Evaluation of the effect of balance training in hemiplegic patients

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Abstract

Aim of the work: To assess the postural instability in hemiplegic patient and evaluate the effect of balance training by the biodex balance system (BBS-SD).

Patients and methods: Forty patients with hemiplegia (hemiplegic group) and 30 healthy volunteers (control group). The hemiplegic group was subdivided randomly into two subgroupsnI and IInaccording to the rehabilitation program .Group I received balance training by BSS-SD in addition to traditional rehabilitation program for hemiplegia .Group II received traditional rehabilitation program for hemiplegia. All patients were functionally assessed by Stroke Specific Quality of life scale (Ss-QOL) scale and balance assessment by berg balance scale and by using BSS-SD.

Results: There was significant affection of overall stability index of postural stability test, fall risk test and parameters of limits of stability (LOS)test in hemiplegic group in comparison to the apparently control group $(p \leq 0.05)$. There was statistically significant improvement in both hemiplegic subgroups but more significant in group I regarding postural stability test, fall risk test and limits of stability test. Also there was improvement in Ss-QOL scale and BBS that was more significant in group I.

Conclusions: Stroke patients have postural instability and increased risk of falling. Balance training by using BSS-SD in addition to the traditional rehabilitation program decreases the postural instability, also improves the quality of life more than the traditional rehabilitation program only.

Keywords: Postural stability, Balance training, Biodex system, Hemiplegia.

Introduction

Stroke is an acute onset of neurological dysfunction due to cerebrovascular affection lasting more than 24 hours with resultant signs and symptoms that correspond to involvement of focal areas of the brain[1].

Stroke is the third cause of death in Egypt and the leading cause of long-term disability.Approximately75% of stroke survivors are left with motor dysfunction [2].

The important component for postural control are movement strategies, cognitive processing, sensory modalities (somatosensory, visual and vestibular), the sensory reintegration and reweighting in central nervous system, all of which can be impaired after stroke .Patients with stroke exhibit uneven weight distribution as increasing weight bearing on the unaffected limb, decreased weight-shifting ability in stance, increasing the risk of falling. Therefore, balance training cause's improvement in gait symmetry and help recovery of activities of daily living [3].

The Biodex Stability System is an effective, reliable and valid tool used for assessment of balance as well as treatment of balance disorders [4].

The aim of this work was to assess the postural stability and balance disturbance in hemiplegic patient, and to evaluate the effect of balance training in those patients.

Patients and methods:

Forty patients with hemiplegia (Hemiplegic group) diagnosed clinically and radiologically .In addition to thirty healthy volunteers as control group, both groups were matched in age and sex .Both groups were selected from the outpatient clinic of Physical Medicine, Rheumatology and Rehabilitation Department, Faculty of Medicine, Tanta University.

Patients included in this study were during the first 6 months of stroke onset, with ability to stand with or without assistance and able to understand and follow simple verbal instruction. Patients with severe spasticity, flaccid stage of stroke, lower limb deformity or past history of any lower limb injury, peripheral neuropathy, dementia and cognitive deficit and impaired vision were excluded.

The study was approved by the ethical committee of Tanta University Hospital. All patients gave their informed consent prior to theirinclusion.

All patients were subjected to assessment for the postural stability by BSS- SD (Biodex Medical Systems, Shirley, NY, USA which consists of handle for supporting, platform, display and printer. The tilting multiaxial circular platform allows free movement in medio-lateral and antero-posterior direction, with a maximum inclination of 20 degrees. Its programs have one stationary level and twelve levels of instability for the platform in dynamic form. It permits visual biofeedback with the center of pressure presented on the monitor.

Assessment of both groups before the rehabilitation regarding postural stability test, fall risk test and limits of stability test by using BSS. Tests were done at static level for 3 trials were conducted then the mean score was measured, the patients were with eyes open, bilateral stance and bare feet, looking forward concentrating on equipment monitor to enhancing the visual feedback.The results gained from tests for the hemiplegic group were compared to the apparently healthy control group results.

The hemiplegic group were subjected to further functional assessment by Ss-QOL scale, which is quality of life measure, consists of 49 items that include the social role, mobility , energy , language , self-care , mood ,personality, thinking,upper extremity function , family role , vision , and work/productivity[5].Also balance assessment by Berg balance scale .

The hemiplegic group randomly divided into two groups according to the rehabilitation program they received .Both groups received 3sessions per week for two months. Both groupsI and IIreceived the traditional rehabilitation program including passive,active assisted and active exercises for affected upper and lower limbs, in addition to PNF techniques.

GroupI received additional training by BSS-SD with the following training programs postural stability,limits of stability,maze control and random control.

Assessment of both hemiplegic subgroups after two months of rehabilitation regarding functional assessment by SS-QOL, balance assessment by Berg balance scale, in addition to assessment of overall stability index of postural stability test, fall risk test and parameters of limits of stability test by BSS-SD.

Statistical analysis
Statistical analysis was carried out using the statistical package for social sciences SPSS software package version 20.0. (Armonk, NY: IBM Corp) Qualitative data were described using number and percent. Student t-test for normally distributed quantitative variables, to compare between two studied groups. Mann Whitney test (MW) for abnormally quantitative variables. P values< 0.05 were considered statistically significant for differences and correlation.

Results
The mean age of hemiplegic patient was 53.97 ± 7.79 years and for the control group was 58.0 ± 8.81.Regarding sex 83.3% of control group were males and 16.7%were females ,while in hemiplegic group 82.5% were males and 17.5 were females**(table1).**

Diabetes mellitus and hypertension were the most common risk factors among the hemiplegic group.60% of patients had right side hemiplegia and 40% were with left side.

There was affection of the overall stability index of postural stability test, fall risk test and all parameters of limits of stability test at the beginning of the study in the hemiplegic group in comparison with the control group**(table 2).**

After 2 months of rehabilitation there was significant improvement in of the overall stability index of postural stability test**(fig 1)**, fall risk test **(table3)**and all parameters of limits of stability test(LOS)**(table4)** on both groups but more in group I with statistically significant difference.

Also there was statistically significant improvement in SS-QOL scale in both groups but more significant in group I the mean value was 182.0 ± 23.54 while in group II it was159.65 ± 14.18.Alsothere was statistically significant improvement of Berg balance scale in both groups but more significant in group I, the mean value was 46.80 ± 4.37while in group II it was38.30 ± 6.04.

Table (1): Comparison between the controls and hemiplegic patients according to demographic data (age and sex)

	Controls (n = 30)		Hemiplegic patients (n = 40)		p
	No.	%	No	%	
Sex					
Male	25	83.3	33	82.5	
Female	5	16.7	7	17.5	>0.05
Age (years)					
Min. – Max.	39.0 – 70.0		43.0 – 70.0		>0.05
Mean ± SD.	58.0 ± 8.81		53.97 ± 7.79		
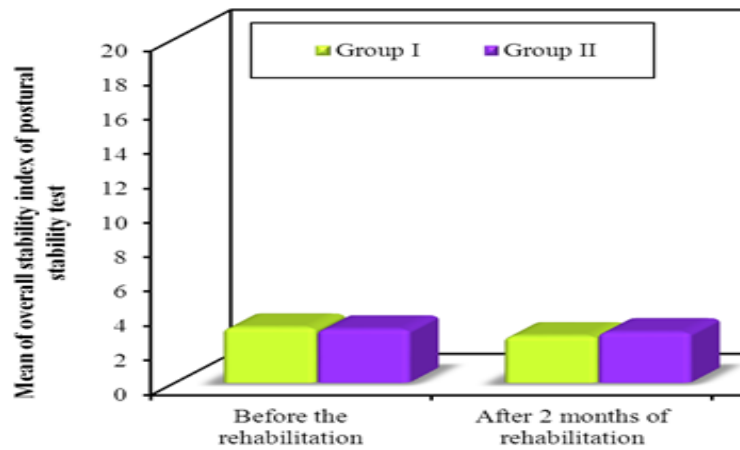
Figure (2) Comparison between before and after rehabilitation program regarding overall stability index of postural stability test in in group I & II

	Controls (n = 30)	Total hemiplegic patients (n = 40)	P
Overall stability indexofpostural stability test			
Min. – Max.	1.0 – 3.10	2.40 – 3.90	<0.001*
Mean ± SD.	2.01 ± 0.50	3.16 ± 0.37	
Overall index of fall risk test			
Min. – Max.	1.50 – 2.50	2.90 – 4.20	<0.001*
Mean ± SD.	2.02 ± 0.23	3.61 ± 0.40	

Table (2): Comparison between the controls and total hemiplegic patients regarding the overall stability index of postural stability test and fall risk test at the beginning of the study

Fall risk test	Group I (n = 20)	Group II (n = 20)	p
Before Min. – Max. Mean ± SD.	2.90 – 4.20 3.74 ± 0.37	2.90 – 4.0 3.49 ± 0.40	0.047*
After Min. – Max. Mean ± SD.	2.40 – 3.60 3.09 ± 0.34	2.10 – 3.40 2.82 ± 0.41	0.043*

Table (3): Comparison between the two studied groups before and after the rehabilitation program regarding the overall index of fall risk test

	Limits of Stability	Group I (n= 20	Group II (n= 20)	p
Backward forward	**After** Min. – Max. Mean ± SD.	33.0 – 98.0 55.50 ± 20.49	20.0 – 55.0 34.75 ± 10.42	<0.001*
Backward	**After** Min. – Max. Mean ± SD.	30.0 – 98.0 63.75 ± 18.49	23.0 – 70.0 40.0 ± 13.16	<0.001*
Right	**After** Min. – Max. Mean ± SD.	20.0 – 91.0 61.70 ± 24.97	20.0 – 66.0 37.0 ± 14.06	0.003*
Left	**After** Min. – Max. Mean ± SD.	32.0 – 97.0 57.70 ± 18.96	15.0 – 79.0 41.35 ± 15.14	0.013*
Overall	Min. – Max. Mean ± SD.	30.0 – 70.0 50.10 ± 10.76	29.0 – 54.0 44.05 ± 7.61	0.030*

Table (4): Comparison between the two studied groups after rehabilitation regarding LOS parameters

Discussion

Balance problems are common after stroke, it affects the recovery of activates of daily livings, mobility and increasing the risk of falls [6]. Balance impairment is related to the mechanisms affected by stroke as decreased muscle strength, decreased range of movements, abnormal muscle tone, motor incoordination, sensory organization, cognition and multisensory integration[7].

Males were most common affected by stroke in this study (82.5%) this is agreed with **Liu et al.** [8] who explained this by increased incidence of intracranial stenosis among men.

Regarding the risk factors of stroke in this study diabetes mellitus, hypertensive and cardiac diseases were the most common risk factors. This agreed with **Rong et al.**[9],**Legge et a.l**[10] **and Ganesan et al.** [11].

Initial assessment of overall stability index of the postural stability test and fall risk test and also parameters of limits of stability index show affection in the hemiplegic patients group in comparison with the controls group with statistically significant difference P values< 0.05.This agreed with **Hesham et al.**[12]. Who reported that stroke greatly affects the postural stability, also reported that balance training using the BSS in addition to traditional program of hemiplegia more significant than traditional program only.

Also agreed with **Ishimoto et al.** [13] reported that falling risk increases with stroke, they also reported that measuring the fall risk by using the visual biofeedback and by other methods such as the stroke assessment fall risk screen shows affection of fall risk parameter.

Also affection of LOS agreed with **Li et al.** [14] reported that the LOS test parameters were affected in stroke patients as the degree of excursion increases and movement control is affected in stroke patients.

There was affection of the SS-QOL scale forhemiplegic patient before the rehabilitation. This agreed with **Ketaki et al.** [15] who reported that SS-QOL measures are greatly affected in

stroke patients mainly due to weakness of upper limb and lower limb which lead to functional impairments in those patients

Reevaluation after two months of rehabilitation revealed improvement of the overall stability index of the postural stability testin both groups but more improvement in groupI this agreed with *Gaurav et al.*[16] *,Puckree et al.* [17] and *Januário et al .* [18].

Balance training program using force platform visual biofeedback in addition to a conventional stroke rehabilitation program improves measures of bilateral postural stability in patients with hemiplegia and improve weight bearing on the paretic side.

Reevaluation of fall risk test after two months of rehabilitation revealed improvement of the overall stability index of fall risk test in both groups but more improvement in group I this agreed with **Ishimoto** *et al.* [13].

After two months of rehabilitation the parameters of limits of stability test improved in both groups but there was statistically significant between both groups ,more significant in group I. This result was agreed with **Dae** [19] who concluded that rehabilitation of stroke patients by using balance training program is more effective in improving LOS test in stroke patients than the traditional rehabilitation program only.

In this study there was statistically significant improvement in the SS-QOL sacle after rehabilitation in both groups , but more improvement was obtained in group I,*Ali et al.* [20] and *Jin et al.*[21] stated that rehabilitation programs involving balance training greatly improves quality of life and ambulation .

Conclusion

Stroke patients showed affection of postural stability, increase in the fall risk and abnormal limits of stability when compared with the apparently healthy control group.

Balance training program by using BSS-SD in addition to the traditional rehabilitation program for patients with stroke decreases the postural instability and the risk of falling, also improves the limits of stability parameters and the quality of life, more than the traditional rehabilitation program.

References

1. Roger G, Mozaffarian A, Benjamin E *et al.* **(2013):** Heart disease and stroke statistics update: a report from the American Heart Association, 127(1):2452-6.

2. Abd-Allah F and Moustafa R (2014): Burden of stroke in Egypt: Current status and opportunities .Int.J.Stroke, 9(8)1105-8.

3. Tyson S, Hanley M and Chillala J (2006): Balance disability after stroke. Phys Ther., 86: 30-8.

4. Bryan R and Randy S (2012): The relationship between various modes of singling postural control assessment .J Sports PhysTher., 7(3): 257–66.

5. Muus I, Williams L and Ringsberg K (2007): Validation of the Stroke Specific Quality of Life Scale (SS-QOL): test of reliability and validity of the Danish version (SS-QOL-DK).Clin Rehabil., 21(7):620-7.

6. Adegoke B, Olaniyi O and Akosile C (2012): Weight bearing asymmetry and functional ambulation performance in stroke survivors. GJHS., 4(2):87-94

7. Sang Hand Jung-Ho L (2016): Impact of sensory integration training on balance among stroke patients: Sensory integration training on balance among stroke patients. Open Med., 11(1): 330–5

8. Liu K, DaviglusM,Loria C et al. (2012): Healthy lifestyle through young adulthood and the presence of low cardiovascular disease risk profile in middle age the coronary artery risk development in (young) adults (cardia) study. Stroke, 125:992–6.

9. Rong C, Bruce O and Wuwei F (2016): Diabetes and stroke. Epidemiology, pathophysiology, pharmaceutical and outcomes. AM J Sci., 341(4):750-9.

10. Legge S, Koch G, Diomedi M *et al.* **(2013):** Stroke prevention: managing modifiable risk factors. Stroke Res Treat., 1-15.

11. Ganesan A, Chew D, Hartshorne T *et al.* **(2016):** The impact of atrial fibrillation type on the risk of thromboembolism, mortality, and bleeding: a systematic review and meta-analysis. Eur Heart J., (20)37:1591-602

12. Hesham G, Emad T, Shamekh M *et al.* **(2017):** Balance training attenuates the postural instability and minimize falling probability in post stroke patients. Int J Pharm Bio Sci.,8(2): 708-14.

13. Ishimoto V, Wada T, Kasahara *et al*. (2012): Fall risk index predicts functional decline regardless of fall experience among community _dewillin elderly .Geritr Gerontol Int., 12 (4)659-66

14. Li X , Lau G , Lo C *et al* . (2017): The Reliability and Validity of Sitting Balance Control Tests in Stroke Survivors. M. J. Ireland, 1; 20-9

15. Ketaki V and SuvarnaS (2017): Quality of life in patients with stroke .J Yoga Physio.,3(1) 215-9.

16. Gaurav A and Anjali J (2016): To evaluate and compare the effectiveness ofsensorimotor integration with that of conventional trainingfor improving balance and gait in stroke hemiparesis: A Comparative Study,J Mahatma Gandhi Inter Med Sc.,1(2):47-54.

17. Puckree T and Naidoo P (2014): Balance and stability-focused exercise program improves stability and balance in patients after acute stroke in a resource-poor setting.PM RJ., 6(12):1081-7.

18. Januário F, Campos and Amaral C (2010): Rehabilitation of postural stability in ataxic/hemiplegic patients after stroke .DisabilRehabil., 32(21):1775-9.

19. Dae J (2016): Influence of biofeedback weight bearing training in sit to stand to sit and the limits of stability on stroke patients, J Phys Ther Sci.,28(11): 3011–14

20. Ali A, Jameh Band Fatholah Q (2015): Effect of Gait Retraining on Balance, Activities of Daily Living,Quality of Life and Depression in Stroke patients.IRJ.,(13);116-9

21. Jin S, Yang-Soo L, Chul-Hyun K *et al*. (2015): Effects of balance control training on functional outcomes in subacutehemiparetic stroke patients.Ann Rehabil Med.,39(6): 995–1001