Rapid assessment of postural instability in Parkinson’s disease (RAPID): a pilot study

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\textbf{Keywords:} falls, fear of falling, pull test, questionnaire

Received 20 January 2010
Accepted 10 May 2010

\textbf{Background:} The Fahn’s pull (or retropulsion) test is an item in the motor section of the Unified Parkinson’s Disease Rating Scale, which is used almost exclusively to classify postural instability in Parkinson’s disease (PD). However, the test is hard to standardize and is often performed incorrectly, making it hard to interpret. Moreover, it may not be safe to administer in patients who experience pain in the shoulders, neck, trunk and/or lower extremities. Identifying and grading postural instability in PD without requiring a physical challenge would not only be useful for the clinician but would assist patients and caregivers in its recognition. We propose the use of the rapid assessment of postural instability in Parkinson’s disease (RAPID) questionnaire as a non-physical assessment tool.

\textbf{Methods:} We determined the associations between the pull test and items on a risk-assessment questionnaire that consisted of three parts: activities of daily living, fear of falling, and frequency of falling.

\textbf{Results:} Significant correlations were found between the pull test and the predictor variables, which ranged between 0.51 and 0.56 whilst the correlations amongst the predictor variables ranged between 0.58 and 0.70. The three parts of the questionnaire, when used in combination, produced a 96\% sensitivity in the classification of postural instability.

\textbf{Conclusions:} The RAPID questionnaire can be used as an adjunct to the pull test or solely if the pull test is contraindicated. It may also be possible to administer the questionnaire via the telephone or Internet. It is hoped that the rapid identification of postural instability would lead to fewer falls.

\textbf{Introduction}

The onset of idiopathic Parkinson’s disease (PD) is insidious, and its progression is gradual. Gait dysfunction is common in PD. In the early stages, it manifests as decreased arm swing, decreased speed, and stride length. In more advanced stages, patients can develop more severe postural deformities, freezing of gait, and postural instability [1]. Long-term studies suggest that falling-related fractures are increased by fourfold in patients with PD compared to age-matched controls [2]. The Hoehn & Yahr PD rating scale (H & Y) [3] describes five stages of the disease progression: unilateral symptoms (Stage 1), bilateral symptoms (Stage 2), mild to moderate bilateral symptoms with postural instability (Stage 3), severe disability requiring assistance (Stage 4), wheelchair-bound or bedridden (Stage 5). A critical aspect in administering the scale involves classifying a patient with PD as Stage 3, which by definition marks the presence of postural instability and could be a harbinger of falls resulting in fractures, fear of falling, and significant morbidity [4].

The Fahn’s pull (or retropulsion) test [5], an item of the motor section test of the UPDRS part III, is used to determine whether a patient with PD has postural instability and therefore has reached Stage 3 of the disease on the H & Y scale. Inter-rater reliability of the pull test is good [6], and good to excellent correlation between the test and the H & Y scale has been found [7]. The test may, however, be hazardous in patients who...
experience pain in the shoulders, neck, trunk or lower extremities. There have been attempts to simplify the documentation of postural instability in PD. These tests, however, remain lengthy to conduct and, like the Fahn’s pull test, still place significant physical demands on the patients. In fact, some physical tests are so challenging that they fail to differentiate early-stage and late-stage PD individuals [8].

Other tests such as a questionnaire that do not require a physical challenge, where the items are significantly correlated with performance on the Fahn’s pull test, not only would be useful to a wider spectrum of the PD population but may be utilized by patients and caregivers to recognize the presence of postural instability and institute a falls prevention programme. For example, multiple studies have suggested that fear of falling, frequent falling, and a decline in activities of daily living (ADL) independence are related constructs to postural instability. At baseline, falls predict the development of fear of falling with an odds ratio (OR) of 1.75. Likewise, fear of falling at baseline predicts future episodes of falling (OR = 1.79) [9,10]. In disease-free elderly persons, fear of falling may be inversely correlated with ADL independence [11]. Moreover, those who fall frequently report a fear of subsequent falls. Many of these individuals who then become fearful of falling show postural abnormalities. Subsequently, they decrease their level of activity because of either a perceived or actual decline in ADL independence.

Poor postural control also appears to be a risk factor for falls [12], and frequent falling is highly associated with the presence of PD [9,13], especially in patients with severe bradykinesia or rigidity, who are in the late stages of the disease where postural instability is prominent [14]. A case–control study demonstrated that PD was one of the most significant risk factors (odds ratio = 9.4) for hip fracture because of falls in women [13]. Early-stage PD patients may rarely report falls, but it is the frequency of falls that seems to differentiate them from patients in the late stages of the disease [15]. Although other symptoms of PD affect a patient’s ADL independence, falls because of postural instability by far have been the determining factor in the need for caregiver assistance in patients with PD. Disease severity, if documented carefully and correctly, can predict recurrent fallers. Self-recall of prior falls has also been shown to be a reliable predictor of future falls [15]. Falling episodes are related to all the major motor symptoms of PD except for tremor. The fact that so many PD individuals continue to fall whilst at the same time report a strong fear of falling and have experienced multiple falls suggests that they may not have the adaptive skills to decrease their tendency for falling. In addition, dopaminergic therapy that ameliorates many of the motor symptoms of PD may not improve postural control [14,16–23].

In this pilot study, we report on the efficacy of the Rapid Assessment of Postural Instability in Parkinson’s Disease (RAPID) questionnaire. As the name suggests, the assessment was developed for the purpose of classifying postural instability in PD without having to perform challenging and sometimes difficult-to-standardized physical tests [24]. It is hoped that the development of such an instrument will assist clinicians, patients, and caregivers in identifying postural instability in a timely manner so that adaptive training can be instituted.

Methods

Subjects

A convenience sample of 57 subjects diagnosed with idiopathic PD [25] with no dementia participated in the questionnaire study approved by the Medical College of Georgia Human Assurance Committee. Subjects gave informed consent to participate in the study. The Fahn’s pull test was administered by the authors, along with other assessments, to determine each subject’s H & Y rating during their ‘on’ state [26]. Subjects who were rated 2.5 or less (no postural instability) were placed in Group 1 whilst subjects who scored 3 or 4 (indicating the presence of postural instability) were placed in Group 2 (Table 1). The H & Y distributions were as follows: Stage 1, n = 22; Stage 1.5–2, n = 10; Stage 2.5–3, n = 17; Stage 4, n = 8.

Procedure

The questionnaire that was administered by the authors consisted of three parts, which evaluated their level of independence with activities of daily living (ADL), fear of falls, and number of falls (# falls) in the last 3 months. Details of the questionnaire and rationale are provided in Appendix A.

Statistics

The SAS 9.1 and NCSS 2007 statistical software packages were utilized to analyze the data. The significance level of 0.05 was used for all analyses, unless otherwise stated.

Spearman correlation coefficient was calculated to assess the degree of association between the three parts of the questionnaire, as well as with the pull test. Mann–Whitney tests were performed to determine differences in ADL, fear of falling, and number of falls between the
two groups (postural stability/instability). The level of significance for the Mann–Whitney test was set at $P < 0.017$ to correct for multiple testing. A receiver operating curve (ROC) was created for each part of the questionnaire to examine its diagnostic performance. AUC (area under the curve) along with 95% confidence intervals was calculated, and optimal cut-off scores for each part of the questionnaire were determined by choosing the value that produced the highest likelihood of a positive prediction of postural instability. Sensitivity and specificity, including 95% confidence intervals for each part of the questionnaire, were calculated based on these cut-offs. Net sensitivity and net specificity were also calculated for the combinations of two or more parts of the questionnaire. To be considered positive for a combination of tests, a patient must be identified as positive by at least one of the tests.

Results

The correlations amongst the predictor variables (ADL, fear of falling, and number of falls) ranged between 0.58 and 0.70 ($P < 0.0001$, Table 2). These variables were also correlated with the pull test ($P < 0.05$). Mann–Whitney tests showed that the two groups were significantly different on all three parts of the questionnaire ($P < 0.0001$, Table 3).

A summary of the receiver operating curve (ROC) analyses, including the AUC, sensitivity, specificity, and cut-off scores for each part of the questionnaire, is presented in Table 4, along with the corresponding 95% confidence intervals. Graphs of the ROC’s are given in Fig. 1. As can be seen in Table 5, combining two or more parts of the questionnaire substantially increases the sensitivity for classification of postural instability.

Discussion

The results of the study suggest that it is possible to accurately classify postural instability in PD by using the 3-part questionnaire without resorting to physical tests that may be inconvenient or unsafe to administer and is hard to standardize in routine clinical practice. This will hopefully facilitate assessment and prediction of who is at risk for falls. Patients can then be referred

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<th>Table 2 Correlations amongst the predictor variables and the pull test. Spearman correlation coefficients</th>
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<th>Table 3 Comparison of Activities of Daily Living (ADL), Fear of Falling, and Number of Falls scores between groupsa</th>
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<td>ADL</td>
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<td>Fear of Falling</td>
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<td>Number of Falls</td>
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<td>Group 1</td>
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aGroup 1: No instability; Group 2: Instability.
bExact Mann–Whitney Test.

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<th>Table 4 Receiver operating curve analyses</th>
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<td>AUC</td>
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<td>95% CI (Sp)</td>
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<td>Likelihood ratio</td>
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ADL, activities of daily living; AUC, area under the curve.

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European Journal of Neurology © 2010 EFNS European Journal of Neurology 18, 260–265
to physical or occupational therapy who may prescribe adaptive equipment or teach strategies to help prevent falls [27]. It may also influence pharmacotherapy, because many patients with PD are treated initially with anticholinergics (trihexyphenidyl), monoamine oxidase inhibitors (selegiline or rasgiline) or dopamine agonists such as ropinirole or pramipexole prior to receiving levodopa therapy.

The questionnaire classifier is also hoped to make patients aware of their risk of falling and initiate interventions such as physical therapy, etc. to promote an adaptive response on the part of the patient and the caregiver. Predicting and reducing falls in patients with PD will help reduce morbidity and mortality because of the disease. Falls are such a significant concern for the clinician, the patient, and caregiver who are assessing the risk factors. Implementing early interventions should help decrease the frequency of falls and/or fear of falling in patients with PD. This psychological trait could be understood by the caregiver who might otherwise not have been aware of the psychological consequences of frequent falling.

Although other researchers have published scales for gait dysfunction in PD, our screening questionnaire is a unique tool to assess postural instability without physically challenging the patient. For example, Giladi et al. [28] have validated a questionnaire, which addresses freezing of gait (FOG-Q). Based on the test–retest and internal reliability, the FOG-Q may be useful as a screening tool and to monitor treatment intervention on freezing of gait. Another scale, the Gait and Balance Scale (GABS) is a more complex scale, which consists of historical information and examination of 14 gait and balance parameters [29]. Both these scales serve a different function when compared to our proposed RAPID scale. The FOG-Q addresses gait freezing and not postural instability and fear of falling; whereas the GABS involves a detailed physical examination of gait function (as do parts of the UPDRS Part III) and is more than a screening tool.

Further research is needed to test the reliability and validity of the RAPID instrument by, for example, testing a new group-blinded test set of PD subjects in larger numbers. The questionnaire may also be further refined by capturing more detailed information that can lead to increasing its sensitivity. For example, our

Table 5 Net sensitivity and specificity for combinations of questionnaire sections

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<th>Net sensitivity</th>
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<td>ADL &amp; Fear</td>
<td>0.92</td>
<td>0.75–0.98</td>
<td>0.91</td>
<td>0.76–0.97</td>
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<tr>
<td>ADL &amp; # Falls</td>
<td>0.92</td>
<td>0.75–0.98</td>
<td>0.91</td>
<td>0.76–0.97</td>
</tr>
<tr>
<td>Fear &amp; # Falls</td>
<td>0.76</td>
<td>0.57–0.89</td>
<td>0.91</td>
<td>0.76–0.97</td>
</tr>
<tr>
<td>ADL, Fear &amp; # Falls</td>
<td>0.96</td>
<td>0.80–0.99</td>
<td>0.88</td>
<td>0.72–0.95</td>
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ADL, activities of daily living.
question regarding the frequency of falls does not include episodes of near-falls, which has been shown to be associated with a four-fold increase in the risk of falling [30]. The intended purpose of the RAPID questionnaire is to serve as an easy, simple screening tool that requires no physical tests. It may therefore be administered not only by clinicians and researchers but by caregivers and even the patients themselves. The questionnaire can be used as an adjunct to the pull test or solely if the pull test is contraindicated. When it is not convenient to travel to the clinic for evaluation, the clinician can administer the questionnaire via the telephone or internet. The rapid identification of postural instability may hopefully lead to fewer falls.

References

Supporting information

Additional Supporting Information may be found in the online version of this article:


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Appendix A

Rapid Assessment Of Postural Instability In Parkinson’s Disease (RAPID).

(Supplementary references for the RAPID questionnaire will be made available in the Supporting information).

Part 1. Function: activities of daily living

Please indicate whether you have difficulty performing the following activities. (Mark 1 if difficulty, 0 if no difficulty):

1 Walking without device at home (have patient walk if necessary to help make a determination)
2 Walking without device in the community
3 Standing up from sitting (have patient demonstrate if necessary to help make a determination)
4 Sitting from standing (have patient demonstrate if necessary to help make a determination)
5 Climbing up and down the stairs (have patient demonstrate if necessary to help make a determination)
6 Toileting
7 Grooming (e.g. dressing, hygiene, washing, combing hair, shaving, brushing teeth, and using toilet) (ask whether unstable, requires assistance, or if spouse complains that the patient is too slow)
8 Bathing
9 Cooking
10 Cleaning
11 Driving
12 Grocery shopping

Total score: ___ out of 12 possible.

Rationale: The initial consultation regarding ADL independence has been suggested to be crucial in establishing a successful clinical relationship between the patient, family, and clinician. Some of the items chosen for the proposed classifier were adapted from the UPDRS. Research have also found, through factor analyses, these items to be the most relevant for indicating the level of independence in PD without significant loss of reliability or validity.

Part 2. Psychology: fear of falling

Please rate your fear of falling (circle):

1 2 3 4 5 6 7 8 9 10
No fear at all Very fearful

Rationale: Falls at baseline were an independent predictor of developing fear of falling [9,31] and vice versa [9]. Although a history of frequent falls and a fear of falling correlate, there are those who have taken adaptive measures to prevent falls but their fear of falling remain. Thus, fear of falling has been suggested to be an important independent risk factor in the assessment and treatment of postural instability in patients with PD.

Part 3. Consequence: number of falls

Please estimate as accurately as you can, how many times you have fallen in the last 3 months? (Assist in recall by probing the location, frequency, process and landing, their activity and fall-avoidance, falls at home, tripping, events arising when turning, falling forward, frequent near-misses and unsuccessful restoration of balance) ______

Rationale: Frequent recounting of processes, locations, and landings suggest that these details are memorable and easily recalled. These studies have used a minimum of 3 months to document fall history.
References for the Rapid Assessment of Postural Instability in Parkinson's Disease (RAPID) questionnaire (online only)


Part 2. Psychology: Fear of Falling [1, 12, 13]

Part 3. Consequence: Number of Falls [14-18]


