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ORIGINAL STUDIES

Rehabilitation in elderly patients with parkinsonism

Reabilitarea complexă a vârstnicilor cu parkinsonism

Rodica Trăistaru [1], Diana Kamal [2], Constantin Kamal [1], Otilia Rogoveanu [1], Ana Maria Bumbea [1]
[1] *University of Medicine and Pharmacy of Craiova, Romania*
[2] *Elga Clinic, Craiova, Romania*

Abstract

Background. Parkinsonism is an umbrella term which covers a group of neurological disorders that cause movement problems (slow movement, abnormal gait and balance problems, rigidity, tremor); only 80-85% of all cases are due to Parkinson's disease (PD); other 15-20% are defined as atypical parkinsonism.

Aims. We evaluated in our study the efficacy of a complex rehabilitation program, based on 6 weeks of aerobic training, for reducing symptoms and improving the quality of life in elderly patients with vascular parkinsonism.

Methods. The study was a randomized controlled trial comprising two groups of patients (E-study group and C-control group), homogeneous in terms of biographical, clinical and functional features. All patients underwent a full clinical, imaging and functional assessment.

Results. All parameters had a significant modification (Up and Go test, Berg scale, 2 MWD and NEADL scale) in patients that performed the rehabilitation program.

Conclusions. The rehabilitation program mainly aimed at maximizing functional ability and quality of life in patients with vascular parkinsonism. Our study is a beginning for the development of an evidence-based practice in the rehabilitation of older patients with parkinsonism.

Keywords: vascular parkinsonism, rehabilitation program.

Rezumat

Premize. Parkinsonismul este un termen umbrelă, care acoperă un grup de tulburări neurologice care cauzează probleme de mișcare (mișcare lentă, probleme anormale de mers și echilibru, rigiditate, tremor); numai 80-85% din toate cazurile se datorează bolii Parkinson (PD); alte 15-20% sunt definite ca parkinsonism atipic.

Obiective. S-a evaluat în studiul nostru eficacitatea unui program complex de reabilitare bazat pe formarea aerobică de 6 săptămâni pentru reducerea simptomelor și îmbunătățirea calității vieții la pacienții vârstnici cu parkinsonism vascular.

Metode. Studiul a fost un studiu controlat, randomizat, care a cuprins două grupuri de pacienți (lotul de studiu E și lotul de control C), omogene în ceea ce privește caracteristicile biografice, clinice și funcționale. Toți pacienții au fost evaluați complet - clinic, imagistic și funcțional.

Rezultate. Toți parametrii au avut o modificare semnificativă (testul Up and Go, scara Berg, 2 MWD și scara NEADL) la pacienții care au efectuat un program de reabilitare.

Concluzii. Programul de reabilitare vizează în principal maximizarea capacității funcționale și a calității vieții la pacienții cu parkinsonism vascular. Studiul nostru este un început pentru dezvoltarea unei practici bazate pe dovezi în reabilitarea pacienților vârstnici cu parkinsonism.

Cuvinte cheie: parkinsonism vascular, program de reabilitare.

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Address for correspondence: University of Medicine and Pharmacy of Craiova, No 2-4, Petru Rareș Str. Craiova, 200349, Romania
E-mail: kamalconstantin@gmail.com
Corresponding author: Constantin Kamal; kamalconstantin@gmail.com
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Introduction

Over the last 10 years there have been various medical studies about the importance of rehabilitation programs in the management of patients with chronic neurological diseases, especially in elderly persons with complex deconditioned status (Cheng et al., 2012). Parkinsonism is an umbrella term covering a group of neurological disorders that cause movement problems (slow movement, abnormal gait and balance problems, rigidity, tremor); only 80-85% of all cases are due to Parkinson's disease (PD); other 15-20% are defined as atypical parkinsonism that includes disorders characterized by parkinsonism but not caused by PD (1).

The category of atypical parkinsonism comprises a number of disorders (progressive supranuclear palsy, multiple system atrophy, Lewy body dementia, corticobasal degeneration), some of which have yet to be clearly defined - vascular parkinsonism, drug-induced parkinsonism, and parkinsonism secondary to infection and other causes (Hohler et al., 2012). These disorders tend to progress more rapidly than PD, are defined through additional symptoms such as early falling, dementia or hallucinations, and do not respond or respond only for a short time to levodopa therapy (1).

Vascular parkinsonism (VP), a controversial clinical concept, is a form of secondary parkinsonism resulting from cerebrovascular disease. Worldwide, VP represents 2.5% to 5.0% of all cases of parkinsonism in various population-based studies and clinical researches.

In Europe, VP is estimated at 3% of all cases of parkinsonism (Vale et al., 2012). Based on diagnostic criteria for VP, 4% to 12% of patients with Parkinson's syndrome are estimated to have a vascular etiology that occurs more frequently in the older population (da Silva et al., 2012).

Despite the progress made in the medical understanding of other parkinsonism syndromes, the concept of VP is still unclear and clinical diagnosis is often difficult (Benamer & Grosset, 2009); it is defined by the following features (Hohler et al., 2012; Chadwick & Aminoff, 2004; Zijlmans et al., 2004):

- an abrupt bilateral and symmetrical onset with stepwise evolution of bradykinesia and rigidity;
- evidence of the presence of risk factors (systemic arterial hypertension, atherosclerotic disease) for neurovascular disease, lacunar infarcts in the basal ganglia or more widespread subcortical white matter lesions obvious on neuroimaging (in elderly patients these alterations in the white matter are often correlated with parkinsonian symptoms);
- focal signs or symptoms consistent with stroke such as pyramidal damage with symmetrical involvement, pseudobulbar paralysis and spontaneous improvement of the symptoms;
- prominent postural instability and gait disorder;
- no rest tremor;
- unresponsive to levodopa treatment (2).

For positive VP diagnosis, a few clinical and imaging exclusion aspects should be taken into consideration: a history of cranioencephalic trauma, defined encephalitis, computed tomography (CT) and magnetic resonance imaging (MRI) evidencing a cerebral tumor or suggesting hydrocephaly (da Silva et al., 2012). VP is characterized by symptom heterogeneity, with the mention that postural instability and falls are more frequent than bradykinesia and upper limb rest tremor (Gupta et al., 2012).

The most important clinical complaint of VP, with the development of a complex dysfunction, is gait impairment (Thanvi et al., 2012). This gait disturbance develops early and has a significant impact on the severity of the patient's status and quality of life (Pokhabov, 2014). VP does not respond well to the typical medications used to treat Parkinson's disease. Treatment of symptomatic vascular parkinsonism involves trying to minimize stroke risk factors as outlined above and a trial of levodopa and other anti-parkinsonian medications. Rehabilitation programs (kinetic and physical measures, using ambulatory devices and development of compensatory strategies) may also play an important role in preventing falling, training to improve balance, gait and postural status (Benamer & Grosset, 2009).

Hypothesis

Taking into consideration the previous recommendations for VP management, we evaluated in our study the efficacy of a complex rehabilitation program, based on 6 weeks of aerobic training, for reducing symptoms and improving the quality of life in elderly patients with VP.

Material and methods

We mention that we obtained the approval of the Ethics Committee of the University of Medicine and Pharmacy of Craiova No 129/16.05.2017 and a signed informed consent from all the subjects participating in the study. Our research was performed on 27 patients, all diagnosed with vascular parkinsonism (VP).

Research protocol

a) Period and place of the research.

We conducted our study during the period May 2017 - October 2017 in the Rehabilitation Department of the "Filantropia" Hospital Craiova.

b) Subjects and groups.

The study was a randomized controlled trial including two groups of patients (E - study group and C - control group), homogeneous in terms of biographical, clinical and functional features (Table I).

All patients underwent a full clinical, imaging and functional assessment.

Clinical evaluation of the studied patients was carefully made and permitted to evidence the defined signs and symptoms of VP - gait difficulties, postural instability and falls, symmetrical predominant lower-body rigidity and bradykinesia. None of them had seriously disabling lower limb osteoarthritis. All patients were diagnosed with arterial hypertension, well controlled by drugs during our study. A comprehensive geriatric assessment was performed, in order to exclude moderate or severe dementia, to diagnose cognitive impairment (impairment of attention, verbal fluency, apathy) and to accurately identify possible risks and benefits of dopaminergic treatment. Diagnosis was made on clinical grounds based on patient history and physical examination, and was supported by neuroimaging

assessment (cerebral MRI showed the minimal infarcts of subcortical gray matter nuclei and diffuse white matter ischemic lesions – all patients reported that they had been previously diagnosed with transient ischemic stroke).

c) Tests applied.

Functional assessment was performed with the following scales and tests:

- The Timed Up and Go test was used to determine how quickly (seconds) some daily activities could be performed at a comfortable speed: rise from a chair; walk as quickly as possible at a comfortable and safe pace to a line on the floor, three meters; turn round; walk back to the chair and sit down. In the starting position the patient is sitting in a chair (seat height approximately 45 centimeters) with his feet resting on the floor. The patient's arms rest on the arms of the chair. If necessary, the patient may use a walking aid. The patient has to be able to walk without the help of others. Two test trials were performed 1 min apart and we used the shortest time in the study. All these aspects are mentioned in the medical literature (Silva-Batista et al., 2017).

- The Berg Balance Scale is a 14-item validated scale that evaluates balance abilities during sitting, standing and positional changes (turning, reaching forward). Items are rated from 0 to 4, with 0 meaning the subject needs assistance, is unable to perform the task; 4 meaning the subject can perform the task safely and independently. Total scores are indicative of overall balance abilities, with a score of 0 to 20 indicating wheelchair bound; a score of 21 to 40 indicating walking with assistance, and 41 to 56 indicating independent. It is easy to administer in approximately 20 minutes (Qutubuddin et al., 2005; Conradsson et al., 2007). Minimal detectable change (MCD) was found to be +/−6 points among patients who suffered a stroke and +/−5 points in patients with parkinsonism, especially with PD (Steffen & Seney, 2008).

- The 2 MWD (two-minute walking distance) test. This test assesses the walking capacity during a 2 minute period; the patient is instructed to walk back and forth along a 20-m corridor and to cover the maximum distance possible in 2 minutes, taking rests as needed. The maximum distance covered is recorded. Examiners provide standardized encouragement every 30 seconds, by telling the patient "you're doing well, keep up the good work." Two trials should be performed at baseline, approximately 20 minutes apart. During the rest interval, participants can sit down. If an assistive device is used, the type of device is recorded (Falvo & Earhart, 2009; Hohler et al., 2012). We chose this short form of test (usually the 6 MWD – six-minute walking distance test is employed) because our patients were old and had gait disturbance, so they had to walk only 2 minutes in order to evaluate and monitor the walking capacity.

- The NEADL (Nottingham Extended Activities of Daily Living) scale was used as a single assessment of independence, to review the progress of a patient over time; it contains 22 items grouped in four sections of daily life (items 1-6 in Section 1 Mobility; items 7-11 in Section 2 Kitchen; items 12-16 in Section 3 Domestic; items 17-22 in Section 4 Leisure); each item is quantified on a 4-point scale (0 - unable, 1 - with help, 2 - possible with difficulty, 3 - able); the maximum possible score is 22, and a higher score means greater independence (Wu et al., 2011). This scale is used in clinical trials to quantify the effects of rehabilitation programs on the quality of life of elderly people with various disorders.

After complete evaluation, all study group patients were trained for 6 weeks. We applied a complex rehabilitation program that covered the following compartments: hygienic-dietary and educational (for risk factors), medication, physical (procedures of electrotherapy - TENS and ultrasound), kinetic, massage, adapted for each patient.

We designed a *kinetic program*, defining the following:

- assistance rehabilitation constituent;
- optimal exercises in the kinetic program applied in relation to the evolution of the condition and global clinical-functional status;
- optimal period of treatment after obtaining the amelioration of neuromotor status, with recovery of motor control, within possible limits;
- optimal number of rehabilitation sessions and also their periodicity for the complete recovery of the patient.

The *objectives of the kinetic program* applied to our patients were:

- body posture correction;
- muscle strengthening;
- decreasing bradykinesia;
- improving functional abilities (especially gait) and decreasing the risk of falling;
- improving quality of life.

Patients were trained 3 days a week, for 6 weeks. Each patient attended two kinetic sessions per day (*a.m.* - strength and physical conditioning training programs and *p.m.* - coordination exercises). Both training sessions were conducted as individual treatment in an outpatient setting with the same duration and frequency as follows: 18 treatment sessions of 30-40 minutes each, 3 days a week, for 6 consecutive weeks.

A.m. exercises. In the first week, all patients performed lower limb and upper limb joint mobilization, 2 sets of 8 repetitions, followed by conventional resistance exercises (for gluteus maximus and medius, half-squat, plantar flexion, and leg-press, trunk extension, in this order). A rest interval of three minutes was allowed between exercises and sets. In the second week, patients performed the same exercises, but 3 sets of 10 repetitions, and in the last week 4 sets of 12 repetitions. We respected a linear progression of training because we tried to maximize training adaptations during our rehabilitation program. We used exercises based on eccentric contraction and progressive resistance training. At the end of the a.m. program, each patient performed walking and stepping activities for 10-15 minutes. Heart rate was monitored.

P.m. exercises. The coordination exercises applied p.m. were represented by the following sequences:

- exercises for axial mobility (head extension, shoulder flexion, trunk extension, in this order) associated with muscle relaxation and diaphragmatic breathing to increase the range of motion of the neck and trunk. The exercises for active mobilization were represented through the Kabat diagonals (flexion and extension first diagonals, flexion and extension second diagonals for each side and

both sides); each patient performed 10 exercises without resistance in the first two sessions and then with resistance; breathing was synchronized with the Kabat diagonal. In the sitting position the patient performed exercises for the scapulohumeral joint and the elbow joint, for the trunk and upper limbs, and finally, for the trunk and lower limbs.

- stretching tight extensor muscles;
- exercises for balance improvement, using compensatory strategies such as the hip strategy and the step strategy, including corrective walking;
- gait training, using external cues (visual and auditory cues) and specific tasks; appropriate assistive devices for ambulation were suggested for all studied patients.

Exercises for corrective walking with visual step cues were necessary for the promotion of balance movements (the upper limbs along the trunk associated with the twisting motion of the trunk). In the first stage, we applied lower limb joint mobilizations; for example:

- walking in a straight line, with the foot placed in the previously marked traces (established through the normal walking scheme); after 3-4 sessions of walking training, we placed sticks and cardboard boxes with a height of 10-15 cm, in order to train patients to walk with small steps and to break through fear of obstacles;
- command during gait (we alternated low and high tones during gait training to stimulate leg drops and lifts) and sudden change of the walking direction;
- stepping front and back;
- making a sudden stop and beginning the walking scheme;
- zigzag walking on tiptoes.
- specific training in standing position, such as activities involving clothing and hygiene, and coordination of movements in order to shift the center of mass inside the body base.

After the rehabilitation program, all patients could perform the exercises on their own at home. A properly designed daily home exercise program included stretching and aerobic training and postural exercises with permanent self-control.

d) Statistical processing.

We used statistical methods to process our results in accordance with the design of our study - p Chi square and two nonparametric tests (Mann-Whitney test and Wilcoxon test) because our data did not have a Gaussian distribution.

Results

The two groups (control and study) were compatible in structure. In both cases, the percent differences had no statistical significance when comparing the distribution by sex and residence (p χ^2=0.686 for sex, respectively p χ^2=0.148 for residence) (Table I).

By comparing the age distributions of the two patient groups with the Mann-Whitney test, no statistically significant differences were obtained (pMW=0.102), but there was a tendency for a younger age in the E group.

The analysis of the UP & GO test scores showed that in the study group there were very significant differences between the initial and the final values (pW = 0.0009), while in the control group the differences were not significant, pW = 0.059 > 0.05. A comparison at baseline of the control and study groups indicated that differences were almost non-existent (pMW = 0.941). Finally, the differences between the groups became significant, with a Mann-Whitney test result pMW = 0.0.011 > 0.001 (Table II).

By analyzing the BERG scores, significant differences (close to the high significance limit) between the initial values and the final values were found in the study group (pW = 0.0010), while there was a significant difference in the control group, pW = 0.020 <0.05. By comparing the control and study groups at baseline, no significant difference was obtained (pMW = 0.679). Finally, the differences between the groups became significant, with a Mann-Whitney test result pMW = 0.015 < 0.05 (Table II).

The analysis of the 2MWD scores evidenced significant differences (close to the high significance limit) between the initial and the final values in the study group (pW = 0.0011 > 0.001), while there was a significant difference in the control group, pW = 0.0024 < 0.05. A comparison at the initial time between the control and study groups showed no significant difference (pMW = 0.846). Finally, the differences between the groups became significant, with a Mann-Whitney test result pMW = 0.003 < 0.05 (Table II).

By analyzing the NEADL scores, very significant differences between the initial and the final values were found in the study group, pW = 0.0009, while there was a difference at the limit of significance in the control group, the Wilcoxon test result being pW = 0.049 < 0.05. By comparing at baseline the control and study groups, no significant difference was obtained (pMW = 0.138). Finally, the differences between the groups became even smaller (p = 0.355 > 0.05) (Table II). This could be explained by the fact that if at the beginning the values in the study group were lower than those in the control group, the situation was finally reversed and the values in the study group became slightly higher than those in the control group.

Table I

The biographical data of our patients

Group	Men	Women	Urban	Rural	Age (years)	
C Control group 13 patients	11 (84.62%)	2 (15.38%)	10 (76.92%)	3 (23.08%)	Minimum	70
					Quartile 1	76
					Median	77
					Quartile 3	78
					Maximum	80
E Study group 14 patients	11 (78.57%)	3 (21.43%)	7 (50.00%)	7 (50.00%)	Minimum	70
					Quartile 1	73.25
					Median	75
					Quartile 3	76
					Maximum	79

Discussions

The signs and symptoms of parkinsonism, particularly of VP, have a high prevalence in older persons, like in our studied patients (Lauretani et al., 2010).

Despite the progress made in the understanding of other parkinsonian syndromes and significant developments in neuroimaging techniques, the concept of VP is still unclear and clinical diagnosis is often difficult. There are no widely agreed upon diagnostic criteria. Patients with VP might have the same symptoms as those with idiopathic Parkinson's disease, although it often affects the lower rather than the upper part of the body (Benamer & Grosset, 2009). Our patients did not present residual deficits from previous strokes because they only had a history of transient ischemic stroke. Vascular parkinsonism (VP) is a poorly defined condition which has clinical, and perhaps pathological, overlap with other diagnoses. Although classical VP involves lesions of the basal ganglia, the majority of the cases actually show diffuse subcortical white matter changes on imaging. The exact pathologies of these white matter changes are debated and likely heterogeneous, but are generally thought to represent areas of chronic or recurrent partial ischemia, a number of small strokes that results in damage to several brain vessels. While this disorder rarely exhibits the symptoms of tremors, patients are likely to lose their mental skills and abilities (Pokhabov, 2014; Gupta & Kuruvilla, 2011). These aspects were evidenced in our study patients after imaging assessment.

A clear correlation between clinical presentation and radiological features was not observed in our study, similarly to other studies (Kalra et al., 2010).

In the assessment of our patients, we used valid and reliable instruments. The Timed Up and Go test is a short practical test by which gait and balance are tested (Keus et al., 2004). Our results for BBS, 2MWD and NEADL scales were less obvious than in other studies (Conradsson et al., 2007; Wu et al., 2011), but changes in the study patients were significant, which suggests the efficiency of the rehabilitation program for the patients' functional gait and balance status.

The rehabilitation program in our study was established and applied after a careful examination of the patients. Also, it is known that parkinsonism is associated with negative outcomes in the elderly and there is still uncertainty about when and how to start the treatment (Lauretani et al., 2010).

The treatment approach for VP can be problematic, and clinicians should emphasize control of comorbidities and vascular risks, and it also involves a multidisciplinary team with a physical therapist, a speech pathologist and an occupational therapist, in order to achieve the best functional performance and quality of life for each patient (Cardoso et al., 2012).

We applied a complex rehabilitation program to our patients because we took into consideration that VP does not respond well to the typical medications used to treat Parkinson's disease. First, we focused on the control of stroke risk factors - a sedentary lifestyle, smoking, high blood pressure and high cholesterol. We considered that physical therapy plays an important role in preventing falling, through training to improve gait, balance and development of compensatory strategies, as mentioned in the literature data (Lauretani et al., 2016; Benamer & Grosset, 2009).

The first rehabilitation measure – control of stroke risk factors in VP patients – was followed by the kinetic program. We structured the kinetic program depending on the dysfunctional aspects of our patients – postural instability, gait and balance difficulties, rigidity, mobility and strengthening impairments.

The control of posture in patients with VP is very important. Due to postural instability and balance impairment, patients lean forward, are prone to falls, have drooping shoulders and a bowed head; to compensate for this, they develop a disturbance of gait, stop mid-walk, and take small and rapid steps to keep their balance. Because of gradual loss of movement, patients are unable to perform ordinary motions and normal activities such as various ADLs (Chang et al., 2008; Factor, 2008).

All these impairments play a decisive role in determining the severity of the patients' status and quality of life (Pokhabov, 2014). So, we considered it very important to perform a complete kinetic program. Perhaps, like in fundamental research for Parkinson's disease (recent animal studies have suggested that exercise rehabilitation may stimulate the production of brain-derived neurotrophic factors, normalize dopamine production, and protect nigrostriatal neurons that usually deteriorate in PD), it is plausible that effective non-pharmacological treatment strategies might lead to lower therapeutic levels of dopaminergic medications for some patients (Johnson & Almeida, 2007).

People with disabilities are less physically active than those without disabilities. Otherwise, there is

Table II

The studied parameter values

Studied parameter	Study group		P	Control group		p
	Initial (M ± SD)	Final (M ± SD)		Initial (M ± SD)	Final (M ± SD)	
UPGO (seconds)	92.07 ± 3.47	83.85 ± 4.84	0.0009	91.69 ± 2.89	91.15 ± 2.96	0.059
BBS	27.92 ± 5.44	34.35 ± 4.30	0.0001	28.23 ± 5.67	29.00 ± 5.88	0,020
2MWD (meters)	48.35 ± 5.44	60.64 ± 7.46	0.0011	48.84 ± 4.45	52 ± 3.26	0.0024
NEADL scale	25.14 ± 5.62	31.28 ± 4.41	0.0009	27.53 ± 4.31	29.46 ± 3.84	0.049

UPGO = Timed Up and Go test, BBS = Berg Balance Scale, 2MWD = 2-minute walking distance, NEADL scale = Nottingham Extended Activities of Daily Living scale

consensus in the literature that regular exercise practice improves physical and functional performance in different populations (Nelson et al., 2007; Dalgas et al., 2009).

The important role of a kinetic program in patients with parkinsonism is mentioned in the medical literature. For example, normalizing the body posture and exercises to improve balance are important components of a rehabilitation program for stimulating the balance of patients with parkinsonism (Toole et al., 2000). It has been demonstrated that in healthy elderly persons, an exercise program focused on walking, mobility of the joints and muscle strength decreases the number of falls, an important aspect for the quality of life of these patients (Gillespie et al., 2003). We obtained the same good results with our patients after combining strength and balance exercises as in other studies, where the authors examined the relationship between muscle strength, power and balance performance in healthy older adults (Orr, 2010; Hess et al., 2006).

Rhythmic recurring cues are frequently used in the assessment and the kinetic program of patients with PD and VP. The assessment of step variability allows to objectively differentiate gait, and the method of tempo-rhythmic correction of gait with sound stimulation allows to significantly improve the patient's gait parameters and quality of life without changing the dose of antiparkinsonian drugs (Pokhabov et al., 2009). It is suggested that cues allow a movement to be directly controlled by the cortex, with little or no involvement of basal ganglia. So-called cues are used to complete or replace this reduced or even absent internal control. Rhythmic recurring cues are given as a continuous rhythmic stimulus, which can serve as a control mechanism for walking.

Various aerobic exercise programs have shown an improvement in gait and quality of life for individuals with parkinsonism. The study conducted by Rodrigues-de-Paula et al. demonstrated a significant improvement in quality of life after a strength training program and aerobic exercises using walking and stepping activities with heart rate monitoring. The advantage of this training program is that it can be applied clinically, since it does not require complex or expensive equipment (Toole et al., 2005). The tempo and difficulty of the kinetic exercises must be adjusted, because fatigue has a negative effect on the performance of activities.

The literature data correlated with clinical trials in the rehabilitation of VP patients is more limited compared to clinical trials for Parkinson's disease. So, the training period recommended for the rehabilitation of patients with parkinsonism is unknown. It could be optimal between 6 and 12 weeks.

Probably, kinetic programs in parkinsonism patients can improve brain performance, and the therapeutic impact on gait and balance could be more significant (Guerini et al., 2004). In our study, we did not apply behavioral therapy because we did not have the support of a psychologist in our rehabilitation team, but we are aware that behavioral therapy may help patients limited by fear of falling.

Conclusions

1. Clinical management is essential before the rehabilitation program.

2. The kinetic program includes active exercises that involve both the somatosensory and musculoskeletal systems, so that patients will be able to respond optimally and improve their postural control, gait and balance.

3. The rehabilitation program is mainly aimed at maximizing functional ability and quality of life in patients with vascular parkinsonism.

4. Our study is a beginning for the development of an evidence-based practice in the rehabilitation of older patients with parkinsonism.

5. Further research on larger samples is needed to validate our results.

Conflicts of interest

No conflicts of interests

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