Intrarater and Interrater Reliability of the Dynamic Gait Index in Persons With Parkinson's Disease

Su-jin Hwang, Ph.D., P.T.
Institute of Health Science, Yonsei University
Young-keun Woo, Ph.D., P.T.
Dept. of Physical Therapy, Andong Science College

Abstract

Clinical measures that quantify falling risk factors are needed for the accurate evaluation of patients and to plan an intervention strategy. The purpose of this study was to examine the test-retest and interrater reliability of the dynamic gait index (DGI) for persons with Parkinson's disease (PD). A total of 22 idiopathic PD patients were recruited from rehabilitation hospital, Korea in this study. The DGI was assessed in two sessions that were, three days apart. We also measured Berg balance test (BBT) and geriatric depression scale (GDS) for concurrent validity with DGI. Intrarater and interrater reliability (.96 and .98 respectively) for DGI were high, indicating good agreement. The DGI was showed a good positive correlation with the BBS (r=.852), but not GDS (r=-.462). Intrarater and interrater reliability of DGI were high in people with PD. The DGI could be a reliable measure to evaluate functional postural control during gait activities in the PD population, and the ability of DGI to detect real change is acceptable in research and clinical settings.

Key Words: Berg balance test; Dynamic gait index; Geriatric depression scale; Falls; Parkinson's disease; Reliability.

Introduction

Falling is a common feature in patients with Parkinson's disease (PD), resulting in secondary injuries such as fall-related injuries, fractures, and functional disability (Dennison et al, 2007; Robinson et al, 2005), and have ultimately devastating effects on the ability of PD patients to live independently (Sadowski et al, 2007). Approximately 70% of PD patient fall annually, almost 50% fall more than twice yearly, and 13% fall more than once weekly (Dennison et al, 2007; Kerr et al, 2010). Falling is also responsible for more than 30% of the acute events that result in PD patients visiting emergency clinics (Martignoni et al, 2004); therefore, preventing falls is in PD patients is one of a major clinical concerns.

The risk of falling in PD is associated with higher disease severity with a longer disease duration, peripheral sensory disturbances, gait and postural disturbances, and impaired foot agility, as well as the PD-specific clinical signs: bradykinesia, freezing, and dyskinesia (Robinson et al, 2005; Sadowski et al, 2007). Clinical measures provide a simple and comfortable method to identify falling risk factors. Many clinical tools have been developed to identify falling risk factors in elderly population using clinical performance-based measures, such as the Berg balance test (BBT), dynamic gait index (DGI), performance-oriented mobility assessment, functional reach test, and timed up and go test (Legters, 2002; Shumway-Cook and Woollacott, 2007).

Recently, several studies have been specifically de-

veloped PD patients to describe their falling (Brozova et al, 2009; Dennison et al, 2007; Kerr et al, 2010; Mak and Pang, 2009). Although falling is a major medical concern in PD patients, there is still insufficient information to evaluate and document their dynamic balance performance during gait activities and functional tasks. The DGI was developed by Shumway-Cook and Woollacott (2007) to evaluate the gait response to changing task demands in ambulatory persons with postural instabilities. The DGI has been used as a measure of dynamic balance during gait activities in older adults, and in patients with vestibular disorders, multiple sclerosis, and stroke (McConvey and Bennett, 2005; Shumway-Cook and Woollacott, 2007; Wrisley et al, 2003). However, it is not appropriate to use the DGI for the evaluation of dynamic balance in populations with PD, because its reliability has not been tested in this population. The major purpose of this study was to examine the test-retest and interrater reliability of the DGI in persons with PD. We also aimed to better characterize the properties of the DGI and the factors that contribute to the outcome of this commonly used test in persons with PD.

Methods

All subjects provided an informed consent before participation according to the guidelines of the Glory Institutional Review Board. Data collection was performed in the outpatient physical therapy of adult rehabilitation unit in Glory hospital (Incheon, Korea). Twenty-two idiopathic PD patients participated in this study. General characteristics of subjects were showed in Table 1. The following inclusion criteria were used: a medically confirmed diagnosis of idiopathic PD and the ability to ambulate at least household distances (15 m) with or without a cane. Patients were excluded from the study if they had a history of any other neurologic or orthopedic disorders that would affect their ambulatory or balance ability, or any cognitive deficits that precluded support with the procedures of this study.

Procedures

Clinical measures were assessed while the subjects were in the 'on' phase of their medication cycle, generally 1~3 h after taking their anti-Parkinson's medications. The subjects performed clinical measures to two-session protocol; the DGI, BBT, and geriatric depression scale (GDS) were assessed for interrater reliability and concurrent validity by two physical therapists in the first session. And then DGI was assessed for intrarater reliability by rater in the second session that was 3 days apart. The testing time in the first session and second session took 45 min and 15 min respectively.

Both raters have more than 10 years of experi-

Table 1. General characteristics in study participant (N=22)

Characteristics	Subject
Gender	
Male	10
Female	12
Age (yr)	80.4±7.1[a]
Post-disease duration	26.8±6.9
Hoehn and Yahr stage	
Stage II	18
Stage III	4
Mini-Mental State Examination's score	25.5±1.1

[a]Mean±SD.

ence in evaluating patients with neurological problems and had previously used the DGI in other patient populations. The raters were not allowed to consult each other during the test and had no access to previous test results. The tests were performed in a quiet and well-organized therapy room and subjects were given the standard verbal instructions of the DGI and BBT. Although the verbal instructions were given once, they were given again if required by the study subjects. Subjects were allowed a rest period between each test in the first session. All of subjects used their normal shoes during the assessment of the DGI and BBS.

Clinical Measurements

To investigate the reliability of the DGI for PD patients, three clinical measures (DGI, BBT, and GDS) were evaluated by clinical observation and interview. The DGI consists of the following 8 walking tasks: walking, walking while changing speed, walking while turning the head horizontally and vertically, walking with pivot turn, walking over and around obstacles, and stair climbing (Herman et al, 2009). Each task is scored on a 4-point ordinal scale ranging from 0~3, with 0 indicating severe impairment and 3 indicating normal ability. The DGI has a maximum possible score of 24, and a score of 19 or less indicates an increased risk of falling. The DGI has been shown to have good interrater and test-retest reliability and is a valid predictor of the risk of falls in older persons (McConvey and Bennett, 2005).

The BBT is a widely used test to assess postural control while sitting and standing in older persons and individuals with neurological disorders. The scale consists of 14 items and has a maximum possible score of 56 points. The BBT has demonstrated to be reliable and valid in PD patients (Conradsson et al, 2007; Franchignoni and Velozo, 2005). A cutoff score of 45 points is used for fall prediction (Qutubuddin et al, 2005).

The GDS is a 30-item self-reported assessment specifically designed to identify depression in the elderly. The items are answered yes or no, instead of using a five-category response set, and include somatic concern, lowered affect, cognitive impairment, feelings of discrimination, impaired motivation, lack of future orientation, and lack of self-esteem. Scores of 0~9 are considered normal, 10~19 indicate mild depression, and 20~30 indicate severe depression (Allen and Annells, 2009).

Statistical Analysis

Pearson's correlations were used to quantify the bivariate associations between the DGI and other measures. Test-retest and interrater reliability of total and item scores of the DGI were statistically evaluated using the intraclass correlation coefficient [ICC(2,1)], where ICC values≥.80 are considered good agreement (Portney and Watkins, 2009). To determine the correlation between the total score of DGI and GDS as well as BBT, we calculated Spearman's correlation coefficients. All statistical analyses were performed using SPSS 12.0.

Results

The mean scores for the DGI, BBT, and GDS are shown in Table 2. No floor or ceiling effect was noted for any of the evaluation scales. The ICC for the rest-retest reliability of the total DGI scores was found to be very high at .96 (95% confidence interval [CI], .90~.98). All of the items had good reliability (.88~1.00) except for item 8 (steps) which was the least reliable (.70) (Table 3). The ICC for interrater reliability of the total scores was .98 (95% CI, .94~.99). Item 8 had the moderate reliability (.78), but the other items showed good reliability (.87~-1.00) (Table 3). The relationship between the DGI with the BBS and GDS are shown in Table 4. The DGI was significantly correlated with the BBS (r=.852). However, the DGI was not showed a good negative correlation with the GDS at r equal to -.462.

Table 2. Mean scores, SD, and minimal/maximal scores of clinical measures

Parameters	Mean±SD	Min~Max[*]
Berg balance test	43.36±4.51	35~50
Dynamic gait index	17.09±2.71	11~22
Geriatric depression scale	8.86±3.01	5~15

[*]minimum-maximum.

Table 3. Intrarater and interrater reliability for the dynamic gait index

Test items	ICC Intrarater	95% of CI[*]	ICC Interrater	95% of CI
Item 1. Gait on level surface	1.00	1.00	1.00	1.00
Item 2. Change in gait speed	.95	.88~.98	.91	.77~.96
Item 3. Gait with horizontal head turns	.88	.71~.95	.95	.88~.98
Item 4. Gait with vertical head turns	.95	.89~.98	.97	.93~.99
Item 5. Gait and pivot turns	.96	.90~.98	.91	.79~.96
Item 6. Step over obstacle	.97	.94~.99	.87	.69~.95
Item 7. Step around obstacles	.95	.88~.98	.91	.79~.96
Item 8. Steps	.70	.28~.88	.78	.48~.91
Total score	.98	.95~.99	.98	.94~.99

[*]Confidence interval.

Table 4. Correlation analysis of the dynamic gait index with other measures

Parameters	Spearman's p	p
Berg balance test	.85	<.05
Geriatric depression scale	-.46	<.05

Discussion

This study was designed to assess the reliability of the DGI and to better characterize the properties of the DGI and the factors that contribute to its outcome in PD patients. The results of this study revealed several significant findings. First, the total DGI scores showed good intrarater reliability and each item's score had good reliability. Second, interrater reliability for the total DGI scores was in good agreement and each item's score had good reliability. Finally, the DGI had a good correlation with the BBT, but not the GDS.

A fundamental issue in any clinical setting concerns how the level's of functional activity are measured in subjects, and PD is no exception. The Unified Parkinson's Disease Rating Scale (UPDRS) is a scale that was developed as an effort to incorporate elements from existing scales to provide a comprehensive means to monitor PD-related disability and impairment (Goetz et al, 2003) However, it is inappropriate to measure in clinically acceptable ways, the degree of balance exhibited by a performer in a patient with PD. Recently, several studies have used the BBT, which is basically a clinical measures of balance, to assess balance and to develop more tailored clinical interventions for PD patients (Franchignoni and Velozo, 2005; Qutubuddin and Cifu, 2005; Wielinski et al, 2006). The BBT evaluates the ability to maintain balance in different positions and during postural changes and movement. The majority of PD fall indoors during positional change, walking in a small space, and performing a dual task, and these individuals have reduced levels of confidence and qual-

ity of life than non-falling PD patients (Ashburn et al, 2001; Koller et al, 1989). However, the BBT and UPDRS would inappropriately assess the ability of patients to maintain postural stability during walking or performing a dual task.

This study assigned numerical values to postural stability, dynamic balance and depression level. DGI is one of most popular clinical measures for the evaluation of functional stability during gait activities in older people, and in those with multiple sclerosis, stroke and vestibular disorders (Jonsdottir and Cattaneo, 2007; McConvey and Bennett, 2005; Shumway-Cook and Woollacott, 2007; Whitney et al, 2003). The result of this study showed good agreement for DGI in people with PD and the reliability of each test item was acceptable. Item 8 (steps) had the lowest agreement of the items. PD patients find it difficult to stare gaze upward and from far during gait; therefore, the results showed that PD patients found that item 8 was difficult to perform, resulting in the low level of agreement for this item. We also administered BBT and GDI in this study. The total DGI score was moderately correlated with the total BBT score, but not with the GDS. The result indicates that the DGI and BBT provide valuable information for the maintenance of functional balance in people with PD. One of reason which showed less correlation between DGI and GDI show that depression was not a characteristic of the early and moderate stages of PD. The individuals who participated in this study were all Hoehn and Yahr stage II to III; therefore, the results cannot necessarily be generalized to the rehabilitation of the more severe stage of PD. Falling and the risk of falling may reduce the participation in daily activities of the community-dwelling PD patients, and ultimately decreasing quality of life.

Conclusion

This study was to examine the test-retest and interrater reliability of the DGI in persons with PD.

The DGI, BBT, and geriatric depression scale (GDS) were assessed for interrater reliability and concurrent validity by two physical therapists. This results suggested that the DGI is potentially a clinical measure that could help identify PD patients at risk factors of falls, and could be a reliable measure to evaluate functional postural control during gait activities in the PD population.

References

Allen J, Annells M. A literature review of the application of the geriatric depression scale, depression anxiety stress scales and post-traumatic stress disorder checklist to community nursing cohorts. J Clin Nurs. 2009;18(7):949-959.

Ashburn A, Stack E, Pickering RM, et al. A community-dwelling sample of people with Parkinson's disease: Characteristics of fallers and non-fallers. Age Ageing. 2001;30(1):47-52.

Brozova H, Stochl J, Roth J, et al. Fear of falling has greater influence than other aspects of gait disorders on quality of life in patients with Parkinson's disease. Neuro Endocrinol Lett. 2009;30(4):453-457.

Conradsson M, Lundin-Olsson L, Lindelof N, et al. Berg balance scale: Intrarater test-retest reliability among older people dependent in activities of daily living and living in residential care facilities. Phys Thera. 2007;87(9):1155-1163.

Dennison AC, Noorigian JV, Robinson KM, et al. Falling in Parkinson disease: Identifying and prioritizing risk factors in recurrent fallers. Am J Phys Med Rehabil. 2007;86(8):621-632.

Franchignoni F, Velozo CA. Use of the Berg balance scale in rehabilitation evaluation of patients with Parkinson's disease. Arch Phys Med Rehabil. 2005;86(11):2225-2226.

Goetz CG, Poewe W, Rascol O, et al. The unified Parkinson's disease rating scale (UPDRS): Status and recommendations. Movement Disord.

2003;18(7):738-750.

Herman T, Inbar-Borovsky N, Brozgol M, et al. The dynamic gait index in healthy older adults: The role of stair climbing, fear of falling and gender. Gait Posture. 2009;29(2):237-241.

Jonsdottir J, Cattaneo D. Reliability and validity of the dynamic gait index in persons with chronic stroke. Arch Phys Med Rehabil. 2007;88(11):1410-1415.

Kerr GK, Worringham CJ, Cole MH, et al. Predictors of future falls in Parkinson disease. Neurology. 2010;75(13):116-124.

Koller WC, Glatt S, Vetere-Overfield B, et al. Falls and Parkinson's disease. Clin Neuropharmacol. 1989;12(2):98-105.

Legters K. Fear of falling. Phys Ther. 2002;82(3):264-272.

Mak MK, Pang MY. Fear of falling is independently associated with recurrent falls in patients with Parkinson's disease: A 1-year prospective study. J Neurol. 2009;256(10):1689-1695.

Martignoni E, Godi L, Citterio A, et al. Comorbid disorders and hospitalisation in Parkinson's disease: A prospective study. Neurol Sci. 2004;25(2):66-71.

McConvey J, Bennett SE. Reliability of the dynamic gait index in individuals with multiple sclerosis. Arch Phys Med Rehabil. 2005;86(1):130-133.

Portney LG, Watkins MP. Foundations of clinical research: Applications to practice. 3rd ed. Pearson/Prentice Hall, Upper Saddle River, N.J., 2009:560-567.

Qutubuddin AA, Cifu DX. Use of the Berg balance scale in rehabilitation evaluation of patients with Parkinson's disease-reply. Arch Phys Med Rehab. 2005;86(11):2226-2226.

Qutubuddin AA, Pegg PO, Cifu DX, et al. Validating the Berg balance scale for patients with Parkinson's disease: A key to rehabilitation evaluation. Arch Phys Med Rehabil. 2005;86(4):789-792.

Robinson K, Dennison A, Roalf D, et al. Falling risk factors in Parkinson's disease. NeuroRehabilitation. 2005;20(3):169-182.

Sadowski CA, Jones CA, Gordon B, et al. Knowledge of risk factors for falling reported by patients with Parkinson disease. J Neurosci Nurs. 2007;39(6):336-341.

Shumway-Cook A, Woollacott MH. Motor control: Translating research into clinical practice. 3rd ed., Philadelphia, Lippincott Williams & Wilkins, 2007:395-396.

Whitney S, Wrisley D, Furman J. Concurrent validity of the Berg balance scale and the dynamic gait index in people with vestibular dysfunction. Physiother Res Int. 2003;8(4):178-186.

Wielinski CL, Erickson-Davis C, Wichmann R, et al. The Berg balance scale as a measure of postural instability in Parkinson's disease. Movement Disord. 2006;21:S553-S553.

Wrisley DM, Walker ML, Echternach JL, et al. Reliability of the dynamic gait index in people with vestibular disorders. Arch Phys Med Rehabil. 2003;84(10):1528-1533.