Effect of Dual Task Training Program on Quality of Life in Patients with Parkinson’s Disease

Soumyakanta Sahu¹, Arpita Srivastava²

Abstract

Introduction: Impairment in the ability to perform another task while walking (i.e., dual tasking [DT]) are associated with an increase in risk of falling, diminished mobility, loss of independence leading to decrease in quality of life (QOL) in patients with Parkinson’s disease (PD). So an attempt has been made with an aim to check the feasibility, potential efficacy of DT program on QOL and its transfer to the performance of untrained task.

Methodology: 54 subjects diagnosed with idiopathic Parkinson’s disease were conveniently allocated into two groups in a pretest and posttest control group study. After obtaining baseline data of gait speed in DT by 10-meter walk test and QOL by Parkinson’s Disease Questionnaire (PDQ-39) respectively, both the groups received occupational therapy services whereas the subjects of experimental group received a 4-week program of one-on-one training included walking while performing several motor and cognitive tasks.

Result: The experimental group showed statistically significant difference in improvement of gait speed during DT (p=0.02) and QOL (0.01) posttest control group study. After obtaining baseline data of gait speed in DT by 10-meter walk test and QOL by Parkinson’s Disease Questionnaire (PDQ-39) respectively, both the groups received occupational therapy services whereas the subjects of experimental group received a 4-week program of one-on-one training included walking while performing several motor and cognitive tasks.

Conclusion: The findings support the feasibility of applying DT gait training program for patients with PD which leads to improvement of the QOL.

Key Words: Dual tasking, Gait speed, Parkinson’s disease, Quality of life

Introduction

During many activities of daily living, people need to perform more than one task at a time. The capacity to do a second task (dual task performance) is highly advantageous during walking because it allows for communication between people, transportation of objects from one location to another, and monitoring of the environment so that threats to balance can be avoided. Dual task (DT) performance is also known as “concurrent performance” and involves the execution of a primary task, which is the major focus of attention, and a secondary task performed at the same time. The gait disturbances that characterize Parkinson’s disease (PD) have been associated with increased fall risk, diminished mobility [1, 2], loss of independence [1, 3], and reduced Quality of life (QOL) [4]. Mobility impairments and fall risk amongst PD patients are further exacerbated when they are engaged in a secondary task [5–7], such as talking whilst walking and the magnitude of gait deterioration is thought to be proportional to the complexity of the motor task being performed [6, 7].

QOL refers to an individual’s sense of well-being, purpose in life, autonomy, and ability to assume worthwhile roles and participate in significant relationships [9]. For individuals with PD, multiple aspects of illness have been identified as potential influences on an individual's QOL including functional status, cognitive and motor symptoms and demands of a changing body, communication dysfunction, unpredictability, and altered sense of identity [9]. The study done by Peto et al. endorsed the view that motor syndrome of PD such as tremor and stiffness and movement impairments were associated with lower quality of life, measured by the Parkinson’s disease questionnaire (PDQ-39) [10]. In a systemic review done by Sze-Ee Soh et al. concluded that motor symptoms that contributed most often to overall life quality were gait impairments and complications arising from medication therapy [11].

A pilot study done by J Baatile, et al. concluded that exercise promotes perceived independence in activities of daily living (ADL) and QOL in persons with stage one, two and three PD [12]. There is growing body of literature showing that people with PD have difficulty performing several tasks at once. Both motor and cognitive secondary tasks appear to produce nonspecific interference with attentional mechanisms that normally allow people with PD to compensate for some of their locomotor disturbances. Because it is not always possible to avoid dual tasks, it is a need to educate people with PD about the likely outcomes and risks of performing a second complex activity at the same time while they are walking [13].

Patients with PD have both motor and cognitive impairments, making them especially vulnerable to

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Period Of Study
March, 2015 - September, 2015

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Paper was presented in OTICON’ 2015 : the 52nd Annual National Conference of AIOTA at New Delhi in April 2015 and Awarded with Kamla V. Nimbkar Trophy for Best Scientific Paper.
but little effects on gait variability training in this patient population. An investigation of the effects

Methods

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were later included in the training program.

were asked to perform a cognitive task and one motor task those following 3 walking conditions (walking conditions 2–4), subjects

Usual walking with no DT:

1. During the pretesting and posttesting, gait speed was assessed session).

Within 3 walking conditions:

2. Stem Cell Therapy Centre, Department of Occupational Therapy

were scheduled for 12 training sessions (3 times a week for 4 weeks)

In the present study, the aim was to evaluate (1) effect of a task specific training of gait and cognitive and motor DT on QOL and gait speed; (2) its feasibility in patients with PD, applying basic elements of motor learning principle. This program differs from the previous training program[16], in that focus was only on cognitive DT gait training.

Overview of Assessment

54 subjects diagnosed with idiopathic PD (both male and female), with moderate impairment (Hoehn and Yahr Stage II–III), taking antiparkinsonian medication and were able to walk unassisted for at least 5 minutes were taken for the study from Plexus Neuro and Stem Cell Therapy Centre, Department of Occupational Therapy within a period from March, 2015 to July 2015 and were conveniently allocated into both control group (Group-A) and experimental group (Group-B), (27 each). Demographic characteristics of the samples are presented in Table 1. Exclusion criteria included coexisting serious chronic medical illnesses (eg, orthopedic, psychiatric, or neurological), severe visual deficits, major depression, dementia or any other cognitive impairment (Mini Mental Status Examination < 25). Informed written consent was obtained from each subject after matching the inclusion criteria.

Study design: Pre-test and post-test control group design.

A baseline assessment was done on gait speed and QOL by 10-meter walk test and Parkinson’s disease Questionnaire (PDQ-39) respectively. At the end of the initial evaluation meeting, subjects were scheduled for 12 training sessions (3 times a week for 4 weeks) and for the postraining testing (2–3 days after the last training session).

During the pretesting and posttesting, gait speed was assessed under 3 walking conditions:

1. Usual walking with no DT: This condition was always first and allowed subjects to become familiar with the walkway. In the following 3 walking conditions (walking conditions 2–4), subjects were asked to perform a cognitive task and one motor task those were later included in the training program.

2. Serial 3 subtractions task: Subjects walked while performing serial 3 subtractions out loud, starting from a 3-digit number (eg, 497).

3. Task of Coin Transfer: In this a commercially available waist bag with a pocket was tied at waist in such a way that, the midpoints of the pocket was situated over the antero-lateral aspect of the hip joint of non-dominant side. This required the subjects’ arms to cross from the dominant side to the non-dominant side repeatedly when transferring the coins. Total of 25 Indian 1 rupee coins were placed in the pocket of the trouser/kurti on the side of their dominant hand. Subjects reported their dominant hand by indicating which hand they would use to catch a small ball. Subjects were then instructed to use their dominant hand to transfer as many coins as they could, one at a time, from the starting pocket to the pocket of the waist bag present on the opposite side.

4. Performance of an additional DT not included in training session: This walk evaluated the performance of an additional DT that was not included in the training session and was only assessed in the preevaluation and postevaluation sessions to assess transfer of learning to a nontrained DT. The subjects were asked to perform a goal directed secondary motor task in which they were instructed to take out an umbrella from a backpack hanging on their back, open it and hold over the head while walking.

During these 3 walks (and during all training), subjects were instructed to walk at their preferred pace on level ground in a well-lit, obstacle-free, 30 m-long corridor for 1 minute. No explicit instruction for prioritization of either task was given. The order of the DT conditions was randomly assigned.

Implementation of the Training Program

The training targeted both the walking and the secondary tasks and aimed to be intensive and progressive. In each training session, subjects completed 5 blocks of 5 minutes of walking (i.e., a total of 25 min of walking in each training session). In each 5-minute block, subjects performed different kinds of secondary tasks: serial subtractions, and coin transfer. The order of the tasks in each 5-minute block is shown in Table 1. The therapist had to guard the subject and provide appropriate feedback (knowledge of result and knowledge of performance during the DT training.

Results

Data analysis was performed with SPSS version 16.0. Statistical test were carried with the level of confidence set at α d” 0.05.

PDQ-39 scores were analyzed using nonparametric Wilcoxon sign Rank test to know the difference within the groups. Mann Whitney U test was used to find the difference between the groups. Paired ‘t’ test was done to show the score changes occurred within the control group and experimental group on 10-meter walk test. Independent ‘t’ test was done for the differences between control group and experimental group on 10 meter walk test.

Every effort was made to carry out the evaluation and training sessions in the “on” state. Paired ‘t’ test done for the gait speed showed, there is a significant increase (p=0.04) in all 2 trained DT conditions, as well as in the non trained DT condition in the postraining evaluation compared with pretraining values for
control group. Likewise experimental group showed statistical significant improvement (p=0.01) in the gait speed for all DT. Independent ‘t’ test showed a significant difference in the gait speed (p=0.02) for all the DT conditions between the groups.

In subtraction walking task, the Wilcoxon sign rank test showed a statistically significant difference of p=0.02 and p=0.001 within the groups for control group and experimental group respectively. Similarly, the number of errors made while doing coin also found to be statistically significant also (p=0.02, p=0.005) respectively by Wilcoxon sign Rank test for control group and experimental group respectively. For between the group comparison, Mann Whitney U test showed significant difference of p=0.05 for number of coin transferred and p=0.001 for the number of errors made while doing coin transfer.

For difference in the QOL, Wilcoxon sign Rank test done for between the group comparison showed significant difference of p=0.01 and p=0.001 for control group and experimental group respectively. Between the group comparisons done by Mann Whitney u test also showed a significant difference of p=0.00.

Discussion
The present study demonstrates that a task specific training program designed specifically to reduce the negative effects of dual tasking while walking is feasible among patients with mild to
moderate PD and it leads to improvement of QOL in them. This study also moves beyond previous work by implementing cognitive as well as motor secondary task in the training and demonstrating positive effects of the training on both gait speed and QOL and on its transfer to a goal oriented non-trained DT [16].

You et al [17] observed no changes in DT gait after intensive training, while we observed relatively large improvements and these findings are consistent with the previous report of DT gait speed improvements in patients with PD [16]. Findings of our study are consistent with previous studies of rehabilitation. The possibility of DT training (where both tasks are not walking) has been examined in several neuropsychologic studies [18, 19]. DT training as a whole task was apparently critical for acquiring attentional control and task coordination strategies [19]. Consistent with this, a functional magnetic resonance imaging study reported reduced activation in brain areas that were initially involved with DT processing after whole-task training, interpreted as an “increase in neural efficiency [20].” In addition to the concept of practicing DT as a “whole task,” several additional principles of motor learning support the result of our study.

**Task-specific training:** Practice should be specific to the desired function (i.e., one has to practice DT walking to improve DT walking). Both animal and clinical studies have demonstrated that task-specific training yields better outcomes and induces and maintains larger cortical changes, compared with traditional therapies that target more general abilities [21]. In our study also, the subjects in experimental group showed a significant difference in the improvement of gait speed as well as in the performance of secondary task (both cognitive and motor).

**Variability of practice:** Training a variety of tasks enhances learning and improves transfer [22]. Practice under variable conditions is also relevant for transfer to daily life. As described earlier, this principle was applied by using different cognitive and motor tasks in the training program and adding obstacles into the walking path which could have been the possible cause of transfer of the learning to a goal directed non-trained DT.

Our study also found a significant difference in the improvement of QOL in subjects of experimental group as compared to control group. The possible reasons for this might be these. Alterations in the ability to walk while simultaneously performing another task have been related to gait and balance impairment [23]. DT while walking frequently occurs in many everyday situations. Given its impact on gait, safe ambulation, and fall risk, DT interference in PD affects both movement [23, 24] and cognition [25] and is accentuated when tasks are part of a long or complex sequence [24]. When patients attention focuses on the second task, their footsteps become short and slow, the ground clearance reduces, and movement can cease [25].

Although depression is a significant predictor of QOL in PD, studies suggest that gait problems, disease severity, mobility, activities of daily living determine the QOL in PD [26, 27]. However, a preliminary study found that the main impairment of QOL in PD lies in the areas related to mobility and physical functioning and increases with increasing disease severity [28].

A study done by Shibley et al. [27] indicated that difficulty in dressing, difficulty in walking, falls, depression, and confusion were PD symptoms, which significantly influenced QOL scores. Among the mobility problems associated with PD, start hesitation, shuffling gait, freezing, festination, propulsion, and difficulty in turning had a significant effect on QOL scores. Taken together, the correlation, suggest that the training program on DT has a positive effect on QOL in patients with PD. However, this study was not intended to find out the relationship between gait speed and QOL in patients with PD. A future study may attribute to the same. As suggested by Yoge et al. [16], the training program described here could also be viewed as a general framework that

### Table 3: Effect of training on gait speed, secondary cognitive and motor tasks and QOL

<table>
<thead>
<tr>
<th>Variable</th>
<th>Test condition</th>
<th>Group A</th>
<th>Group B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gait Speed (10-meter walk Test)</td>
<td>Cognitive DT</td>
<td>39.61 (9.34)</td>
<td>40.68 (9.08)</td>
</tr>
<tr>
<td>Non-trained DT</td>
<td>40.04 (9.66)</td>
<td>33.83 (8.35)</td>
<td>8.81</td>
</tr>
<tr>
<td>Cognitive Task (serial 3 subtractions)</td>
<td>Number of calculations generated</td>
<td>9.88 (2.16)</td>
<td>9.45 (2.25)</td>
</tr>
<tr>
<td>Number of errors made</td>
<td>2.04 (0.69)</td>
<td>2.98 (0.73)</td>
<td>1.14</td>
</tr>
<tr>
<td>Motor Task (coin transfer)</td>
<td>Number of coins transferred</td>
<td>14.73 (2.04)</td>
<td>14.42 (1.96)</td>
</tr>
<tr>
<td>Number of errors made</td>
<td>2.32 (0.71)</td>
<td>2.05 (0.64)</td>
<td>0.83</td>
</tr>
<tr>
<td>QOL (PDI 39)</td>
<td>62.15 (10.04)</td>
<td>63.04 (10.01)</td>
<td>41.25 (9.22)</td>
</tr>
</tbody>
</table>
could be modified to best fit the needs of the individual patient and clinician. For example, different tasks could be chosen for the training program, provided that there is adherence to the principles outlined in designing the program (eg, variability of practice and choosing tasks that challenge different cognitive and motor domains).

Conclusion

The results of the present study indicate the feasibility of task specific training of gait with cognitive and motor DT to improve QOL and gait speed. This adds weight to the growing body of literatures and sets the stage for clinical implementation of a program that may help to reduce the negative impacts of DT on gait and QOL. The result of our study also sets a platform for future research on its effect on detrimental factors for QOL in patients with PD.

Future Recommendations

- Follow up study to check the retention effect.
- Effect on other gait parameters can be carried out.
- Future study can be done by comparing the effects of cognitive DT training and motor DT training on gait parameters and QOL.
- Effect on risk of fall and ADL can also be evaluated.

References