Clinical Impact of Dual Task Exercise Training on Gait, Balance and Walking Speed of Stroke Patient

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Abstract
Background: *The primary concern of all stroke patients is to reacquire the capability to balance and walk independently, therefor, physical rehabilitation is imperative for stroke.*
Aim of the study*; To investigated effects ofdual task exercises on gait, balance, and walking speed in stroke patient.*
Methods;*A quasi-experimental research design was applied.The study was conducted in Neurology departments at Mansoura University Hospital. Participants(n=100)were distributed randomly to into two groups.Participants in intervention group have balance, and gait training and perform the cognitive and motor tasks during walking. The practical sessions were 30 min/session, 4 sessions/week for 2 weeks. Three points of assessment were done before intervention, two weeks and one month after intervention.*
Results*: There is lack of significant difference between study groups regarding Barthal index, gait, balance total score of Tenitti scale as p=0.643, p=0.880, there was only a statistically significant difference between intervention and control groups regarding TUG after2 weeks and 1 -month assessment as p=0.001 p=0.046.*
Conclusion*;Dual task training exercises did not reach significant difference. Therefore, other types of exercises can add to enhance gait, and balance for strokepatient.*
Keywords*: balance, dual task exercises, gait, stroke, walking*

I. Introduction

Stroke is a major health problem and the importantorigin of frustrating longstanding disability all over the world.It is defined as thequicklydeveloped clinical symptoms and/or signs of focal changes of cerebral function,lasting more than 24 hours or causing death, and the cause must be of vascular origin only to confirm stroke diagnosis.Also, it considered the third reason of death and the first one of acquired adult disability in the world [1]. The stroke prevalence based mainly on age and gender, and it is reported to be 1% of the population [2]. It is expected that, in 2030 the stroke occurrence will be 23 million first ever strokes while, death rate will be 7·8 million stroke deaths [3]. Countries in Eastern Europe, North Asia, Central Africa, and the South Pacific suffering from the maximum stroke mortality and stroke burden[4].

Numerous evidence represents thedeficiencies in speech, grasp, balance, walking, and gait in stroke patient that significantly impact activities of daily living, quality of life, and rise risk for falls [5]. Therefore, stroke patient needs to receive multidisciplinary rehabilitation soon after stroke. Dual-task training methodology has morepreference in current stroke rehabilitation research as effectivemeasures that help stroke patient to regain the maximum level of functional independence. [6]

II. Significant Of Study

Stroke remains one of the main sources of death and disability worldwide. A lot of stroke survivors always facing a combination of sensory, motor, cognitive and emotional losses, accordinglylimiting their ability to complete activities of daily living (ADL) [7].Falls are highly expected among stroke patient with an incidence of 50% to 70% [16]. Post-stroke falls prompt serious health problems such as hip fractures, and distress of falling affect physical mobility and social participation [8].So, fall is avital clinical worry in individuals suffering from stroke both during rehabilitation and subsequently[9]Similarly,dual tasks have important roles in everyday life activities as making a conversation while walking, using a mobile phone, holding a bag or watching traffic[10].

Therefore, it seems imperative to assess patient gait, balance and walking ability to perform proper rehabilitation exercise.

III. Methodology

3.1 Aim;
To examine the effectiveness of dual task exercise on improving balance, walking speed and gait pattern in stroke patients.

3.2 Research Hyposesis
   StrokePatients who perform dual task exercise will exhibit better balance control, walking speed and gait pattern than patients who don't perform the exercise.

3.3Research design
Quasi-experimental research design was utilized.

3.4 Setting
The study was conducted in Neurology Department and outpatient clinics at Mansoura University Hospital.

3.5 Participants
       A purposive sample of 100 adult patients of both sexes, who have a first attack stroke and able to walk independently without an assistive device, were involved in the study. The study participant was divided into two equal groups; a study group, consisting of 50 adult patients who received the routine hospital care and the planned dual task rehabilitation exercise, and a control group, consisting of 50 adult patients who received the routine hospital care only.

3.6Tools
Four tools were used for data collection in this study as the following;

3.6.1 Tool I: Structure Interview questionnaire
This tool consists of; Socio-demographic characteristics and health relevant data. The demographic data included age, gender, educational level, and occupational status. The clinical data included stroke type, affected side, chronic disease history and smoking.

3.6.2 Tool II: Barthal index scale
       It measures baseline functional disability by evaluating patient performance in 10 activities of daily life. These activities can be assembledregarding self-care (feeding, grooming, bathing, dressing, bowel and bladder care, and toilet use) and movement (ambulation, transfers, and stair climbing). greater score of 100 showing that a patient is completely independent in functional activity, and theminimum score of 0 representing a fully dependent (bedridden state), while mid categories suggest that the patient can perform 50 % of the effort.

3.6.3 Tool III:Time Up and Go Test[11]
The Timed Up and Go (TUG) test was adapted from (Mathias et al.,1986). It is a largely used test to measure gait, motor speed, walking ability and physical function, besides being a predictor of risk of falls. A faster time indicates a better functional performance.

3.6.4Tool I V- Gait and Balance assessment scale (**Tinetti Balance Assessment Scale**)
This tool is adopted from (Tinetti, Williams &, Mayewski 1986), it is easly, simplymanaged test that evaluates a patient's gait and balance. The scoring of this scale based on the patient's capacity to accomplishdefinite tasks, it takes about 10-15minutes to complete. It includes two main sections one for gait and the second for balance. The total score for the gait section is 12 points. The maximum score for the balance section is 16 points. The maximum total balance and gait score is 28 points. Generally, patients who have score less than 19 are at a high risk for falls. Patients whose score ranged from 19- to 24 has a risk of falls.

3.7 Validity and reliability of the instruments
       The developed tool was verified for content- related validity by 7 experts, five experts from the faculty of nursing and two from the faculty of medicine, who reviewed the tool for clarity, relevance, understanding, and applicability for implementation. According to their critiques, minor modifications were done accordingly. Thereliability of BI scale was found to be 0.73 and 0,77and showed high inter – rater reliability (0.95) and test - retest reliability (0.89) [12]. Regarding Timeup and Go test reliability values were high, the intra-rater (r = 0.99) and inter-rater (r = 0.98) [13]. the Tinetti Assessment Scale has good interrater reliability. (Lewis ,1993).

3.8 Pilot study
A Pilot study was done on 10 stroke patients so as to examine the clarity and relevance of the tools. These patients were not included in the study sample. Tools were modified to be clear and understood.

3.9 Ethical considerations
The proposal was submitted for acceptance from research ethical committee, Faculty of Nursing, Mansoura University. Official written consent was obtained from accountable authorities of the neurology department in Mansoura-University hospital.

3.10 Procedure
1   Patients were interviewed individually to explain nature and purpose of the study.
2   The researcher started by introducing herself to the patients and giving them a brief idea about the aim of the study, prepare needed equipment to complete work (chair, stop watch, glass of water ……).
3   Time Up and Go test done at the first day of intervention under single task condition Consequently, patient's activity of daily living was assessed by using Barthal index scale by asking the patient and his caregiver and also by observation, after that patient's balance and gait pattern were assessed by using Tinetti Assessment Scale, scored overall gait and balance score=
4   For study group the developed dual task exercises were conducted at 30 to 45 min per session, 4 sessions \ week based on individual needs and tolerance.
5   The researcher starts with the easier form of dual task as walking while talking, a simple conversation took place, e.g., a researcher asks the patients to say2 when she says 1 then he says 4, researcher 3 …. Etc., the patient must walk while counting. carrying a cup filled with water and patient asked to walk while carrying it without spilling of water were used.
6   Three repeated assessment was taken (before the intervention, 2 weeks after first assessment, and one month after the intervention).
7
3.11 Statistical analysis;
Collected data were gathered, computed and statistically evaluated using The Statistical Package for Social Sciences (SPSS) version 22. Qualitative variables were showed as number and percentage. Quantitative variables were presented as mean ± SD. To check the difference between two groups independent t-test, andChi square ($\chi2$), was usedP ≤ .05 was representing the significant difference.

IV. Results

Table (1) showed thatApproximately more than half of intervention group aged from 51to 60, with a mean age 52.24± 7.50-year, half of control groupranged from 51to 60with a mean age52.02 ± 7.16year.Males were more prevalent in the studied sample, they represent (76%) of the intervention group, and (68%) of the control group. The majority of the patient (62% &56%) respectively were married,Concerning the level of education, illiteracy prevailed among (32% &34%)of study participant.In relation to the working condition, about (40% &30%) were active.Table 2 represented that (52%&48%) of patients have previous hospitalization. The majority (48%&46%) respectively were smoker.ischemic stroke was the commonest between (78%&80%)of patient. Regarding the affected side, the majority of (54%&60%) suffered from right-sided hemiparesis. Table3 showed that there was a statistically significant difference in total score of gait and balance by using Tenitti assessment scaleof study groups after 2 weeks of intervention regarding high risk for falls as P-value less than 0.05,the high risk for falls participant in intervention group has improved from 68% to 42 %. While control group improved from 76%to 60%. Table4indicated that there is lack of significant difference between study groups regarding total score of Barthal index, gait and balance total score, and there was only a statistically significant difference between intervention and control groups regarding TUG after2 weeks and 1 -month assessment as p=0.001 p=0.046.

Table 1: socio-demographic characteristics of study groups dataN=100

Demographic data			Intervention (n = 50)		Control (n = 50)		p
Age(years)			**No.**	**%**	**No.**	**%**	
		31 – 40	6	12.0	7	14.0	
		41 – 50	14	28.0	18	36.0	0.720
		51 – 60	30	60.0	25	50.0	
Mean ± SD			52.24 ± 7.50			52.02 ± 7.16	
		Male	38	76.0	34	68.0	0.373
		Female	12	24.0	16	32.0	

Marital status	Single	1	2.0	3	6.0	0.836
	Married	31	62.0	28	56.0	
	Widow	12	24.0	13	26.0	
	Divorced	6	12.0	6	12.0	
Education	Illiterate	16	32.0	17	34.0	0.839
	Read and write	9	18.0	12	24.0	
	Secondary education	15	30.0	12	24.0	
	High education	10	20.0	9	18.0	
Occupation	Active working	20	40.0	15	30.0	0.430
	Sedentary work	12	24.0	12	24.0	
	Retired	12	24.0	11	22.0	
	House wife	6	12.0	12	24.0	

Table 2: The health relevant data of study participants N=100

Health data		Intervention (n = 50)		Control (n = 50)		p
		No.	%	No.	%	
Previous hospitalization	No	24	48.0	26	52.0	0.689
	Yes	26	52.0	24	48.0	
Smoking	Yes	24	48.0	23	46.0	0.356
	No	24	48.0	21	42.0	
	Previous smoker	2	4.0	6	12.0	
Type of stroke	Ischemic	39	78.0	40	80.0	
	Hemorrhagic	11	22.0	10	20.0	0.806
Affected side	Right	27	54.0	30	60.0	0.545
	Left	23	46.0	20	40.0	

Table 3: Comparison between the study groups regarding gait and balance total score N=100

Total score gait and balance	Intervention group (n = 50)						Control (n = 50)						P_1	P_2	P_3
	Before-intervention		After 2 weeks		After 1 Month		Before-intervention		After 2 weeks		After 1 Month				
	No.	%	No	%	No.	%	N	%	No	%	No	%			
High risk for fall &<18	34	68.0	25	50.0	21	42.0	38	76.0	36	72.0	30	60.0	0.745	0.039*	0.151
Moderate risk 19-23	15	30.0	22	44.0	23	46.0	11	22.0	10	20.0	14	28.0			
Low risk& 24	1	2.0	3	6.0	6	12.0	1	2.0	4	8.0	6	12.0			
Mean ± SD.	6.60 ± 1.99		7.24 ± 2.04		7.60 ± 1.93		6.70 ± 1.74		7.02 ± 1.94		7.54 ± 2.03		0.790	0.582	0.880

Table 4: Comparison of studies parameters between study groups

Total scores	Intervention group (n = 50)						Control (n = 50)						p_3	p_4	p_5
	before-intervention		After 2 weeks		After 1 Month		before -intervention		After 2 weeks		After 1 Month				
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%			
Mean ± SD.	71.90±15.68		75.6±15.24		79.7±15.30		71.9±14.56		74.4±13.20		78.4±12.51				
Time Up and Go test (sec)															
Less than 12 sec for 10 feet	4	8.0	19	38.0	20	40.0	3	6.0	5	10.0	30	60.0	1.000	0.001*	0.046*
More than 12 sec for 10 feet	46	92.0	31	62.0	30	60.0	47	94.0	45	90.0	20	40.0			
Total score Barthal IndexScale Mean ± SD	71.90±15.68		75.6±15.24		79.7±15.30		71.9±14.56		74.4±13.20		78.4±12.51		1.000	0.675	0.643

V. Discussion

Stroke survivors are severely affected as stroke considered a pathological entity with high prevalence,additionally it is a leading source of adult disability and inpatient admission for rehabilitation. Dependence in mobility is the main reason for hospital admission after stroke [14]. The chief concern of all post stroke hemiparetic patient is to have the ability to walk again freely. This concern is vital for patients as well as clinicians and physiotherapists as the walking ability is the primarydefining factor that determinesif post stroke hemiparetic patient will achieve his or her earlier level of competence and activity or not. [15].

In relation to age, the present study represented that more than half of intervention group aged from 51to 60year, with a mean age 52.24± 7.50 year, and half of control group also aged from 51to 60 years with a mean age52.02 ± 7.16 years. This because this age group is suffered from the cumulative effect of responsibilities and stressor. This result is in agreement with Patibandla, Appikatla, and Jayasingh (2017) [16] On the other hand, this result is in disagreement with Neha, Singh, and Sumandeep, (2015) [17]who presented that age group from 40to 70year is more frequent.Males were more prevalent in the studied sample, this is because ofmale more high risk for stroke than female and other factors increasingrisks for strokes such as smoking, hypertension and vasoconstriction are more prevelent in men. This agreeswith Plummer, Villalobos, Vayda, Moser, and Johnson (2014) [18]. In the opposite direction, Hong et al., (2013) [19]; Sasaki, Pinto, Mendel, Sá, Oliveira-Filho, and D'Oliveira (2015) [20] found that most of their studied sample were female. As regards marital status the majority of patient were married because married people always facing psychological stressors of social role. These subjects' marital status was similar to El Tallawyet al., (2015) [21]. In contrast, it disagrees with Li, Cao, Liu, and Qi. (2017) [22] who illustrated that widowhood is more presentable in this study sample. Regarding educational level, the findings of the present study represented that, majority of sample, were illiterate. as majority of patient were coming from rural areas where education opportunities were limited previously in this age. These subjects' educational characteristic was similar to El Tallawyet al. (2015) [23], on the other hand, Amarenco et al. (2016) [24]found that Secondary education is common. while Madae'en et al., (2013) [25] founded that majority of study sample were highly educated. In reference to occupation, the results concluded that less than half of sample was active working because majority of patient with low socioeconomic status interested in manual and farm work, this result is consistency with El Tallawyet al. (2015) [23] who indicated that less than half of sample were employee. While unemployed is prevalent in study of Mutai, Furukawa, Nakanishi, and Hanihara, (2016) [26].

In the present study it was found that more than half of patients have previous hospitalization due to surgical intervention. Canonicoet al., (2016) [27] have study sample with previous hospitalization also, as well as Liao, Chou, Yeh, Hu, Chiu, and Chen, (2014) [28] reported majority of cases have previous hospitalization. Inrelation to smoking, less than half of studied sample wassmoker. As Smoking increases the stickiness of the blood, increasing blood pressure and reducing oxygen in the blood. This result is in agreement with Hong et al., (2013) [29] who revealed that smoking is well established risk factors among stroke patient. Regarding to stroke type and affected side the results at the same line with Choi, Kim, Han, and Kim, (2015) [30] found that the ischemic stroke was the commonest and the affected side were left side. Also, El-Tallawyetal., (2013) [31] reported that ischemic type is more prominent. In contrast, it disagrees with Obembe, Olaogun, and Adedoyin, (2014) [32] who found that most of their sample were hemorrhagic type and reported also right side was mostly affected. This study revealed that, there was a positive statistically significant difference in study groups after 2 weeks of intervention regarding high risk for falls overall total score gait and balance as P- value less than 0.05. This is because the patient encouraged to maintain telephone contact with researcher to emphasize importance of continuous rehabilitation exercises This result also is inconsistent with Bernocchi, et l., (2016) [33] who have study about Home-based tele surveillance and rehabilitation after stroke supported the significant improvement of patient after intervention. In addition to López-Liria, et al. (2016) [34] who supported the results of present study.Morone, et al., (2016) [35] found that the significant improvement doesn't present on baseline assessment but improved after intervention and follow-up. On the other hand, De Figueiredo et al. (2014) [36] who evaluate balance, gait, and total score on the Tinetti Index and found that there were no significant statistical results.

The statistically significant difference was detected between intervention and control groups regarding TUG after2 weeks and 1 -month after intervention. This could bedue to the clarity, simplicity of the planned exercises and it based on the patient'sneeds and patient first priority was to resume normal walking habits to meet needs of himself and family. The findings of the current study were congruent with Taveggia,et al (2016)[37]. Also, significant improvements in Timed Up and Go of ischemic patient were demonstrated in study of Dierick, et al., (2017) [38]; Gosh, Duwarah, and Dutta, (2015) [39] found significant relation of TUG. The results in the same line with Portnoy, Reif, Mendelboim, and Rand, (2017) [39]who founded that TUG have significant difference with study groups. In addition, the finding of Satow, et al., (2016) [40]. support the study results as TUG significant improved with intervention.Also, findings are congruent with Jayabalan, et al., (2014) [41] who reported that there is a significant improvement of TUG from begining of intervention to discharge. As well as Kim, Lee, and You, (2015) [42] who illustrated that TUG test score was significantly reduced after the

exercises. Geiger, Bonnyaud, Fery, Bussel, and Roche, (2017) [43] found that Stroke patients completed the TUG test significantly more slowly than the control subjects.

At this study, as well as other investigations reported no change or minor changes, has reported in outcomes by comparing scores completed at baseline, after 2weeks assessment and after one month of intervention for gait and balance with improvement in walking ability. There are numerousprobable explanations for the lack of significant findings. forgetfulness was a widely reported factor that causes non-compliance with exercises at home in addition to noncompliant with exercise due to lack of knowledge about its benefits, or inability to perform exercise. also, the effects of exercise are more specific to certain domain like walking and also training intensity is the most important parameter for improving exercise capacity. This result agrees with Gobbo, Bergamin, Sieverdes, Ermolao, and Zaccaria, (2014) [44] who demonstrated that initial findingsdisplay that the present body of evidence does not support that exercises used in these interventions. There was no association between pre-exercise cognitive function and post-exercise improvement on study of Tang, Eng, Tsang, & Liu-Ambrose, (2016) [45]. In addition to Nematollahi, Kamali, Ghanbari, Etminan, and Sobhani, (2016) [46] who reported that thereis no changes in the gait pattern and walking speed on three training groups.

On the opposite side, several studies have found improvement in patient-reported improvement regarding using of dual-task exercise in rehabilitation of stroke patient gait, balance and walking speed as said by An, et al., (2014)[47] who said that , the motor and cognitive dual task gait training was more effective at enhancing the balance and gait abilities of chronic stroke patients than motor dual task gait training or the cognitive dual task gait training alone .As well as on systemic review and meta-analysis study by Plummer, Zukowski, Giuliani, Hall, and Zurakowski, (2016)[48] concluded that Physical exercise interventions can improve dual-task walking in older adults primarily by increasing the speed at which individuals walk in dual-task conditions. A randomized control study illustrated that many types of dual task gait training can be modified to improve gait performance in stroke (Liu, Yang, Tsai, & Wang, 2017) [10]. This also at the same line with Plummer, Villalobos, Vayda, Moser, and Johnson, (2014) [18] who concluded that Dual-task gait training is harmless and achievableduring the first 12 months after stroke, and may enhance dual-task walking speed. systematic review and meta-analysis displayed that balance abilities can be amended by well-established exercise rehabilitation programs in chronic phase after stroke. Exactly, balance and/or weight-shifting and gait training were recognized as effective training regimens (van Duijnhoven, et al.,/.2016) [49].

VI.   Conclusion

In conclusion, this study demonstrated that dual task exercises have positive effect on walking ability with minimum effect on gait and balance of stroke patients.The limitations on the present study must be considered when analyzing the findings. First,sample size can be considered a small. second, the participant characteristics are fundamentallyrelated to the particular neurorehabilitation center where the study bone, which could limit the generalization of the results. finally, the frequency of sessions and the duration of the intervention need to be increased.

VII.   Recommendation

Additional research using a dual task exercise program with more various training items would help to recognize a wider rehabilitation strategy for clinical practice.

Acknowledgements

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