
Effects of aquatic physical therapy on balance and gait of patients with Parkinson's disease

Efeitos da fisioterapia aquática no equilíbrio e na marcha de pacientes com doença de Parkinson

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Abstract

Objective – To evaluate the effects of aquatic physical therapy on balance and gait of Parkinson's disease patients. Parkinson's disease is caused by degeneration of dopaminergic neurons of the substantia nigra that causes rigidity, bradykinesia, resting tremor, and postural instability. Functional abnormalities of Parkinson's disease can be treated through aquatic therapy, among other methods of rehabilitation.

Methods – Seventeen patients with PD on stages 1-4 of Hoehn and Yahr scale were selected. Patients were assessed before and after treatment using the Time Up and Go (TUG), Dynamic Gait Index (DGI), Berg Balance Scale (BBS) and Unified Parkinson's Disease Rating Scale (UPDRS). Patients performed 36 sessions of hydrotherapy, 40 minutes each one, during three months. Data were analyzed using the paired t test. **Results** – The scores of the scales before and after the program were: TUG 12.387 (SD 2.646) e 10.648 (SD 2.419); DGI 19.235 (SD 3.945) e 18.882 (SD 3.945); BBS 45.824 (SD 8.218) e 49.294 (SD 6.789) and UPDRS 28.471 (SD 18.682) e 21.529 (SD 15.629). There was statistically significant improvement on TUG, BBS and UPDRS scales after the treatment. **Conclusion** – The aquatic physical therapy promoted improvement on balance and gait of patients with Parkinson's disease.

Descriptors: Parkinson disease; Hydrotherapy; Postural balance; Gait; Exercise

Resumo

Objetivo – Avaliar os efeitos da fisioterapia aquática no equilíbrio e na marcha de pacientes com doença de Parkinson. A doença de Parkinson é causada pela degeneração de neurônios dopaminérgicos da substância negra que causa rigidez, bradicinesia, tremor de repouso e instabilidade postural. As alterações funcionais da doença de Parkinson podem ser tratadas por meio da fisioterapia aquática, entre outros métodos de reabilitação. **Métodos** – Foram selecionados 17 pacientes com doença de Parkinson nos estágios 1 a 4 da escala de Hoehn e Yahr. Os pacientes foram avaliados antes e depois do tratamento por meio do Time Up and Go (TUG), Índice do Andar Dinâmico (IAD), Escala de Equilíbrio de Berg (EEB) e Escala Unificada de Avaliação da Doença de Parkinson (UPDRS). Os pacientes participaram de 36 sessões de hidroterapia, com duração de 40 minutos cada, durante três meses. Os resultados foram analisados por meio do teste t pareado. **Resultados** – As pontuações obtidas nas escalas antes e depois do programa foram: na TUG 12.387 (DP 2.646) e 10.648 (DP 2.419); no IAD 19.235 (DP 3.945) e 18.882 (DP 3.945); na EEB 45.824 (DP 8.218) e 49.294 (DP 6.789) e na UPDRS 28.471 (DP 18.682) e 21.529 (DP 15.629). Houve melhora estatisticamente significativa nas escalas TUG, EEB e UPDRS. **Conclusão** – A fisioterapia aquática promoveu melhora no equilíbrio e na marcha de pacientes com doença de Parkinson.

Descritores: Doença de Parkinson; Hidroterapia; Equilíbrio postural; Marcha; Exercício

Introduction

Parkinson's disease is caused by progressive degeneration of dopaminergic neurons in the basal ganglia¹⁻³. Classical symptoms of the disease are rigidity, bradykinesia, resting tremor, abnormal posture, postural instability and gait alteration. In addition to these symptoms are also found cognitive and behavioral impairments that together can cause social isolation, anxiety, sleep disturbances, fatigue and depression⁴⁻⁸.

The treatment of Parkinson's disease aims to minimize the functional limitations and contributes to improve the quality of life of patients, but does not prevent the disease progression⁹.

The aquatic physical therapy through the physical properties of water in association with physical exercise can promote motor and sensory benefits, through balance and proprioceptive stimulation, which could contribute

to the improvement on functional independence of patients with Parkinson's disease¹⁰⁻¹¹.

There are few studies about the effects of aquatic physical therapy on balance of patients with Parkinson's disease. Andrade *et al.*¹⁰ (2010) assessed the effects of aquatic exercises in seven patients with Parkinson's disease through a treatment program consisting on adaptation to the aquatic environment, stretching and static and dynamic balance exercises. The results showed that the 12 session of treatment promoted balance improvement.

Vivas *et al.*¹² (2011) compared the effects of aquatic physical therapy with conventional physical therapy exercises on postural stability and transfer of patients with Parkinson's disease. Eleven participants were randomly divided into two groups: 5 participants in the active control group (water therapy) and 6 participants in the experimental group (conventional physical the-

rapy). The groups performed the protocol for four weeks, two sessions per week, with duration of 45 minutes each one. Both protocols, consisted on specific movements of the trunk, pelvis, lower limbs and upper limbs, divided into warm-ups, trunk mobility, postural stability, transfers and changes in body position. The protocol for aquatic physical therapy was associated with Halliwick method in water and the conventional physical therapy was performed through exercises performed on a therapeutic ball. The results showed that both groups had statistically significant improvement in functional reach however only the aquatic physical therapy group obtained improvement in UPDRS and BBS.

According to what has been described, there is evidence that aquatic physical therapy could promote improvement on balance of patients with Parkinson's disease. However, the studies contained small numbers of participants what makes it difficult to generalize the results. Thus, the objective of this study was to assess the effects of aquatic physical therapy on balance and gait of patients with Parkinson's disease assessing a higher number of participants.

The hypothesis of this study is that aquatic physical therapy could promote improvement on balance and gait of patients with Parkinson's disease due the stimulation promoted by the physical properties of water associated with the effects of the proposed exercises.

Methods

The study was conducted after approval by the Research Ethics Committee (approval number 100/10), at the Center for Health Promotion and Rehabilitation and Social Integration (Centro de Promoção e Reabilitação em Saúde e Integração Social – Promove São Camilo), São Paulo, Brazil.

Patients were recruited from the waiting list of the above-mentioned center. Inclusion criteria were: diagnosis of idiopathic Parkinson's disease, aged 50-80 years, no cognitive impairment, absence of skin diseases, no physical therapy conducted over the past six months. Exclusion criteria were: patients who had two consecutive absences on sessions and patients with another associated neurological impairment. The selected patients signed an informed consent form.

Seventeen patients were selected with the mean age of 67.58 (8.55) and mean HY of 2.17 (0.98). The sessions were performed in groups in a pool with dimensions of 7 m by 86 m, depth 1.40m and temperatures between 32°C to 34°C.

The intervention program was conducted for three months, three times per week with sessions of 40 minutes, a total of 36 sessions, supervised always by the same physical therapist and performed by the students of the last year of the physical therapy course.

The program was composed of: five minutes of warm-up with backward, sideward and frontward gait with and without turbulence associated with external cues through lead shin-pad to demarcate the floor of the pool and 10 minutes of rhythm activity, coordination and ba-

lance involving exercises for the patient to change the direction of the movement, alternation of members during the activity, exercises in the standing position involving rotational movements of the trunk and upper limb function with balls, 10 to 15 minutes of exercises for the trunk (Halliwick rotation method and Bad Ragaz Method standards), 5 to 10 minutes with Ai-Chi method of water relaxation and passive muscle stretching.

The sessions were performed with different musical backgrounds in order to promote rhythm to the exercises.

Assessments were carried out before and after the proposed treatment using the following instruments: Modified Hoehn and Yahr Scale (HY)¹³⁻¹⁴ in order to assess the severity of Parkinson's disease; Time Up and Go Scale¹⁵ (TUG) for the functional assessment of the gait and mobility; Dynamic Gait Index (DGI)¹⁶ for the assessment of gait and balance; Unified Parkinson's Disease Rating Scale (UPDRS)^{14,17-18} that assesses the signs, symptoms and certain activities through patient reports and clinical observation and Berg Balance Scale¹⁹ (BBS) used to evaluate the static and dynamic balance.

The physical therapists which performed the assessment were blinded in relation to the intervention and study objectives.

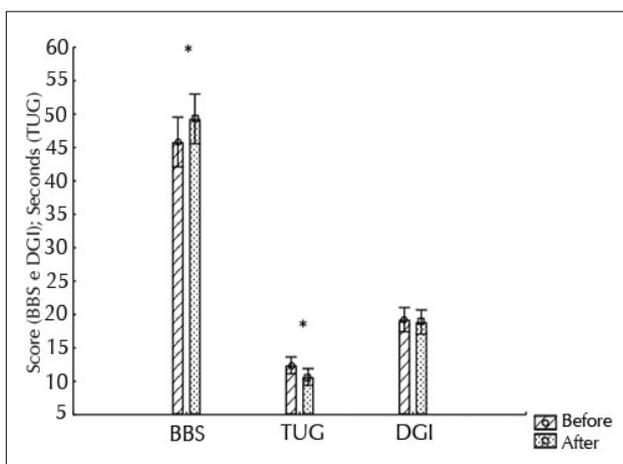
We used the paired t test in order to compare the results obtained before and after treatment, considering p value <0.05 as a statistically significant result.

Results

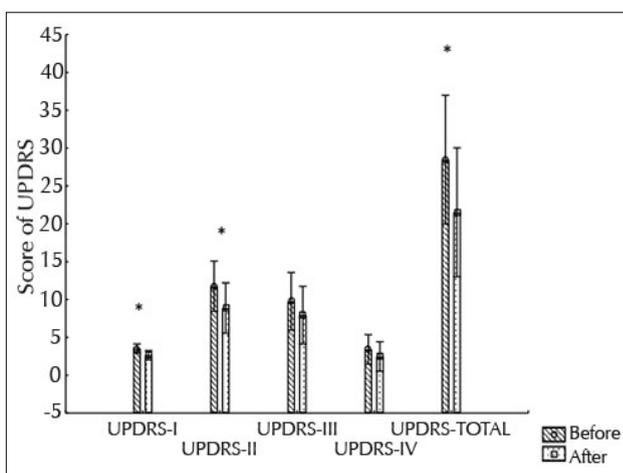
Patients in this study were between the 1-4 HY stages, with mean of 2.17 (SD 0.983), the mean age of patients was 67.58 (SD 8.55), 7 males and 10 females.

The score obtained by patients in the BBS was 45.824 (SD 8.218) before the program and 49.294 (SD 6.789) after the program and the TUG was 12.387 (SD 2.646) before the program and 10.648 (SD 2.419) after the program. There was a statistically significant difference between the means obtained before and after the program (paired t test, p=0.05 and p=0.005, respectively). The score obtained in the DGI was 19.235 (SD 3.945) before training and 18.882 (SD 3.945) after training. There was no statistically significant difference between measurements before and after training on DGI (paired t test, P> 0.05) (Graph 1).

The score obtained by patients in UPDRS-I was 3.529 (SD 1.281) before the program and 2.647 (SD 1.169) after the program, in the UPDRS-II was 11.765 (7.327) before the program and 8.882 (SD 6.051) after, in UPDRS-III was 9.765 (SD 7.822) before and 7.941 (SD 7.57) after the program, in the UPDRS-IV was 3.412 (SD 4.473) before and 2.471 (SD 3.338) and after the program and the UPDRS-TOTAL was 28.471 (SD 18.682) before and 21.529 (SD 15.629) after the program (Graph 2). There was a statistically significant difference between measurements obtained before the program of aquatic physical therapy and after the program in sections I and II and on the total UPDRS score (paired t test, p <0.05).



Graph 1. Patients performance before and after aquatic physical therapy, on Berg Balance Scale (BBS), Time Up and Go (TUG) and Dynamic Gait Index (DGI). There was a statistically significant difference among results before and after training evaluated by BBS and the TUG. *(paired t test, $p < 0.05$)



Graph 2. Assessment of the four sections of the UPDRS before and after aquatic physical therapy. There was a statistically significant difference between results before and after the aquatic physical therapy on the sections I, II and total UPDRS. *(paired t test, $p < 0.05$)

Discussion

The results of this study demonstrated that the proposed aquatic physical therapy program promoted improvement in static and dynamic balance in Parkinson's disease patients, assessed by the BBS.

The aquatic physical therapy, through the water properties like the hydrostatic pressure, turbulence and buoyancy, creates instability that increases sensory stimulation and, as a consequence, causes balance reactions that could contribute to improvement on postural control and mobility of patients with Parkinson's disease^{10,20}.

Vivas *et al.*¹² (2011) reported that both, aquatic and conventional physical therapy exercises, promoted strengthening of the muscles of the trunk, and suggested that this fact could have improved the postural responses of patients with Parkinson's disease. In addition, the authors have suggested that aquatic physical therapy could provide best results due to the physical properties

of water. These benefits may be responsible for the improvement on the BBS. The results of our study also show an improvement in functional mobility of patients with Parkinson's disease assessed by the TUG.

Vivas *et al.*¹² (2011) described that water therapies could promote satisfactory results in reducing muscle tone, postural instability and functional mobility. These gains could be explained by analyzing the relationship between the physical properties of the water and its therapeutic effects.

The temperature of the heated water used in the therapy, associated with the compression caused by the hydrostatic pressure leads to a reduction on blood vessel tone increasing the peripheral blood supply, which could influence the improvement of functional mobility due to the increased delivery of oxygen, better removal of toxic products in the muscle metabolism and momentary reduction of the muscle tone which generates muscle relaxation. The decrease of weight-bearing on the joints generated by the force of buoyancy also contributes to the facilitation of movement and could facilitate the performance of muscle strengthening exercises, gait training and decrease of the muscle rigidity²¹⁻²³.

Chistofolletti *et al.*²⁴ (2010) performed a randomized controlled trial aimed to assess the static and dynamic balance in 23 patients treated through conventional physical therapy. The interventions were conducted for six months, three sessions per week of 60 minutes each. This study found improvement on TUG scale, which leads us to believe that the intervention time could influence the results. Patients of the present study performed 36 sessions of aquatic physical therapy with the same improvement, that suggest that aquatic physical therapy could be more efficient to improve balance and mobility than conventional physical therapy. In order to answer this question it is necessary to perform a randomized clinical trial to compare the effects of aquatic physical therapy with conventional physical therapy.

The results of our study also showed that aquatic physical therapy can promote improvement in the total score of UPDRS, and specifically on section I, that evaluates the mental and emotional states and behavior, and on section II, that corresponds to the activities of daily life.

Factors that may influence the improvement of section I of UPDRS were shown by Pereira *et al.*²⁵ (2009) who suggested that group therapy can promote the psychological conditions and promote social interaction of patients.

The improvement found on section II of UPDRS after the program may reflect the better performance of the patients on activities of daily life, probably due to improvement in functional mobility and balance, skills needed in a lot of everyday tasks.

The study of Pellecchia *et al.*²⁶ (2004) demonstrated the improvement of UPDRS after aquatic physical therapy. The authors suggested that this improvement could occur due the effects of proprioceptive neuromuscular facilitation, coordination exercises for upper and lower limbs and trunk control stimulation. The therapy was performed by 20 patients with Parkinson's disease for 20 weeks with three sessions per week. Patients showed improvement on UPDRS after the intervention which was maintained

after three months. These results are in agreement with our results, reinforcing that the aquatic physical therapy could contribute to the improvement of specific alterations of Parkinson's disease assessed by UPDRS.

The proposed treatment of the present study did not cause improvement of DGI, which assesses gait adaptability in the environment out of the water. Probably, the lack of improvement on DGI, suggest that the aquatic physical therapy did not bring specific benefits to the conditions of gait assessed by this instrument. On the other hand, the improvement on TUG suggests that the patients could stand up, walking, turn on and sit down with best performance. Thus, we suggest that the aquatic physical therapy could be used in association with traditional physical therapy for treatment of balance and gait disorders of patients with Parkinson's disease.

Conclusion

We can conclude that aquatic physical therapy promoted improvement on balance and gait of patients with Parkinson's disease.

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