Effectiveness of Otago Exercise to Improve Balance, Quality of Life and to Reduce Risk of Fall in Hemiplegic Patients

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Abstract: _Background: Hemiplegic patients have a two-fold higher risk of falling than other patients of the same age or gender. Otago exercises are the interventions given for fall prevention in elderly. It is a muscle strengthening and balance retraining program. The objectives of the study is analysing the effectiveness Of Otago exercise in improving Balance, Quality of Life and to reduce Risk of Fall in hemiplegic patients._ _Methods: 30 subjects satisfying the inclusion criteria were allocated to 2 groups of 15 members each. Group A received Conventional Physiotherapy alone and Group B received Otago exercise program along with Conventional physiotherapy. The participants were treated for three times per week for 4 weeks. The subjects were assessed by Berg Balance Scale, SF-36 Questionnaire and Timed up and go Test._ _Results &Discussion: Statistical analysis was done using SPSS Statistics 20. Significant improvement in all main outcome parameters was observed in response to the intervention. Between group analysis showed a statistical difference in favour of Otago exercise program, in the parameters of Balance, Quality of life and Risk of fall._ _Conclusion: Repetitive training using the Otago exercise will leads a significant improvement in balance, quality of life and significant reduction in fall risk in hemiplegic patients._

Keywords: Hemiplegia, Otago exercises, Balance, Quality of Life, Risk of Fall

1. Introduction

The word 'Hemi' means half and 'plegia' implies paralysis or severe weakness. Hemiplegia refers to severe or complete loss of strength in the arm, leg, and sometimes face on one side of the body whereas hemiparesis refers to a relatively mild loss of strength.[1] It is the result of lesions present in the contralateral pyramidal tract in the brain or less frequently, in the ipsilateral pyramidal tract in the upper cervical spinal cord.[2]There are two types of hemiplegia: Congenital and Acquired. Congenital hemiplegia happen before, during or soon after birth (up to two years of age approximately), and those that occur later in life as a result of injury or illness, in which case it is called as Acquired hemiplegia. [3]

Generally, an injury to the right side of the brain will cause a left-sided hemiplegia and vice versa. Stroke is the commonest cause of hemiplegia. Other causes are Head injury, Brain tumour, Diabetes, Infections like meningitis and encephalitis, Migraine syndrome, Inflammation of the blood vessels like vasculitis, and Diseases affecting the nerves likes Multiple Sclerosis and Acute necrotizing myelitis. Congenital hemiplegia is caused by Birth trauma, difficult labour, cerebral palsy, hereditary diseases like leukodystrophies etc. [4]

According to preliminary epidemiological survey of Vellore, South India,(the first community based study), the prevalence of 'completed strokes' and hemiplegia due to any cause is 56.9 per 100,000.[5] The age standardized annual incidence rate of stroke in Trivandrum were 135 per 100,000. The annual incidence rate of stroke in India as observed in the Kolkata (123.15 per 100,000),Mumbai (148 per 100,000) and Trivandrum studies are higher than that in United States (107 per 100,000 per year).[6]

Generally, complete paralysis exists on one side of the body as a result of hemiplegia. However, symptoms may vary from person to person based on their individual case. Common symptoms may include: muscle weakness or stiffness on one half of the body, difficulty in balancing and walking, lack of fine motor skills, sensory abnormalities, developmental delays, especially with motor skills. Also there are problems in memory, speech, concentration, attention, behaviour and social communication. [7]

A hemiparetic gait is characterized by abnormalities in muscle activation pattern, timing, grading of muscle activity, muscle tone, joint kinetics and kinematics and posture control. Gait speed, stride length and cadence are reduced and stance duration on the non paretic side and double support time are increased relative to neurologically healthy individuals. [8, 9]

Hemiplegic stroke patients have a two-fold higher risk of falling than other peoples with same age or gender. [10] In particular, 30% to 50% of the elderly those over 65 years old, experience falls every year.[11] Falls can be due to various factors, including personal, social, and environmental factors.[12] Fear of falling is one of the significant complication of falls. The Otago exercise program (OEP) was developed at the Otago Medical School. The OEP is an evidence-based fall prevention program developed and designed for performance in the home by physical therapists. The OEP is composed of three domains, namely muscle strengthening, balance training and walking. [13]

Otago exercises are the interventions given for fall prevention in elderly.OEP is a muscle strengthening and balance retraining program. The rationale behind it is that muscle strength, flexibility, balance and reaction time are the risk factors for falls which in turn are considered as the most readily modifiable. Both leg muscle strength and balance must be maintained above the threshold level required to achieve stability.[13] The parameters used in this study are balance, fall risk and quality of life. The study is aimed to evaluate the effect of Otago exercise program in improving our parameters.

2. Methodology

Source of data: Home Based Physiotherapy in and around Ernakulam district, Kerala. Patients who were referred from Little Flower Institute of Medical Sciences Angamaly, Rajagiri hospital Aluva, and St. James hospital Chalakudy.

Research design: The study was an experimental study.

Sample Size: 30 subjects satisfying the inclusion criteria were assigned to two groups: Group A-Control Group and Group B- Experimental Group (with 15 subjects each)

Study Duration: 4 weeks

Outcome Measures:
1) BERG BALANCE SCALE: To measure Balance
2) SF-36 QUESTIONNAIRE: To evaluate Quality Of Life
3) TIMED GET UP AND GO TEST: To assess Fall Risk

Study method:
Thirty subjects were selected based on the inclusion criteria. The subjects were aged between60 and 75 years of either sex, post hemiplegia within 6 months after diagnosis, those who were able to walk with or without a caregiver and those who scored at least 24 in mini mental score examination. Those subjects who had other acute orchronic disease, that restricted the exercise performance and who had participated in any other fall prevention exercise program were excluded. The participants were grouped into 2 groups- control group (group A) and experimental group (group B), each consisting of 15 subjects, based on convenient sampling technique. Group A received conventional physiotherapy and Group B received Otago Exercise Program along with conventional physiotherapy. The study procedure were explained to the subjects and consent were taken before training pre test scores was measured by berg balance scale, timed up and go test and SF 36 questionnaire.

The study duration was3 days in a week, for 4 weeks and each session lasted for approximately 50 minutes along with warm up and cool down phase before and after exercise respectively. The exercise protocol included in conventional physiotherapy were active assisted range of motion exercise for upper and lower extremity, functional mobility exercises, peg board activities and balance training. The Otago exercise programconsisted of strengthening, balance retraining and walking that included various exercise activities with frequent assessment, intensity modulation, and progression according to performance and with a frequency of 3 times a week.

All the participants were pre and post tested the day before commencing and the day after concluding the training. The parameters used were balance which was measured by Berg balance scale, fall risk which was measured by Timed up and go test and quality of life which was measured by SF 36 questionnaire.

3. Results

A total of 30 subjects participated in this study. They were conveniently assigned to either control group or experimental group. The data were analysed using SPSS Statistics 20. Paired t test was used to analyse the intra group significance. Independent t test was used to analyse the inter group significance.

Table 1: Analysis of pre-test and post-test values of Berg Balance Scale, TUGT and SF-36 in Group A

Group A	Test	Mean	S.D.	n	Mean difference	t	df	Significance (p-value)
Berg balance	Pre-test	34.33	6.49	15	3.54	13.81	14	$p < 0.05$*
	Post-test	37.87	6.78					
TUGT	Pre-test	26.27	5.35	15	4.20	13.47	14	$p < 0.05$*
	Post-test	22.07	5.44					
SF 36 Questionnaire	Pre-test	1056.33	281.92	15	51.67	13.59	14	$p < 0.05$*
	Post-test	1108.00	274.55					

Table 1 shows paired t test of berg balance scale, timed up and go test and SF-36questionnaire of group A. From the result the Mean, S.D. And t value assists in assessing the effectiveness of Conventional Physiotherapy in Hemiplegic Patients.

Since the significance (p-value) is less than 0.05, we can conclude that the average improvement in the berg balance scale, 3.54 is significant and the calculated t value is greater than the table value for 14 degree of freedom. So there is a significant effect of Conventional physiotherapy treatment to improve balance in hemiplegic patients.

In the timed up and go test the significance (p-value) is less than 0.05, we can conclude that the average improvement by decrease in score of 4.20, is significant and the calculated t value is greater than the table value for 14 degree of freedom. So there is a significant effect of Conventional physiotherapy treatment to decrease fall risk in hemiplegic patients.

For SF-36 the significance (p-value) is less than 0.05, we can conclude that the average improvement in the quality of life, 51.67 is significant and the calculated t value is greater than the table value for 14 degree of freedom. So there is a

significant effect of Conventional physiotherapy treatment to improve quality of life patients.

Table 2: Analysis of pre-test and post-test values of Berg Balance Scale, TUGT and SF-36 in Group B

Group B	Test	Mean	S.D.	n	Mean difference	t	df	Significance (p-value)
Berg balance	Pre-test	34.60	5.85	15	6.00	15.37	14	p < 0.05*
	Post-test	40.60	5.31					
TUGT	Pre-test	25.93	6.10	15	6.93	13.09	14	p < 0.05*
	Post-test	19.00	5.05					
SF 36 Questionnaire	Pre-test	1246.00	440.15	15	71.67	10.39	14	p < 0.05*
	Post-test	1317.67	440.87					

Table 2 shows paired t test of berg balance scale, timed up and go test and SF-36 questionnaire of group B. From the result the Mean, S.D. And t value assists in assessing the effectiveness of Otago exercise program along with Conventional Physiotherapy in Hemiplegic Patients.

Since the significance (p-value) is less than 0.05, we can conclude that the average improvement in the berg balance scale, 6.00 is significant and the calculated t value is greater than the table value for 14 degree of freedom. So there is a significant effect of Conventional physiotherapy treatment to improve balance in hemiplegic patients.

In the timed up and go test the significance (p-value) is less than 0.05, we can conclude that the average improvement by decrease in score of 6.93, is significant and the calculated t value is greater than the table value for 14 degree of freedom. So there is a significant effect of Conventional physiotherapy treatment to decrease fall risk in hemiplegic patients.

For SF 36 the significance (p-value) is less than 0.05, we can conclude that the average improvement in the quality of life, 71.67 is significant and the calculated t value is greater than the table value for 14 degree of freedom. So there is a significant effect of Conventional physiotherapy treatment to improve quality of life patients.

Table 3: Comparison between Groups; independent t test

	Group	Mean	S.D.	n	Mean Difference	t	df	Significance (p-value)
BBS	Group A	3.53	.99	30	6.93	5.28	28	p < 0.05*
	Group B	6.00	1.51					
TUGT	Group A	4.20	1.20	30	2.73	4.45	28	p < 0.05*
	Group B	6.93	2.05					
SF 36	Group A	51.67	14.72	30	20	2.54	28	p < 0.05*
	Group B	71.67	26.70					

The calculated t value for balance is 5.28, fall risk is 4.45 and quality of life is 2.54, which are greater than the table value for 28 degree of freedom (2.45) with *p < 0.05*

Hence, in the comparison between groups, the experimental group is showing a better result than the control group, in the parameters of Balance, Risk of fall and Quality of life with level of significance 0.05.

4. Discussion

This study was an experimental approach to find the effectiveness of Otago exercise program on improving balance, quality of life and reducing fall risk in hemiplegic patients. The age of the subjects was almost identical in both groups with a mean age of 68.2 and 67.53 in group A and group B respectively. The duration of the condition was 6 months post diagnosis of hemiplegia.8males and 7 females participated in group A and 9 males and 6 females participated in group B. the mean BMI in group A and group B was 23.03 and 23.14 respectively.

Each subjects in both the group received the conventional treatment and Group B received an extra Otago exercise program, three days in a week, for 4 weeks and each session lasted approximately 50 minutes Just before the first day and on completion of 4 weeks treatment session, a pre-treatment score and a post treatment score was taken.

The Berg Balance Scale was used to assess balance, SF-36 Questionnaire was used to assess quality of life, and Timed Get up and Go Test were used to estimate fall risk.

Standardized instruments that are often used in hemiplegic patients were used in all of the measurements for this study

Even though both groups showed improvement, a significant improvement was shown by the experimental group where OEP along with conventional physiotherapy significantly improved Balance, Quality Of Life and Risk of Fall in hemiplegic patients.

An independent gait increases the confidence of an individual and makes life more productive.The ankle strategy and hip strategy shows an improvement with the practice of Otago exercise. Otago exercise is helpful in walking, standing erect, and control of the body when itmoves in a small range of area, and regaining balance when moving unconsciously. With the improvement in ankle strategy, the body can move as a single entity about the ankle when the foot muscle is activated on the ground. The hip strategy is used when the body moves faster as the velocity increases along with the distance. [14] Otago exercise helps in walking, posture control with regard to movement correction and muscle activation pattern and helps with balance control with regard to the base of support. [15]

In Otago exercise program the individuals are trained in backward walking; walking and turning around, heel to toe walking, stair walking. The subjects worked on speed, distance, direction, rhythm and muscle tone, and strength while walking. In addition, through stair walking, the subjects practiced with a fixed foot support, acceleration, balance control, extension and contraction of the lower limb, and ankle dorsiflexion to move the centre of gravity to

control the afferent, efferent, and contraction of the lower limb muscles. Coordination and weight shifting were learned through movement of the lower limbs and this improvement results in an overall improvement in gait and Risk of Fall. [15]

Self-efficacy is the self-belief or capability to organize and execute a plan. Self-efficacy is affected in hemiplegic patients and decreases according to the severity of the disease. One psychosocial factor is the fear of fall and the other is loss of balance and it can be a hazardous factor for declining Quality of Life. In this study, Otago exercise group showed a significant improvement in SF-36 questionnaire score. This may be resulted from the improved gait and mobility of subjects in the Otago exercise group, which helped in performing activities of daily living and social activities and was also related to positive physical activity. In this study, the Otago exercise training put forward a goal to the subjects, which they could achieve by succeeding at each level, and hence self-pride increased. The increase in self-pride was related to self-efficacy, which leads to an increase in falls efficacy. Therefore, repetitive training using the Otago exercise will leads to improve in Quality of Life of hemiplegic patients.

5. Conclusion

Falls are common in elderly people as well as hemiplegics and it is a leading cause of injury. The reason may be of decreased muscle strength, flexibility, balance and reaction time. OEP is a muscle strengthening and balance retraining programme and it significantly increases balance, quality of life and reduces fall risk in hemiplegic patients.

From our study it can be showed that Otago exercise program demonstrated a significant improvement in balance, quality of life and significant reduction in fall risk as measured by berg balance scale, SF36 questionnaire, and timed up and go test respectively.

6. Future Scope

Limitations
- The study was of short-term duration.
- Study was done only in hemiplegic patients, diagnosed within 6 months duration.
- Study included subjects in the age group of 60 to 75 years only
- As the measurements were taken manually, this may introduce human error, which could threat the study's reliability.

Suggestions
- The duration of study should be increased as the disease process is long, hence it may lead to better and valuable results.
- A follow up study could ensure the long term effect of the treatment program.
- Studies can be done to find out the efficacy of OEP in other neurological conditions as well as a gender based difference in result.

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