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The Effect of Sensomotoric Integration Exercise on Balance Disorder of Post Stroke Patients

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Abstract

Stroke is a common condition that cause disability and dependency among adults. One of the common symptoms of stroke that often arises is balance disorder. Sensorimotor integration is an exercise targeted to improve the functional capacity of stroke survivors. This study aims to explore the effect of sensorimotor integration exercises in improving balance of people with stroke. This is a quasi-experimental design, with time-series experimental design. Fifteen people were participated in this study and recruited purposively based on inclusion and exclusion criteria. The subjects were divided into two groups, 3 times group and 6 times group. The intervention was conducted for 2 weeks with the total of 6 times exercise. The outcome measure used to measure balance is the Berg Balance Scale, measured at baseline, 3 times and 6 times for both groups. Wilcoxon test was used to analyze the difference between the collected data. The results showed a significant decrease in the Berg Balance Scale ($p<0,01$). This shows that sensorimotor exercise integration has an significant effect in improving balance in people with stroke.

Keywords: sensorimotor integration exercise; balance; berg balance scale; stroke.

1. Introduction

Stroke is a condition that often cause disability on adults and can lead to early death [1]. Stroke is still a major problems in many countries including ASEAN countries.

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Based on data from the South East Asian Medical Information Center (SEAMIC), the highest crude death rate of stroke is in Indonesia, followed sequentially by Singapore (54.2 / 100,000), Brunei (25 / 100,000), and Philippines (20.5 / 100,000). As in other countries, In Indonesia, ischemic stroke is the most common type of stroke (52.9%), followed sequentially by intracerebral hemorrhage, embolism, and subarachnoid hemorrhage (38.5%) [2]. According to the Indonesian National Basic Health Research 2013, the prevalence of stroke in Indonesia based on diagnosis of health professionals or symptoms was 12.1 per mile. Among them, 57.9 percent have been been diagnosed by health workers. The prevalence of stroke based on the diagnosis of health professionals was highest in North Sulawesi (10.8%), followed by DI Yogyakarta (10.3%), Bangka Belitung and DKI Jakarta. The highest prevalence of stroke based on diagnosis of health and symptom is found in South Sulawesi (17.9%) [3].

In addition to many other symptoms such as weakness, limitation, and pain, stroke sufferers often experience balance disorder. Every activity, both static and dynamic, requires balance. Balance is one of the important aspects in the process of improving post-stroke patients, because balance requires the integration of sensory systems (vestibular, visual, somatosensory including proprioceptor) and musculoskeletal (muscles, joints, and other soft tissues) [4]. Balance disorder can cause compensation mobility to stroke survivors. Patients with moderate to severe balance disorders usually use many additional movements to compensate for their motor deficits, whereas for patients with mild balance disorders, the ability to walk closer to the ability of healthy people [5].

One method to improve balance disorders in stroke patients is by applying sensomotoric integration exercise. It can provide a functional and adaptive motor response and can provide a repair effect on the brain responsible for regulating body balance. Sensomotoric integration exercises apply a variety of sensory systems in the form of visual, vestibular, somatosensory and tactile which are owned by individuals, which are then integrated with motor activity (motion) to achieve a directed, purposeful, and functional motion [6]. The aim of this study is to explore the effect of sensomotoric integration on balance disorder of people with stroke.

2. Materials and Methods

2.1. Description of the Study Area

This research was carried out at the Physio Sakti Clinic and the Asyifa Clinic, private physiotherapy clinics in Makassar, South Sulawesi, Indonesia. This research is a quasi-experimental design with time-series design approach.

2.2. Population and Sample

The population in this study were stroke patients who have balance disorder. Subjects were 15 people, who agree to participate in this study and met the eligibility criteria.

2.3. Inclusion Criteria

The inclusion criteria were patients with post-stroke balance disorders with a Berg Balance Scale (BBS) of less

than 46, having MMT values 3-5, 30-70 years old, willing to be a participant, do not use crutches and wheelchairs during exercise or daily activities and have controlled blood pressure.

2.4. Exclusion Criteria

The exclusion criteria were:

1. Patients with complications that limiting the participation
2. Patients with balance disorder not related to stroke
3. Patients with cognitive disorders
4. Patients with communication problems

2.5. Collecting Data and Procedure Intervention

The data collection was conducted from April to June 2018 at Physio Sakti Clinic and Asyifa Clinic. Patients were screened during their visits at the clinics. Those who met the eligibility criteria were asked to participate and signed informed consent if agree to participate. Subjects were treated with standard physiotherapy treatment plus sensomotoric integration specific for their balance disorders.

The treatment program were given for six times for all participants. The BBS were measured at three occasion, at baseline, after three times of intervention and after six times. The measurement was conducted by a trained physiotherapist.

2.6. Data Analysis

The data of subjects was analyzed descriptively. As the data was found not normally distributed, data were analysed using ANOVA test to find difference between the groups of measurement time. Post hoc analysis was conducted for in-depth analysis purpose.

The results of data analysis are presented in the form of tables, graphs, and narratives.

2.7. Ethical consideration and clearance

Ethical approval for this study was obtained from the Ethics Committee, Hasanuddin University, Makassar, Indonesia.

3. Results

The characteristics of subjects were presented in Table 1.

More than 75% of participants were less than 60 years old, and more male than female. According to muscle strength measurement, more than half of participants can only move against gravity but not against small load.

Table 1: The General Characteristics of Subjects

Subjects Characteristics		Group of NHS and HS	
		N	%
Age			
	31-40	2	13.3
	41-50	3	20.0
51-60		7	46.7
61-70		3	20.0
	Total	15	100
Gender			
	Male	9	60
	Female	6	40
	Total	15	100
Manual Muscle Strength			
Inferior (MMT)			
	3	9	60
	4	6	40
	5	0	0
	Total	15	100

Information: n = number of samples;

The statistical inference analysis results are shown in Table 2.

There were significant differences between the application of sensomotoric integration, after 3 times, and after 6 times ($p<0.01$). Based on the value it is clear that the 6 times group shows more balance improvement compare to the other groups.

Table 2: Data Analysis of Pre-Test and Post Test

Exercises	Min			
	n	Median	Max	P
Sensomotoric Integration				
Pre-test	15	29 35	44	0,001
Post test 1(3 times exercises)	15	29 36	46	0,001
Post test 2 (6 times exercises)	15	30 38	48	0,000

Information: SD = Standard Deviation; p = *Paired Sample T test*; pp = *Independent Sample T test*

4. Discussion

The results of this study indicate that those who have balance disorder are mostly less than 60 years with a total. This is in accordance with the results of research conducted by Christanto and his colleagues [7] said that the distribution of stroke patients according to age was found to be the most number of patients aged 51-65 years with a percentage of 45.2%. However, it is quite not similar with the risk factor of age principal. Age factor is not modifiable, but some modifiable risk factors such as hypertension, diabetes mellitus are prone to old age [7]. Other studies conducted by Mahendra [8] also say that the incidence of stroke increases with increasing age. Individuals over the age of 55 have a risk of ischemic stroke doubling every decade.

According to gender distribution, men were more than women. This is in line with the research conducted by Sofyan [9] that strokes occur more frequently in men (52%) compared to women with (48%). In the research conducted by Farida and Amalia [10], it is known that dominating the occurrence of stroke is a male sex subject. Men are more at risk of stroke compared to female. It is probably related to the fact that men more likely to smoke than female and can lead to risk of stroke [10]. As Watila and his colleagues [11] stated that men are more likely to get a stroke than women because in men there are hormones testosterone. This hormone can increase LDL levels and can increase cholesterol levels in the blood. Cholesterol can lead to hypertension, one of the commonest risk factor of stroke.

The results showed that the average muscle strength (MMT) in inferior limb muscles was at a value of 3. Muscle strength is a supporting factor in maintaining balance in stroke patients. In accordance with a study by Ismaningsih [12] that muscle strength is very important in performing activities such as walking. All movements produced are the result of an increase in muscle tension as a motor response. The muscle strength of the legs, knees and hips must be adequate to maintain the balance of the body when there is an external force. Muscle strength is directly related to the ability of the muscles to resist the force of gravitation and other external loads that continuously affect body position [12].

The results of this study indicate that sensomotoric integration is effective both in three times and six times with better improvement in six times compared to baseline and three times group. This is because the application of continuous training will provide an adaptation effect on the innervation system. Beaumont and Gardiner, in Wijaya [13] say that with the method of adaptation (Adaptation Theory) sensory input is processed into a stimulus so that it can produce a movement. The effect of the adaptation movement will adapt neuronal impulses from sensory stimulation activities so that it will affect the output produced so that the output can produce a coordinated movement which is the result of cooperation from the cortical response [13].

Sensomotoric integratain has been combined with neurodevelompmental training in Hazmi et.all [14] and found to be better improving the standing balance in down syndrome patients compared to NDT alone. Anothr study by Purwindra [15] found that the combination of NDT and sensomotoric integration tretatment are effective in improving standing balance in children with intellectual challenges with mild and moderate categories at ages 16-26 years.

According to a study by Xie and Cui, in Wijaya [13] shows that activities involving sensomotoric components of integration will improve functional nerve connectivity between different areas. The resulting model is a neural interaction and the relationship between cortical region connectivity. This change in cortical connectivity patterns will improve motor nerve work. As in terms of improving balance in post-stroke patients, it requires continuous adaptation, so that interactions occur in the innervation system and reorganize again to carry out the recovery process [13].

5. Conclusions

In conclusion, there are significant differences between before and after giving sensory exercise integration to balance values in post-stroke patients. This study states that giving sensomotoric integration as much as 6 exercises is more effective in improving balance than giving sensory motor exercises 3 times.

6. Abbreviations

BBS: Berg Balance Scale

7. Competing interest

The authors declare that they have no competing interest or work with organization that can be benefited by the results of this study.

8. Recommendations

Based on the results of this study, it is recommended to add sensomotoric integration in the exercise program of people with stroke, especially those with balance disorder.

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