five percent of PD patients suffering from FOG reported that this problem is most disturbing at home or out of the neurologist's office [4]. The poor correlation of reported FOG with observed FOG during the exam conducted in the office makes it impractical to assess this symptom observationally. Only extended periods of observation, in a variety of daily activities, can provide a reliable assessment of FOG. Consequently, researchers have little choice but to rely on patients' self-reports for quantification of FOG.

To date, a number of different scales have been developed to assess FOG [5,6]. However, the adequacy of these scales in terms of reliability and validity has never been demonstrated. The Unified Parkinson's Disease Rating Scale (UPDRS), which is the most commonly used scale for assessing parkinsonian severity [7], contains only two items relating to FOG. One of these, appearing in the ADL section of the scale, evaluates FOG by asking the patient, relating FOG severity to the appearance of falls. The other item assesses gait objectively on exam.

* Corresponding author. Tel.: + 972-3-697-4912; fax: + 972-3-697-4911.

E-mail address: ngiladi@tasmc.health.gov.il (N. Giladi).

1353-8020/00/$ - see front matter
PII: S1353-8020(99)00062-0

Because of the repercussions of FOG on patients' function and quality of life it is important to assess this symptom more comprehensively. Therefore, we set out to construct Gait and Falls Questionnaire that will be both reliable and comprehensive to assess gait symptoms and falls.

2. Subjects and method

We constructed a questionnaire containing 16 questions about gait and falls. This questionnaire was administered to 40 patients (26 males) with PD diagnosed according to the United Kingdom Brain Bank clinical criteria [8], being treated at the Movement Disorders Unit of the Tel Aviv Sourasky Medical Center in Israel. Patients with dementia according to DSM IV criteria were excluded. The mean age was 72.3 ± 9.3 years (mean ±SD; range: 44–87). Mean disease duration was 7.6 ± 6.3 years (range: 1–24) and mean Hoehn & Yahr (H&Y) [9] stage at the "off" state was 2.85 ± 0.84 (range: 1.5–5). The mean total UPDRS score at the best state was 54.7 ± 18.8 (range: 25–107) for the group of patients assessed.

Twenty-two patients experienced FOG, eight had motor fluctuations. Thirty-six patients were taking levodopa treatment while three patients had never been treated with any anti-parkinsonian medications.

2.1. Assessment measure

The detailed gait and falls questionnaire (see Appendix A) consisted of 16 items assessing the following areas:

1. gait in daily living;
2. frequency and severity of FOG;
3. frequency of festinating gait and its relation to falls;
4. frequency and severity of falls.

Responses to each item were on 5-point scales where a score of 0 indicated absence of the symptom, while 4 indicated the most severe stage. Thus, the information obtained from these items could be treated statistically as interval level data.

2.2. Assessment procedure

The gait and falls questionnaire, the four parts of the UPDRS and the H&Y staging were administered to each patient during a single session. The assessment was conducted by a movement disorders specialist, who asked the patients each question, ensuring that the subjects understood each item. We used the term "feet glued to the ground" to explain FOG (Appendix A, item 4) and "accelerated, short stepped gait" to clarify festination (item 15). Where required, the physician demonstrated freezing or festinating. The questionnaire and parts I, II and IV of the UPDRS were completed during the "On" or best state. Motor examination (part III of UPDRS) was always performed at "On" state, and for the eight patients who experienced motor fluctuations also during "Off" prior to their first morning dose.

2.3. Statistical analyses

2.3.1. Scale construction

A principal component analysis (PCA) with Varimax rotation was conducted on the 16 interval scale items of the gait and falls questionnaire. Item analyses were performed and reliabilities computed for the scale suggested by the principal component with the highest eigenvalue.

2.3.2. Relation between UPDRS and gait and falls questionnaire

The total score on the gait and falls questionnaire (GFQ) was correlated with UPDRS total score and relevant subscores. In addition, the GFQ was correlated with UPDRS items relating to freezing, gait and falling.

3. Results

3.1. Scale construction

A PCA of the 16 interval level items from the extended gait and falls questionnaire (Appendix A) revealed one large component consisting of 10 items (Appendix A—marked with asterisk) accounting for 58.6% of the variance. The remaining two components with eigenvalues over 1.0 accounted for very little variance relative to the first component (11.3 and 7.1%, respectively). In addition, the scales suggested by these two components correlated highly with that suggested by the first principal component. Consequently, only one questionnaire was constructed for assessing FOG.

Reliability and item analyses were computed on the 10 items whose highest loadings were on the first principal component. A Cronbach alpha reliability of 0.96 emerged, which is extremely high in the context of self-report measures. Item analyses indicated that exclusion of any one item from the questionnaire would not reduce alpha to below 0.96.

A scale consisting of six items was chosen based on statistical criteria (item–total correlations) and content (medical considerations) (Appendix A—marked by italics; Appendix B). The items chosen are all related to FOG and walking. We excluded all items related to falls and festination (unmarked items). Reliability analysis revealed this questionnaire to be highly reliable (Cronbach alpha = 0.94). Thus, by reducing the size of the extended GFQ by 10 questions, reliability was little affected. The scale consisting of these six items was chosen as the final FOG questionnaire (FOGQ) (Appendix B).

Table 1
Relationship between the FOGQ and UPDRS sub-scales and Hoehn &Yahr (UPDRS, Unified Parkinson's Disease Rating Scale; ADL, Activity of Daily Living; FOGQ, Freezing of gait Questionnaire)

	UPDRS: Total score	UPDRS: Mental	UPDRS: ADL	UPDRS: Motor	Hoehn &Yahr
Pearson correlation	0.48	0.05	0.43	0.40	0.66
Significance*	$p < 0.01$	$p = 0.08$	$p < 0.01$	$p < 0.01$	$p < 0.01$

* Significance was assessed by 2 tailed tests.

3.2. Relation between UPDRS and FOGQ

The total score on the FOGQ was correlated with UPDRS total score and relevant sub-scale scores. In addition, the FOGQ was correlated with UPDRS items relating to FOG and falling.

High FOGQ values were related to disease severity. As can be seen in Table 1, all but the UPDRS mental subscale show at least a moderate correlation with the FOGQ. The correlation between the FOGQ and H&Y staging was highest.

Table 2 presents correlations between the FOGQ and those items in the UPDRS that are assumed to be related to the freezing phenomenon in PD. Not surprisingly, the strongest relationship of the FOGQ was observed with the "Freezing of Gait" items ("On" and "Off") of the ADL part in the UPDRS. Moderate correlations were found with the "falling" and "walking" items in the ADL part, and with the "postural reflexes" item in the motor part of the UPDRS. We observed higher correlations between the FOGQ and the "falling", "walking", "postural reflexes" and "gait" items at "Off" than at "On" state. In contrast, the FOG item of the UPDRS had highest correlation with the FOGQ at "On" more than at "Off" state ($p < 0.001$).

The actual relationship between the UPDRS FOG item and the FOGQ scores is presented in Table 3. There was very good correlation between the two scales in the non-freezers and those with milder FOG. The nine cases who experienced falls in addition to FOG and as a result had three or four points on the UPDRS FOG item did not have a higher score on the FOGQ. This clearly demonstrates that the FOGQ assesses FOG severity unrelated to falls, in contrast to the UPDRS.

4. Discussion

FOG is a very disturbing and common symptom in parkinsonism with variable presentations [1,2]. The common observation that in most patients FOG is most severe out of the doctor's office or the gait lab makes it a difficult symptom to evaluate objectively [4,9]. FOG evaluation is complicated further by its episodic nature and the strong effect of behavioral factors as well as its response to "motor tricks" [10,11].

In the present study we have constructed and validated a new FOGQ. Taking into account the above dilemmas regarding FOG assessment we believe that this is the correct way to assess FOG. The FOGQ was found to be highly reliable assessing FOG with only moderate correlation with the UPDRS sub scales (ADL or motor) or related items.

Falls during a freezing episode may be a manifestation of the freezing episode, may be caused by a challenge to postural reflexes, or due to the exaggerated effort of the patient to overcome the freezing episode by making small rapid steps while standing on the toes, leaning forward. This common strategy might lead to festinating gait and falls due to inappropriate positioning of the center of gravity.

We chose to use a time scale as reflection of FOG severity where a freezing episode of 1–2 s in duration will be conceptualized as mild/not disturbing episode + 1/4. In contrast a freezing episode lasting more than 30 s will be understood by the patient as a very severe and disabling episode. From administering the questions to many patients prior to the performance of this study, we had good basis to believe that patients can differentiate between a very brief 1–2 s episode, a longer but still short 3–10 s, moderate in severity of 11–30 s and very unabling >30 s episode. We believe such a duration scale should not be taken literally, but as a subjective tool.

Our present study supports the clinical impression that falls are not necessarily a result of severe FOG but an associated symptom. We found no relationship between FOG or falling scores on gait and falls questionnaire, and only moderate correlation between FOGQ and falls-related items in the UPDRS. Therefore, we believe that FOG severity is assessed better by the FOGQ than by UPDRS-FOG item. It should be noted that the questions regarding festinating gait detracted from the original scale after applying the PCA and creating a shorter questionnaire with only 10 items. This can be interpreted as a poor relationship between FOG and festinating gait, despite the fact that they are two classic parkinsonian disturbances of gait locomotion. Taking this observation one step further, one can speculate that festinating gait and FOG have different pathophysiology.

In conclusion, we have constructed a reliable and simple to use questionnaire that assesses freezing of gait in parkinsonian patients, which can be used in future clinical trials of FOG assessment.

Table 2
Correlations between UPDRS items and the FOGQ in 40 patients with Parkinson's disease (ADL, Activity of Daily Living; UPDRS, Unified Parkinson's Disease Rating Scale; Postural, Postural reflexes; FOG, Freezing of Gait; FOGQ, Freezing of Gait Questionnaire)

UPDRS		ADL				MOTOR					
		Falling "On"	Falling "Off"	FOG "On"	FOG "Off"	Walking "On"	Walking "Off"	Postural "On"	Postural "Off"	Gait "On"	Gait "Off"
Pearson correlation	FOGQ	0.27	0.56	0.77	0.66	0.21	0.63	0.28	0.64	0.18	0.64
Significance (2-tailed p-value) $<$	FOGQ	0.09	0.001	0.001	0.001	0.20	0.001	0.08	0.001	0.25	0.001

Table 3
The relationships between the FOGQ and the FOG item on the ADL part of the UPDRS (FOG, Freezing of Gait), (FOGQ, Freezing of Gait Questionnaire), (UPDRS, Unified Parkinson's Disease Rating Scale), (ADL, Activity of Daily Living), (SD, Standard deviation)

UPDRS FOGG at best or "On" state	Mean FOGQ item score (mean ± SD)	Number of patients
0	0.94 ± 0.76	22
1	1.96 ± 0.58	4
2	3.30 ± 0.54	5
3	3.00 ± 0.52	5
4	3.00 ± 0.71	4
Total		40

Appendix A

A.1. Gait and Falls Questionnaire (GFQ) ([1], italics)

A.1.1. During your best state—do you walk:

0 Normally
1 Almost normally—somewhat slow
2 Slow but fully independent
3 Need assistance or walking aid
4 Unable to walk

A.1.2. During your worst state—do you walk[1]

0 Normally
1 Almost normally—somewhat slow
2 Slow but fully independent
3 Need assistance or walking aid
4 Unable to walk

A.1.3. Are your gait difficulties affecting your daily activities and independence?[1]

0 Not at all
1 Mildly
2 Moderately
3 Severely
4 Unable to walk

A.1.4. Do you feel that your feet get glued to the floor while walking, making a turn or when trying to initiate walking (freezing)?[1]

0 Never
1 Very rarely—about once a month
2 Rarely—about once a week

[1] The 10 items marked by footnote revealed by principal component analysis to have the highest loading on the first component. Italics: items written in italics were chosen as the final/short FOG questionnaire (Appendix B).

3 Often—about once a day
4 Always—whenever walking

A.1.5. How long is your longest freezing episode?[1]

0 Never happened
1 1–2 s
2 3–10 s
3 11–30 s
4 Unable to walk for more than 30 s

A.1.6. How long is your typical start hesitation episode (freezing when initiating the first step)?[1]

0 None
1 Takes longer than 1 s to start walking
2 Takes longer than 3 s to start walking
3 Takes longer than 10 s to start walking
4 Takes longer than 30 s to start walking

A.1.7. How long is your typical turning hesitation (freezing when turning)[1]

0 None
1 Resume turning in 1–2 s
2 Resume turning in 3–10 s
3 Resume turning in 11–30 s
4 Unable to resume turning for more than 30 s

A.1.8. How long is your typical destination hesitation (freezing when approaching the target, such as when stepping onto a scale or approaching a chair to sit down)?[1]

0 None
1 Resume walking in 1–2 s
2 Resume walking in 3–10 s
3 Resume walking in 11–30 s
4 Unable to resume walking for more than 30 s

A.1.9. How long is your typical tight quarters hesitation (freezing when attempting to get through narrow space such as a doorway)?[1]

0 None
1 Resume walking in 1–2 s
2 Resume walking in 3–10 s
3 Resume walking in 11–30 s
4 Unable to resume walking for more than 30 s

A.1.10. How long is your typical freezing episode while walking on straight?[1]

0 None
1 Resume walking in 1–2 s
2 Resume walking in 3–10 s
3 Resume walking in 11–30 s
4 Unable to resume walking for more than 30 s

A.1.11. How long is your typical freezing episode during stressful time-demanding situations, such as when the telephone rings, at elevators or street crossing?[1]

0 None
1 Resume walking in 1–2 s
2 Resume walking in 3–10 s
3 Resume walking in 11–30 s
4 Unable to resume walking for more than 30 s

A.1.12. How often do you fall?

0 Never
1 Very rarely—about once a year
2 Rarely—about once a month
3 Often—about once a week
4 Very often—once a day or more

A.1.13. How often do you fall when standing?

0 Never
1 It happened once or twice
2 It happened 3–12 times in the last 6 months
3 More than once a week
4 Whenever trying to walk unassisted

A.1.14. How often do you fall because of freezing episodes?

0 Never
1 It happened once or twice
2 It happened 3–12 times in the last 6 months
3 More than once a week
4 Whenever trying to walk unassisted

A.1.15. Do you experience festinating gait? (Festinating gait = accelerated, short steps, gait)

0 Never
1 Very rarely—about once a month
2 Rarely—about once a week
3 Often—about once a day
4 Whenever walking

A.1.16. How often do you fall because of festinating gait?

0 Never
1 It happened once or twice
2 It happened 3–12 times in the last 6 months
3 More then once a week
4 Whenever trying to walk unassisted

Appendix B

B.1. Freezing of Gait Questionnaire (FOGQ)

B.1.1. During your worst state—Do you walk:

0 Normally
1 Almost normally—somewhat slow
2 Slow but fully independent
3 Need assistance or walking aid
4 Unable to walk

B.1.2. Are your gait difficulties affecting your daily activities and independence?

0 Not at all
1 Mildly
2 Moderately
3 Severely
4 Unable to walk

B.1.3. Do you feel that your feet get glued to the floor while walking, making a turn or when trying to initiate walking (freezing)?

0 Never
1 Very rarely—about once a month
2 Rarely—about once a week
3 Often—about once a day
4 Always—whenever walking

B.1.4. How long is your longest freezing episode?

0 Never happened
1 1–2 s
2 3–10 s
3 11–30 s
4 Unable to walk for more than 30 s

B.1.5. How long is your typical start hesitation episode (freezing when initiating the first step)?

0 None
1 Takes longer than 1 s to start walking
2 Takes longer than 3 s to start walking
3 Takes longer than 10 s to start walking
4 Takes longer than 30 s to start walking

B.1.6. How long is your typical turning hesitation: (freezing when turning)

0 None
1 Resume turning in 1–2 s
2 Resume turning in 3–10 s
3 Resume turning in 11–30 s
4 Unable to resume turning for more than 30 s

References

[1] Giladi N, McMahon D, Przedborski S, Flaster E, Guillory S, Kostic V, Fahn S. Motor blocks in Parkinson's disease. Neurology 1992;42: 333–9.
[2] Giladi N, Kao R, Fahn S. Freezing phenomenon in patients with parkinsonism. Mov Disord 1992;12:302–5.
[3] Fahn S. The freezing phenomenon in parkinsonism. In: Fahn S, Hallett M, Lüder HO, Marsden CD, editors. Advances in neurology, vol. 65. Philadelphia, PA: Lippincott-Raven Publishers, 1995. p. 53–63.
[4] Nieuwboer A, De Weerdt W, Dom R, Lesaffre EA. A frequency and correlation analysis of motor deficits in Parkinson patients. Disabil Rehabil 1998;20:142–50.
[5] Narabayashi H, Kondo T, Nagatsu T, Hayashi A, Suzuki T. DL-threo-3,4-dihydroxyphenylserine for freezing symptom in parkinsonism. In: Hassler RG, Christ JF, editors. Advances in neurology, vol. 40. New York: Raven Press, 1984. p. 497–552.
[6] Achiron A, Ziv I, Goren M, Goldberg H, Zoldan Y, Sroka H, Melamed E. Primary progressive freezing gait. Mov Disord 1993; 8:293–7.
[7] Fahn S, Marsden CD, Calne DB, Goldstein M, editors. Recent developments in Parkinson's disease, vol. 2. Florham Park, NJ: Macmillan Health Care Information, 1987. p. 153–63 (also p. 293–304).
[8] Huges AJ, Daniel SE, Kilford L, Lees AJ. Accuracy of clinical diagnosis of idiopathic Parinsons's disease—a clinico pathological study of 100 cases. J Neurol Neurosurg Psychiatry 1992;55:181–4.
[9] Hoehn MM, Yahr MD. Parkinsonism: onset, progression and mortality. Neurology 1967;17:427–42.
[10] Burleigh-Jacobs X, Horak FB, Nutt JG, Obeso JA. Step initiation in Parkinson's disease: influence of levodopa and external sensory triggers. Mov Disord 1997;12:206–15.
[11] Stern GM, Lander CM, Lees AJ. Akinetic freezing and trick movements in Parkinson's disease. J Neural Transm 1980; 16(Suppl.):137–41.