Case Report

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Balance and Walking Improvement After Robotic Assisted Gait Training in Cortico basal Degeneration: A Need for More Studies

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Abstract

Objective: Corticobasal Degeneration (CBD) is a slowly progressive tauopathy, frequently associated with balance and gait impairments with associated increased risk of fall and poorly responding to pharmacological treatments. To date, no data are available about the effectiveness of a rehabilitation programs including robotic-assisted gait training (RAGT) in these patients. Aim of this study is to test the effectiveness of a RAGT program on balance and gait performances in a patient affected by CBD.

Subject: A 75-year old female affected by CBD.

Methods: The patient was assessed by means of clinical scales and instrumental analysis, at the beginning (T0), after 4 consecutive weeks of conventional physical treatment (CPT) with over ground gait training (T1), and after other 4 consecutive weeks of RAGT, in addition to CPT (T2). Both over ground training and RAGT were performed for 30 minutes/session, 6 sessions/week, for 4 weeks (24 sessions in total).

Results: Both conventional gait training and RAGT led to improvements in balance and walking performances, after ground floor gait training and RAGT were reported, with better results after RAGT
Conclusions: This study showed that RAGT, more than a ground floor gait training performed in addition to a CPT, can be effective to improve balance and gait in CBD patients.

Keywords: Corticobasal degeneration; Balance; Robotic assisted gait training

Introduction

Cortico-basal degeneration (CBD) is an increasingly recognized neurodegenerative disease, classified as tauopathy and characterized by an asymmetric rigid syndrome and apraxia along with cortical dysfunction related to an asymmetric fronto-parietal neuronal loss with variable subcortical involvement [1]. Postural instability and gait impairment with an increased risk of falls are the most disabling motor symptoms and represent the major source of morbidity in these patients [2]. As to date, there are no treatments to modify the pathophysiology of tau-associated neurodegeneration; indeed, pharmacologic therapy is typically symptomatic and minimally effective, especially in the advanced stages of the disease [3]. Despite an increasing evidence that support the efficacy of exercise in neurodegenerative disorders and in particular in Parkinson's Disease (PD) patients [4], little is known about the effects of exercise on tauopathies or other parkinsonian disorders. Specifically, there is still scarce evidence regarding the efficacy of exercise programs in people affected by CBD [5] and no description of the effect of robotic-assisted gait training (RAGT) in this population was reported. We report the case of a CBD patient who performed a rehabilitation program based on RAGT aimed at improving balance and walking performances.

Case Description

A 75 year-old right-handed female, affected by CBD, with asymmetric limb rigidity, apraxia, impaired balance and gait, was admitted to our Department of Neurorehabilitation, to perform a rehabilitation program. Her medical history began in 2010 with a lack of dexterity and a mild clumsiness to the upper right limb (URL). Over the months, a bilateral plastic rigidity (more pronounced on the right side), gait abnormalities including short and slow steps with decreased arm swing, also appeared. In 2012 she was, first, diagnosed as having PD, and treated with levodopa, pramipexole and rasagiline without benefits. Meanwhile, ideo-motor apraxia (particularly on the right hand), a flexion dystonic attitude and an irregular tremor appeared on the right arm. A brain magnetic resonance (MR) highlighted an initial cortico-subcortical atrophy. The FGT-PET disclosed an asymmetrical uptake (left>right), thus suggesting a CBD diagnosis. Progressively, a loss of coordination and a tendency to fall while walking were developed. In 2014, on the basis of the progressive worsening of her clinical history, a diagnosis of probable CBD was posed, and a rehabilitative program proposed. At the admission, she presented mild difficulties in executive and praxic skills (ideo-motor and ideational apraxia, with a MMSE 25/30; alien URL syndrome, bradykinesia with prevailing impairment on the right side, irregular tremor to the right hand and postural instability with multidirectional swings to the Romberg test were also evidenced. Uncertain gait characterized by short and slow steps, episodic freezing on starting and turning was revealed. No rehabilitation or changes in pharmacological treatment in the three months before the study were reported. She gave informed consent before study participation. The study was approved by the local ethics committee.

Clinical and instrumental assessment

The patient was assessed both clinically and instrumentally at the admission (T0), after 4 consecutive weeks of conventional physical treatment (CPT) with overground gait training (T1), and after other 4 consecutive weeks of RAGT, in addition to CPT (T2). The following clinical and motor scales were administered: the Movement Disorder Society – Unified Parkinson's Disease Rating Scale motor sub-scores (MDS-UPDRS-III) to quantify disease severity and extrapyramidal signs, and Tinetti Test (TT) to assess balance and walking ability [6]. The instrumental assessment of gait was performed by means of Myolab Clinic (BTS engineering, Milan, Italy). The Myolab Clinic is equipped by footswitches that placed under each sole provide a measure of the vertical forces under the foot (heel, external and internal side). The patient was asked to walk barefoot, at her own natural pace (self-selected and comfortable speed), along a 10 meters walkway. Plantar pressures under each foot were recorded at a rate of 100 Hz, measurements were stored in a memory card during the walk, and successively transferred to a computer for the offline analysis. Instrumental assessment provided the following data: cadence (number of step/minute), step length (cm), gait speed mean (m/s) and double support time (%).

Rehabilitation program

During the hospitalization the patient performed overground gait training (24 sessions, 6 sessions/week, each session lasting 30 minutes) in addition to CPT (24 sessions, lasting 60 minutes) designed for people with PD and available at the "exercise with PD" website . The CPT provided a general exercise program consisting of 10 minutes of cardiovascular warm-up exercises, 20 minutes of trunk and lower extremity stretching and strengthening, 10 minutes of upright balance and strengthening exercises, 20 minutes of coordination and dual task activities. At the end of this program a RAGT based on Lokomat combined with a CPT (24 sessions, 6 sessions/week, each session lasting 30 minutes) was performed. Lokomat (Hocoma, Zurich, Switzerland) is an exoskeleton robotic device for the lower limbs that offers a mechanical guidance to the lower extremity trajectories. The system uses a dynamic body weight-support system (BWSS) to support the participant above a synchronized motorized treadmill. It ensures physically guided repetitive, rhythmic, bilateral lower extremity movements in order to simulate a physiological gait cycle, while the patient is encouraged to actively step during the robotic movement. The RAGT started with BWS setted to 70% body weight-support and an initial treadmill speed of 1.5 km/h. The speed was progressively increased up to 2 km/h while BWS was decreased to 40%. Range of motion at the hip joint was set at 45 °.

Results

Data obtained at T0, T1 and T2 are summarized in **Table 1**. No adverse effects were detected during or after the treatment. The score at the MDS-UPDRS-III decreased from T0, T1 and T2 (50, 47 and 41 respectively) showing an improvement of motor function; the total gain (T2-T0=-9) revealed an increase of 18% compared to the starting value. The scores at the TT increased from T0, T1 and T2 for both balance (6,7 and 10) and gait (2, 3 and 5) indicating an improvement of balance and ambulation. The total gain indicated an increase of 66.7% for balance (T2-T0=4) and of 150% for gait (T2-T0=3), when compared to the baseline. The spatiotemporal parameters of gait cycle improved through T0, T1 and T2 (see **Table 1**). Reliable change index (RCI) was used to evaluate whether a change in an individual's score (i.e., between T0 and T1, and T2 and T3) was statistically significant or not (based on how reliable the measure is). RCI is defined as the change in an individual's score divided by the stan-dard error of the difference (SEdiff) for the test being used. The boundary value for statistical significance within the RCI is ≥ 1.96 (1.96 equates to the 95% confi-dence interval)

Table 1: Clinical and instrumental data

Clinical data	**T0**	**T1**	**T2**
MDS-UPDRS-III	50	47	41 (RCI 2.2)
TT-B	7	7	10 (RCI 2.6)
TT-G	2	3	5 (RCI 2.3)
Instrumental data			
Gait Speed (m/s)	0.32	0.39 (21.9% *vs* T0)	0.56 (43.6% *vs* T1) (RCI 3)
Cadence (s/m)	69.3	66.2 (4.5% *vs* T0)	60.1 (9.2% *vs* T1)
Step length (cm)	48.9	51.4 (5.1% *vs* T0)	58.5 (13.8% *vs* T1) (RCI 1.9)
Double support time (%)	53	50 (5.6% *vs* T0)	45(10% *vs* T1)

Discussion

The results of this study showed that RAGT induced a greater improvement on balance and walking ability than a ground floor gait training in a CBD patient. Balance impairment and gait disorders represent very disabling features of parkinsonian syndromes influencing the independence and the quality of life. Several studies supported the relevance of physical exercise in PD patients suggesting also a neuro-protective effect. In the last 10 years, a number of studies considered RAGT a promising tool for gait rehabilitation, also in preventing risk of falls in several neurological disorders. To date some studies reported that RAGT can slow the clinical progression of PD improving mainly postural instability and gait disturbances. To our knowledge, this is the first report about the effectiveness of RAGT on balance and gait recovery in CBD patients. This report has to be considered as a pilot study and pinpoints the need for further explorations on the role of exercise in maintaining functional mobility also in patients affected by parkinsonian syndromes. Although preliminary, our results support the hypothesis that a RAGT can be effective on balance and walking performances in CBD patients.

We believe that the improvement in motor and cognitive function and mood may be partly related to our intensive Lokomat rehabilitation program. Indeed, the patient did not present significant improvement when he performed only traditional physical and cognitive therapy. Thus, the active combination of cognitive therapy and Lokomat may have been more effective in potentiating his global functional status. The positive effect of robotic gait rehabilitation on our patient’s outcome may be related either to the intensive and repetitive aerobic exercises or to the task-oriented training with computerized visual feedback, which can be considered as a relevant tool to increase patients’ motor output, involvement, and motivation during gait training, as we have recently demonstrated in chronic stroke. Lokomat, stimulating the selective attention processes through the use of cues, feedbacks and motivation, probably work positively on the executive functions (including set-shifting, planning and categorization), frequently altered in these patients. The protocol used was easy, reproducible and safe and it allowed the training of CBD subjects with moderate to severe lower limb impairment, thus suggesting it’s routinely application. This may encourage further researches to develop rehabilitation protocols in order to improve balance and walking ability and therefore functional impact on daily life in parkinsonian syndromes.

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