Multiple Sclerosis and Related Disorders 7 (2016) 85–91

Contents lists available at ScienceDirect

Multiple Sclerosis and Related Disorders

journal homepage: www.elsevier.com/locate/msard

Effects of motor-motor and motor-cognitive tasks on balance in patients with multiple sclerosis

Fulya Mercan [a,*], Bilge Kara [b], Bedile Irem Tiftikcioglu [c], Emrah Mercan [d], Filiz Meryem Sertpoyraz [d]

[a] Department of Physical Therapy and Rehabilitation, Dr. Suat Seren Chest Diseases and Surgery Education and Research Hospital, 35170 Izmir, Turkey
[b] Dokuz Eylul University School of Physical Therapy and Rehabilitation, Izmir, Turkey
[c] Department of Neurology, Tepecik Education and Research Hospital, Izmir, Turkey
[d] Department of Physical Therapy and Rehabilitation, Tepecik Education and Research Hospital, Izmir, Turkey

ARTICLE INFO

Article history:
Received 27 July 2015
Received in revised form
20 October 2015
Accepted 28 March 2016

Keywords:
Multiple sclerosis
Dual task
Balance
Quality of life
Rehabilitation

ABSTRACT

Background: Dual tasking is frequently impaired in Multiple Sclerosis (MS), substantially impairing quality of life (QoL). We aimed to examine the effects of motor-motor and motor-cognitive tasks on balance in highly mobile patients with relapsing-remitting MS (RRMS), with mild disability.
Methods: Thirty-eight patients and 34 controls were included. Steady Stance Test (SST), Berg Balance Scale (BBS) and Activities-specific Balance Confidence Scale (ABC) were used to evaluate the balance. Expanded Disability Status Scale (EDSS), Mini-mental State Examination (MMSE), Beck Depression Inventory (BDI) and Fatigue Impact Scale (FIS) were used to evaluate disability, cognitive impairment, depression and fatigue, respectively.
Results: BBS and ABC scores were significantly different between the groups. Also, balance was significantly impaired in patients. Eyes-open left single stance test was the most efficient test to reveal the balance impairment in RRMS patients independent of dual-task. Physical component of FIS affected this test independent of age and BMI. Visual input significantly increased the stance durations in majority of SST, especially in tough stance positions with reduced balance area. However, visual input during dual-tasking impaired the balance. In addition, eyes-closed left tandem stance test with MM dual task significantly improved the balance in patients. BBS was significantly correlated with EDSS(r: −0.336), ABC (r: 0.688), FIS physical subgroup(r: −0.614) and FIS social subgroup(r: −0.475).
Conclusion: Dual-tasking improves balance and increases QoL in patients with RRMS. Eyes closed balance treatment with motor-dual task could be beneficial.

1. Introduction

Multiple sclerosis (MS) is a chronic neurological disease, which affects the patients and their caregivers in the worst sense (Soyuer et al., 2006). Impairment in balance and cognition are the two major challenges in individuals with MS (Chiaravalloti and DeLuca, 2008; Frzovic et al., 2000). Disability in balance in MS patients is mainly caused by neurophysiological factors including visual, somatosensory and vestibular impairments, muscle weakness, and spasticity (Cattaneo et al., 2002; Sosnoff et al., 2011). MS also causes deterioration in cognitive function in 30–70% of MS patients (Rao et al., 1991). The domains that are most often affected are attention, memory and information processing speed (Wallin et al., 2006).

During many activities of daily living (ADL), people need to perform more than one task at a time. The capacity to do a second task simultaneously (dual task performance) is essential during walking; because it allows for communication with environment, transportation of objects from one location to another and performing various other activities (Sethi and Raja, 2012). Thus, assessment of walking and cognitive abilities separately may not truly reflect everyday activity. In testing the “dual tasking”, people are often required to do a motor task and perform a cognitive task together (Leona et al., 2015).

Dual tasking is frequently impaired in MS (Hamilton et al. 2009). There are three possible explanations for the development of a dual-tasking deficit: (1) deficits in motor functions (Mulder et al., 2002), (2) deficits in memory capacity and (3) deficits in attention control system (Logie et al., 2004). Impairment in dual tasking has a strong impact on ADL that often require the ability to perform two actions simultaneously (Monticone et al., 2014). Loss of balance effects ADL negatively and decreases quality of life

* Corresponding author.
E-mail address: fulyamercan.d@gmail.com (F. Mercan).

http://dx.doi.org/10.1016/j.msard.2016.03.015
2211-0348/

(QoL). Several studies have demonstrated the adverse consequences of balance impairment such as loss of independence, difficulties in ADL and decreasing the QoL (Finlayson and Van Denend, 2003; Overs et al., 2012; Naci et al., 2010).

However, to the best of our knowledge, the effects of motor-motor and motor-cognitive dual tasking on balance in patients with MS have not been investigated extensively, yet. Therefore, we investigated the effects of motor-motor and motor-cognitive dual tasks on balance in patients with MS in this study.

2. Participants and methods

2.1. Study population

This study was conducted in a single, tertiary-care, Multiple Sclerosis referral center. Forty-four adult patients diagnosed with RRMS according to the McDonald's Criteria (Mc Donald WIi Compston et al., 2001), who had no clinical relapse within the last one-month and EDSS ≤ 5 (Kurtzke, 1983) were recruited, consecutively. Control group consisted of 36 age and gender matched, healthy, volunteering individuals selected from the hospital staff and relatives of the patients who do not have any physical disabilities.

Exclusion criteria were having a diagnosis of depression, dementia, any systemic disease including cardiovascular, respiratory, vestibular and endocrine systems, orthopedic disabilities, and usage of any medication or substance, which may affect cognition or balance. Also, individuals whose Minimental State Examination Test (MMSE) less than 24 and Beck Depression Inventory (BDI) less than 17 (Aydemir and Koroğle, 2009) were excluded from the study.

Six patients with RRMS who had low scores in MMSE and 2 control subjects with the diagnosis of depression were excluded. Finally 38 patients with RRMS and 34 healthy controls were included in the study.

The Local Ethics Committee approved this study. All volunteering patients and control subjects eligible for the study criteria were informed about the aim and the protocol of the study and all participants signed a written informed consent.

2.2. Clinical and demographical data

Demographical data including age, gender, height, weight, education (years) and hand dominancy of all study participants were recorded. Body mass index (BMI) was calculated and categorized according to the WHO classification. Clinical data of MS patients including disease duration, EDSS, falls in the last 6 months and need for walking assistance were also noted. EDSS was calculated by the study neurologist (BIT).

2.3. Measurements

Same physiotherapist (FM) performed all the measurements in the same examination room. All evaluations were conducted in the morning, 2 h after breakfast. Participants had a rest for at least 10 min before starting the tests. The temperature of the examination room was kept constant between 22 and 24 °C. The tests for the assessment of depression, balance and fatigue were performed once in every participant.

2.3.1. Balance

2.3.1.1. Steady stance test (SST). Balance in steady stance is assessed in 5 positions. Subject is instructed to keep the position for 30 s A successful test is ended after standing still for 30 s (Soyuer et al., 2006; Frzovic et al., 2000). Subjects stood on footprint templates (Fig. 1) that corresponded to the stance position being tested. Test positions are:

1. Feet apart, with feet placed 10 cm apart
2. Feet together
3. Stride stance, with feet placed 10 cm apart and with the toes of the rear foot in line with the heel of the front foot
4. Tandem stance, with one foot directly in front of the other with the heel of the front foot in contact with the toes of the rear foot
5. Single leg stance, with the subject standing on one leg

Stride and tandem stances were each tested twice: once with the right foot in front and once with the left foot in the front position. Single leg stance was also measured twice: once with subjects standing on the right leg, and once with subjects standing on the left leg.

All positions were repeated in both eyes opened (EO) and closed (EC). Then, all tests were repeated with motor and cognitive tasks.

1. Motor - motor (MM) dual task: Subject is instructed to maintain balance while carrying 3 empty paper cups on a tray during performing the tests.
2. Motor-cognitive (MC) dual task: Subject is instructed to maintain balance while one-by-onecounting down a randomly selected two-digit number during performing the tests.

2.3.1.2. Berg balance scale (BBS). This scale has been validated for MS patients and assesses 14 daily tasks (Sahin et al., 2008; Cattaneo et al., 2002). Each task is scored between 0 and 4; the maximal score is 56. Scores between 0 and 20 indicates a high fall risk, 21-40 indicates a medium fall risk and 41-56 indicates a low fall risk.

2.3.1.3. Activities-specific balance confidence scale (ABC). This scale describes the degree of confidence one feels during the activities and is assessed by 16 questions (Powell and Myers, 1995). Each question is scored between 0 (fully insecure) and 100% (fully safe) and the final test score is the average of them all. A score of $\geq 80\%$ indicates high level of physical functioning, 50-80% indicates moderate and score less than 50% indicates a low level of physical functioning (Cattaneo et al., 2002). Previously, scores less than 67% have been found as a risk factor for falling in older adults and denoted as a predictor of a future fall (Nilsagard et al., 2014).

2.3.2. Fatigue

2.3.2.1. Fatigue impact scale (FIS). This scale includes 40 questions and assesses the amount of fatigue affected by the person's activities of daily living (ADL) (Fisk et al., 1994). The maximum score is 160. First 10 questions evaluate cognitive fatigue, second 10 questions evaluate physical fatigue and the remaining assesses the social fatigue.

2.4. Statistical analysis

Statistical analysis was performed using SPSS v.17.0 (Statistical Package for Social Sciences) for Windows. Kolmogorov-Smirnov normality test was used for testing the normal distribution of data, where needed. Categorical data were compared using the $\chi 2$ - test or Fisher's exact tests, where appropriate. The mean values of normally distributed data were compared using student's *t* test or Mann–Whitney *U* test was used otherwise. Wilcoxon signed ranks test was used to evaluate the effect of tasks on balance (comparisons between tests without task *vs.* tests with MM-dual task, tests without task *vs.* tests with MC-dual task and tests with MM-dual task *vs.* tests with MC-dual task) and the effect of visual input