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ANALYSES OF EFFECT OF SYMPTOM FATIGUE AND MUSCLES FATIGUE IN THE GAIT OF THE PATIENTS WITH PARKINSON'S DISEASE

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SUMMARY

Patients with PD show more muscle fatigability than individuals without PD [4]. The muscle fatigue changes the kinematic parameters of the gait in elderly and young individuals [5]. However, it is little known about the effects of symptom of fatigue on walking in the individuals with PD, specially before muscle fatigue. Sixteen patients with DP participated in the study. The patients were distributed into two groups according to the presence (n = 8) or absence (n = 8) of fatigue. The participants performed 3 trials of walking in the pathway (8 meters) before and after muscles fatigue task. To induce muscle fatigue, the participants performed the sit-to-stand task. The dependents variables were stride length, stride width, stride duration, single and double support duration, stride velocity and maximum force in the maximum voluntary contractions. We concluded that patients with symptom of fatigue were more affected than patients without symptom of fatigue, who need more stability after muscle fatigue.

INTRODUCTION

The symptom of fatigue is a usual non-motor in patients with Parkinson's disease (PD) [1]. Increase in this symptom has been associated with falls [2] and longer Up and Go performance time [3]. Moreover, patients with PD show more muscle fatigability than individuals without PD [4]. The muscle fatigue changes the kinematic parameters of the gait in elderly and young individuals [5]. However, it is little known about the effects of symptom of fatigue on walking in the individuals with PD, specially before muscle fatigue. So, the aim of this study is to compare the effects of muscle fatigue on walking kinematics parameters between patients with PD with symptom of fatigue and without symptom of fatigue. The results indicated that patients with symptom of fatigue increased the stride length and stride velocity while the patients without symptom of fatigue decreased stride length and stride speed after muscle fatigue

METHODS

Sixteen patients with PD participated in this study. The patients were distributed into two groups according to the presence (n = 8) or absence (n = 8) of fatigue. A presence of symptom of fatigue was defined as a score $\geq$ 8 on the Parkinson Fatigue Scale [6,7]. A neuropsychiatric evaluated the clinical variables of the groups by Unified Parkinson's Disease Rating Scale (UPDRS) [8] and Hoehn and Yahr Rating Scale (H&Y) [9].

The participants performed 3 trials of gait before and after muscle fatigue. The instruction given to the participant was to walk over an 8 m pathway, at self-selected speed. We analyzed the stride in the middle of the pathway.

Acquisition of kinematic gait parameters was accomplished with a three-dimensional optoelectronic system (OPTOTRAK Certus), positioned in the sagittal right plane, using a sample rate of 100 samples/s. Four infrared emitters were placed over the following anatomical points: lateral face of calcaneus and head of the fifth metatarsus of the right limb, and medial face of calcaneus and head of the first metatarsus of the left limb.

To induce muscle fatigue, the participant performed the sit-to-stand task, with arms across the chest region from a chair [11], with the speed controlled by a metronome (30 beats/min). The fatigue protocol was stopped when the participant indicated that he or she was unable to continue, when the movement frequency fell below and remained below 0.5Hz after encouragement, or after 30min.

The kinematic variables analyzed were the stride length, step width, stride duration, single and double support duration, and stride velocity. The dependent variables of interest were statistically analyzed with SPSS 15.0 for Windows® ($p < 0.05$). The data were normally distributed, verified by the Shapiro-Wilk test. The age, anthropometric characteristics and clinical variables were compared between the groups (with and without fatigue symptom) through the ANOVA. The kinematic parameters were analyzed by MANOVA (group x walking) with repeated measures for muscle fatigue (before and after muscle fatigue). Bonferroni post hoc test was used to localize the differences.

RESULTS AND DISCUSSION

The groups were similar for age, anthropometric characteristics and clinical variables (Table 1).

Table 1. Age, Anthropometrics and Clinical Characteristics in the Groups without and without fatigue patients with PD.

	Patients with PD	
	Without Fatigue	With Fatigue
Age (year)	68.63 ± 11.5	65.5 ± 7
height (cm)	164.7 ± 6.8	168.03 ± 8.9
Weight (kg)	73.18 ± 4.1	73.99 ± 4.2
H&Y	1.69 ± 0.26	1.75 ± 0.27
UPDRS motor	19.25 ± 4.71	21.5 ± 4.41

The MANOVA did not show effect of group (Wilks' Lambda = 0.895; F = o,984; p= 0.489) and muscle fatigue (Wilks' Lambda = 0.890; F = 1.599b; p= 0.181), but it indicated group*condition interaction (Wilks' Lambda = 0.72; F = 3.19; p= 0.016). Post hoc testes indicated that patients with symptom of fatigue increased the stride length and stride velocity while the patients without symptom of fatigue decreased stride length and stride speed after muscle fatigue (Table 2).

The patients with symptom of fatigue appeared to seek more stability during gait after muscle fatigue. An increase in step length would facilitate control of balance in the forward direction [12]. Increased speed appears to be the preferred strategy to deal with balance threats [12], moreover when stride duration is reduced, which did not happen in this study. On the other hand participants may have tried to perform the task as quickly as possible and the increase in speed could be a risky strategy [12].

The patients with symptom of fatigue seemed more affected by muscle fatigue. This strategy may occur due to worse muscle condition of patients with symptom of fatigue [3]. The patients without symptom of fatigue decreased the velocity and the stride length after muscle fatigue. This strategy seems a safe strategy since the muscles are fatigued and the individual can reduce the energy cost and muscle requirement. With the reduction in the stride velocity, the patients without symptom of fatigue have more time for online adjustments during the gait.

CONCLUSIONS

Patients with PD with and without symptom of fatigue showed different strategy after muscle fatigue. Patients with symptom of fatigue were more affected than patients without symptom of fatigue, who need more stability after muscle fatigue.

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Table 2. Mean and standard deviation kinematics gait parameters for the patients with Parkinson's disease before and after muscle fatigue task

Stride Length (cm)*		**Step width (cm)**		**Stride duration (s)**		**Single Suport (s)**		**Double Suport (S)**		**Stride velocity (cm/s)***	
Before	After	Before	After	Before	After	Before	After	Before	After	Before	After
119.76 ± 18.28	113.26 ± 14.56	9.242 ± 3.54	10.32 ± 2.29	1.04 ± 0.102	1.06 ± 0.11	68.83 ± 4.05	67.33 ± 4.47	31.17 ± 4.02	32.673 ± 4.48	117.57 ± 25.28	109.45 ± 24.51
117.87 ± 14.78	123.41 ± 13.5	9.25 ± 3.30	11.53 ± 3.6	1.03 ± 0,14	1.011 ± 0.12	69.42 ± 4.7	70.35 ± 4.76	30.6 ± 4.71	29.65 ± 4.75	117.09 ± 21.9	125.23 ± 27.24