POSTURAL CONTROL AND BALANCE REACTIONS IN PATIENTS WITH ISCHEMIC STROKE IN THE CHRONIC PERIOD

Vasileva Danche[1] MSc, Lubenova Daniela[2] PhD, Mihova Marija[3]PhD

1 Faculty of Medical Sciences - University "GoceDelchev" – Shtip, Macedonia
2 Department of Kinesitherapy and rehabilitation - National Sports Academy "Vasil Levski" – Sofia
3 Faculty of Computer Sciences and engineering – University "Ss.Kyril and Methodius" – Skopje, Macedonia

Address for correspondence:
Teaching assistant Dance Vasileva, MSc
Faculty of Medical Sciences
University "GoceDelchev"
St. KrsteMisirkov 10-A
2000 Stip, R.Macedonia
Тел. +389 78 493 331
e-mail: dance.vasileva@ugd.edu.mk

Address for correspondence:
Assistant Professor Daniela Lubenova, PhD
Department of Kinesitherapy and Rehabilitation
National Sports Academy "V. Levski"
1 Gurgulyat St.,
1000 Sofia, Bulgaria
tel: (+359 2) 988 15 13, ext. 250
e-mail: lubenova@abv.bg

Address for correspondence:
Professor Marija Mihova, PhD
Faculty of Computer Sciences and engineering
University "Ss.Kyril and Methodius"
16 Rugjer Boshkovikj St,
1000 Skopje, Macedonia
e-mail: marija.mihova@finki.ukim.mk

Keywords: Static balance, Functional balance, Kinesitherapy, Ischemic stroke, Chronic period

Introduction

Postural control is the ability to retain the center of gravity of the body on the support surface while sitting and in standing position. It is a dynamic phenomenon which combines simultaneously mobility and stability of a necessary condition for lending and retaining the required body posture when is necessary to perform controlled and coordinated motor activity [11]. Impaired balance reduces the ability of independence in daily life [17]. Patients with stroke have limited physical activity that changes the sensorimotor control, postural control, the musculoskeletal system and the autonomous control. This creates progressive cardiovascular risk for development of disease, and predisposition to recurrent stroke [8, 13, 14]. Due to the long-lasting constraints, physical performance and the social adaptation of the patients has been hampered [2].

In stroke, abnormal postural response can not be due only to the unilateral sensorimotor dysfunction. It is known that stroke can reduce the vestibular function and that this may affect

the postural reaction on both sides of the body with violation of the vestibulo-ocular reflex [5]. In patients with stroke is impaired ability for transferring the burden in swing phase. Patients have difficulties in maintaining upright standing position with the affected side, have difficulty controlling the muscles and difficulty to respond to proprioceptive feedback effect, providing additional balance difficulties. Balance in patients with stroke can be further aggravated by postural hypotension, adverse drug effects, mental status, abnormal vision, and other conditions associated with neuropathy, arthritis, and altered cognitive status [15].

The plasticity of the central nervous system is necessary to re-establish the balance while sitting and standing, in patients with stroke [10]. But still is not clear whether the improvements to sitting balance leads to an improvement in straightening, standing, sitting and walking [12].

Kinesitherapeutic means which in modern neurorehabilitation are often applied to improve the postural control, balance reactions and the daily capabilities of the patients with stroke, are using treatment within Bobath methods [3], stimulation of sensory function and biofeedback [19], various exercises, including dual task [9] and sling exercise therapy [6].

According to Gencheva, N., (2003) the exercises with Swiss Ball can significantly improve muscle strength and endurance, coordination of movement and balance control of the body, both in sitting and standing position [7]. In a study of the effect of the application of the kinesitherapeutic methodology with exercises on a Swiss ball, Dimitrova, A., et al., (2007) found a positive effect on the static balance in patients with ischemic stroke in the vertebral-basilar system in the subacute period [4].

The aim of this study was to investigate the influence of specialized kinesitherapeutic methodology (SKTM) on static and functional balance reactions in patients with ischemic stroke in the chronic period, which is developed on the grounds of the principles of motor control, motor learning and modern guidelines to neurodevelopmental treatment (NDT).

Methodology

In the study were included 11 patients with chronic right- sided (63.6%) and left-sided (36.4%) hemiparesis (Tabl. 1) after ischemic stroke within 3 months and one year duration of the disease. The patients studied were evaluated on performance of Berg Balance Scale (BBS) at the beginning of the 10th day, 1st month and 3 months. Performance of Berg Balance Scale has strong psychometric properties and that is valuable in the evaluation of clinical change of the balance after stroke [1].

The original test involves implementation of 14 tasks with elevated difficulty, reflecting the normal activities of daily living (rising from a seated position, taking an object from the floor, standing position on one leg, turning, reaching, step on the block). The first 5 assignments are used to assess the main balance capacity and the remaining 9 (6 to 14 assignments) include more complicated balance tasks. Evaluating the possibilities of the studied patients to maintain the balance while performing tasks with a gradual reduction in the support surface, with weight transfer of the body to turn and reach. The first task is performed by seating and ends with standing position on one leg. The assessment uses a 5 point scale (0-4) depending on the possibilities to perform a task. These levels are based on precisely defined criteria [18].

The clinical characteristics of the patients are given in Table. 2, where the descriptive characteristics of the studied patients are specified by age, weight and height, the mean and standard deviation of the scores of the stage of functional recovery of Brunnstrom and Ashworth's test for spasticity at baseline of study. For presence of a homogeneity in the study, patients were selected by the following criteria: have not severe respiratory insufficiency, cardiovascular insufficiency (third functional class), uncontrolled diabetes mellitus, cognitive

and memory disorders, acute thrombophlebitis, severe decubital ulcer, severe orthopedic disorders impaired coordination and gait, ischemic heart disease, malignancies, severe progressive neurological disorders. The patients gave a written consent to participate in the study. All patients were able to move around alone or with help, and without serious problems in communication.

The daily specialized kinesitherapy is with moderate overload. In the introductory part, the exercises are focused on preparing the body for the forthcoming exercises, a gradual adaptation of the cardiovascular system (chest and diaphragmatic breathing). The main part of kinesitherapy includes exercises to move from occipital lying to standing position, upper limb exercises and shoulder girdle control, lower limb exercises and control of the trunk, pelvis, and walking. The final part includes relaxation exercises for patients. After 10-day daily kinesitherapy, patients have made adaptations for home rehabilitation program for 3 months.

The resulting data were statistically processed using the descriptive analysis. Paired Samples Test is used to compare the parameters at the beginning of the 10 days, the 1st and 3rd month after kinesitherapy.

Results

Descriptive characteristics by age, weight and height of the studied patients are presented in Table 2. At the study start, have been introduced average values and standard deviation of scores along the stage of functional recovery by Brunnstrom and Ashworth spasticity test. From the values clearly appears that the patients are with mild damage after ischemic stroke, the assessment of the stage of functional recovery by Brunnstrom for upper limb is 3.73 for lower limb - 4.36, and the evaluation of the test for spasticity in Ashworth for upper limb is 2.18 and lower limb - 1.63.

It was found significant change in the mean and standard deviation of static and functional balance with the crisper changes in the value of 10 days (Table 3).

In Table. 4 presents the results of the changes in static and functional balance of the monitored patients. Performance of 1^{st} day, 1^{st} month and 3^{rd} months are not significantly changed ($p > 0.1$). On the 10th day after the beginning of treatment the data were statistically significant ($p = 0.018$). The static balance is significantly lower than the functional improvement, at a value of significance of $p < 0.05$.

In Table. 5 shows the changes in the balance possibilities of the monitored patients being referred to the difference in performance between the 10th and the 1st day, 1st month, 10th day and 3^{rd} month and 1^{st} month. There is improvement in absolute values during treatment, but the statistical significance of the changes is not established.

Discussion

From the present study establishing that SKTM has a tendency to improve static and functional balance in patients studied. To normalize the control between the unaffected and affected side of the body, are used exercises for transition from lying occipital position to standing position, self-taught in changing the initial position and gradual verticalization. The exercises for upper limb and shoulder girdle control normalize the control of movements of the upper limb, control of the health and the affected side of the body and facilitate the performance of the daily living activities.

Exercises for lower limb and control of the trunk and pelvis normalize the control of movement of the lower limb, control of the healthy and the affected side of the body, improve the balance reactions of the body, better coordination and consistency of the motor responses, improved

static balance and the postural control (optimal position of the trunk and lower limbs), stimulate response in m.quadriceps femoris and facilitate walking. Walking exercises normalize control of the trunk and the upper limbs, normalize the control of the healthy and the affected side of the body, improve the balance reactions, better coordination and consistency of the motor response, improved dynamic control and facilitate movement. Similar results were indicated by other authors, arguing that the exercise of the unaffected upper limb during sitting, in which patients are trained to transfer the burden of the body (arm's length), have a positive effect on the seating balance [12]. The exercises in symmetrical standing and seating have a positive effect on the lateral distribution of the burden during these changing situations and the speed of implementation of these activities [16].

Conclusions

The applied by us methodology continued later as an exercise program at home, is with tendency to improve postural control and balance reactions in patients with ischemic stroke in the chronic period.

Acknowledgement

None of the authors and their institution have received any commercial, financial support related to this study.

References

1. Blum, L., Bitensky, N. Usefulness of the Berg Balance Scale in Stroke Rehabilitation: A Systematic Review. Physical Therapy, 88, 55, 2008, 559–566.
2. Bradom, R. Physical Medicine and Rehabilitation. 3rd edn, Tabernakul,2011; 1175-1212.
3. Brock, K. Does physiotherapy based on the Bobath concept, inconjunction with a task practice, achieve greater improvement in walking ability in people with stroke compared to physiotherapy focused on structured task practice alone? A pilot randomized controlled trial. Clin Rehab, 25, 10, 2011, 903-912.17
4. Dimitrova, A., Lubenova, D., Stefanova, D., Simeonova, A. Changes in static balance after applied kinesitherapy for patients with stroke in the vertebral-basilar system. Kinesitherapy, 7, 3, 2007, 50-55.
5. Fitzgerald, D. Persistent dizziness following head trauma and perilymphatic fistula. Arch PhysMedRehabil, 76, 1995, 1017-1020.
6. Fu, J., Tong, S., Chen, Y., Yao, Y., Li, Y. et al. The effect of sling exercises therapy on the balance function in hemiplegic patients after stroke. Chin J Phys Med Rehabil, 34, 2012, 926-997.
7. Gencheva, N. Fit-Ball and Kinesitherapy, Sofia, 2003.
8. Hafer-Macko, C., Ryan, A., Ivey, F., Macko, R. Skeletal muscle changes after hemiparetic stroke and potential beneficial effects of exercise intervention strategies. Journal of Rehabilitation Research & Development, 45, 2, 2008, 261–272.
9. Her, Y., Park, K., Yang, Y., Ko, T., Kim, H., Lee, J., Woo, J., Ko, J. Effects of Balance training with vaious dual task condition on stroke patients. J PhysTherSci, 23, 2011, 713-717.
10. KNGF- Clinical Practice Guideline for physical therapy in patients with stroke. Royal Dutch Society for Physical Therapy, 114, 5, 2004.
11. Morioka, S., Hiyamizu, M., Yagi, F. The effects of an attentional demand tasks on standing posture control.JPhysiolAnthropolAppl Human Sci, 24, 2005; 215-219.

12. Mudie, M., Winzeler-Mercay, U., Radwan, S., Lee, L. Training symmetry of weight distribution after stroke: a randomized controlled pilot study comparing task-related reach, Bobath and feedback training approaches. ClinRehabil, 16, 6, 2002, 582-92.
13. National Stroke Foundation, Clinical Guidelines for Stroke Management, 2010, http://www.nhmrc.gov.au/_files_nhmrc/publications/attachments/cp126.pdf
14. Pang, M., Eng, J., Dawson, A., Gylfadottir, S. The use of aerobic exercise training in improving aerobic capacity in individuals with stroke: a meta-analysis. ClinRehabil, 20, 2, 2006, 97-111.
15. Parik,Sh., Bid, K. Vestibular Rehabilitation. In: DeLisa, J. Physical Medicine and Rehabilitation Principles and practice, Tabenakul, 1, 2012, 957-974.
16. Pollock, A., Durward, B., Rowe, P., Paul, J., The effect of independent practice of motor tasks by stroke patients: a pilot randomized controlled trial. ClinRehabil, 16, 5, 2002, 473-80.
17. Shumway-cook, A.,Woolacott, M. Motor control: Traslating research into clinical practice (3rded). Philadelphia: Lippincott Williams & Wilkins, 2006;
18. Stefanova, D. Study on the postural balance and prevention of falls in elderly people. PhD thesis, 2012; 180-183.
19. Ye, H., Yang, Q., Hang, C., Lin, J. The effect of visual biofeedback training on the balance function in hemiplegic patients after stroke. Chin J Phys Med Rehabil, 34, 2012, 45-47.

Tables

Tabl.1 Distribution by sex and hemiparetic side

Sex / hemiparetic side	Frequency	Percent	Valid Percent	Cumulative Percent
Man	5	45.5	45.5	45.5
Woman	6	54.5	54.5	100.0
Right-sided	7	63.6		
Left-sided	4	36.4		
Total	11	100.0	100.0	

Tabl.2 Descriptive characteristics of the patients by age, weight, height, a stage of functional recovery of Brunnstrom and Ashworth's test for spasticity at baseline of study.

Parameters	Minimum	Maximum	Mean	Std. Deviation
Age	53	76	65.00	6.372
Weight	60	82	71.27	7.072
Height	152	174	163.64	6.727
Brunnstrom-upper limb			3.73	.647
Brunnstrom-lower limb			4.36	.505
Ashworth-upper limb			2.182	.7508
Ashworthlower limb			1.636	.3931

Tabl.3 Mean and standard deviation of the static and functional balance of the 1st day, 10 day, 1st month, 3rd month

	Mean	Std. Deviation	Std. Error Mean
static balance _1st day	1.2727	.79415	.23945
functional balance _1st day	1.4545	.84778	.25561
static balance _10 day	3.0227	.45352	.13674
functional balance _10 day	3.2909	.46358	.13978
static balance _1st month	3.5909	.35834	.10804
functional balance _1st month	3.7364	.29419	.08870
static balance _3rd month	3.9318	.11677	.03521
functional balance _3rd month	3.9545	.06876	.02073

Tabl.4 Paired Samples Test of the static and functional balance of the 1st day, 10 day, 1st month, 3rd month

Paired Samples Test

		Paired Differences - Static / Functional Balance					t	df	Sig. (2-tailed)
					95% Confidence Interval of the Difference				
Pairs		Mean	Std. Deviation	Std. Error Mean	Lower	Upper			
Pair 1	Static - functional - 1st day	-.18182	.34948	.10537	-.41660	.05297	-1.725	10	.115
Pair 2	Static - functional - 10 day	-.26818	.31644	.09541	-.48077	-.05559	-2.811	10	.018
Pair 3	Static - functional - 1st month	-.14545	.29534	.08905	-.34387	.05296	-1.633	10	.133
Pair 4	Static - functional - 3rd month	-.02273	.10090	.03042	-.09052	.04506	-.747	10	.472

Tabl.5 Paired Differences of the static and functional balance of the 1st day, 10 day, 1st month, 3rd month

Paired Samples Test

		Paired Differences Static / Functional Balance					t	df	Sig. (2-tailed)
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper			
Pair 1	S1/10day F1/10day	-.08636	.21224	.06399	-.22895	.05622	-1.350	10	.207
Pair 2	S10day/1month F10day/1month	.12273	.31652	.09543	-.08991	.33537	1.286	10	.227
Pair 3	S 1/3mesec F1/3mesec	.12273	.30607	.09229	-.08290	.32835	1.330	10	.213