Hand exercise using a rubber ball increases grip strength in patients with non-haemorrhagic stroke

By Ira Rahmawati

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Hand exercise using a rubber ball increases grip strength in patients with non-haemorrhagic stroke

Ira Rahmawati[1], Ratna Dewi[2], Sumirah Budi Pertami[3], Budiono[4], Ester Pasaribu[5]

[1,3,4]Department of Nursing, Poltekkes Kemenkes Malang, Indonesia

[2,5]Department of Nursing, Faculty of Health, Esa Unggul University

ABSTRACT

Stroke can cause various degrees of disturbance, such as decreased muscle tone, loss of sensibility in some parts of the body, limits the ability to move the affected limbs and incapacity in certain activities. This study aimed to identify the effect of hand exercises using a rubber ball on muscle strength in patients with non-haemorrhagic stroke. we measure handgrip strengths of the respondents as it reflects the muscle strength and integrity functions of the upper limbs. The sample in this study were 40 patients with one-sided upper extremity paresis causing by ischaemic stroke. A pre-experimental method with one group pre-post-test design was used in this study. The respondents were given hand exercise using a ragged rubber ball for seven days twice a day. Handgrip strength of were measured by a handgrip dynamometer before and after the interventions. The Wilcoxon signed-rank test was performed with p-value of 0.000 ($\acute{\alpha} < 0,05$) which means that hand exercises using a rubber ball does increase the muscle strengths of the upper extremity. We suggest that hand therapy using a ragged rubber ball can be used as an alternative for motor exercise in post-stroke patients.

Keywords: Stroke, hemiparesis, hand exercises, handgrip strength, handgrip dynamometer.

Introduction

Stroke is one of the leading causes of mortality and disability with enormous economic costs globally. Stroke accounted for 5.5 million of deaths in 2016, with 2.7 million of the deaths were due to ischaemic stroke. Globally, Stroke is also the second leading cause of Disability-adjusted Life Years (DALYs) in 2016 (Feigin et al. 2019; Randolph 2016). The prevalence of ischaemic stroke is higher than haemorrhagic stroke.

In Indonesia, stroke exerts a great economic burden on Indonesian Households, costing a total of Int$ 0,29 billion in 2010 and is predicted to increase to Int$ 1,27 billion

in 2020 (Finkelstein, Chay & Bajpai 2014). According to the Ministry of Health of Indonesia (2019), there are 500.000 cases of stroke Indonesia each year, causing 12.500 deaths and leaving the rest disabled. 80% of the stroke are ischaemic and the rest 20% are haemorrhagic stroke (Ministry of Health Indonesia 2018).

Stroke is defined as sudden onset of focal or global neurological deficits, lasting for more than 24 hours, or leading to death with no apparent cause other than a vascular origin. When the disruption of blood supply to the brain is caused by occlusion of the cerebral blood vessels, it is called ischaemic stroke. Meanwhile, hemorrhagic stroke is caused by a rupture of the cerebral blood vessels preventing blood flow to the brain (Catangui & Slark 2012; Hickey 2013). Stroke may cause a various degree of disruption of the patients' psychological and physical functions. These include decrease in muscle tones, loss of sensibility and muscle strength of the affected body's parts and decrease of the ability to perform certain activities.

One of the most devastated sequelae of stroke is a loss of mobility. In Indonesia about 70% of the stroke case is non hemorrhagic stroke (Azmi 2012; Yudiarto et al. 2014) and more than 70% of these patients were having weakness on one side of the body (Heriyanto & Anna 2015; Oktraningsih 2017; Yazid 2017). Paresis of the upper extremity is the most frequent motor problem experienced by individual with stroke (Winstein Carolee et al. 2016). Rehabilitation after stroke is indeed an important part of the stroke management and should be started early. However, the initiation of stroke rehabilitation within 24 hours may be not beneficial for the long term outcomes or even harmful. Growing evidence suggests that constraint-induced movement therapy for the upper extremities may be significantly beneficial to be initiated within 2 weeks of stroke (Belagaje 2017; Coleman et al. 2017).

Hand strength may be improved by resistance trainings, such as weight-bearing training, medicine balls, and elastic balls. Grasping a rubber ball can be used as an alternative for hand exercise, especially for patients with paresis of the upper extremities. Squeezing the ball will stimulate the upper extremity's muscles including fingers, hands, and wrists. It also stimulate the brain to coordinate the movement. In addition, grasping a rubber ball may help the muscles relax: gripping and releasing patterns lessen tension and stress. Several studies have used different means for the hand training resulted in varied results of muscles strength improvement (Mardati, Setyawan & Kusuma 2014; Prok, Gessal & Angliadi 2016).

This study aimed to evaluate the effect of hand training using a rubber ball on the muscles strengths of the patients with hemiparesis after stroke. The exercise was conducted in the patients' home in an urban area of West Jakarta in March to June 2019. The muscle strengths of the affected hand was measured before and after the intervention using a handgrip dynamometer.

Methods

This study employed a pre experimental one-group pre-posttest design. Forty stroke-survival individuals with weaknesses in one sided of the hands were recruited using purposive sampling method. The inclusion criteria were patients with non-haemorrhagic stroke with hemiparesis. All respondents were given hand exercise twice a day for fourteen days. We asked the individuals to squiz a ragged rubber ball for five seconds then relaxed for five seconds. These procedures were repeated seven times for ten minutes. The hand strength were measured before and after interventions using *handgrip dynamometer*. Data analysis was conducted using *Wilcoxon test,* specifically to identify the difference of the patients' muscle strength before and after the intervention.

Results

Table 1. Distribution of respondent by gender and age group

Age group (in years)	36-45	46-55	56-65	>65
Male	2	15	4	2
Female	1	10	5	1
N (%)	3 (7.5%)	25 (62.5%)	9 (22.5%)	3 (7.5%)

The majority of our respondent were 45 – 55 years old, that is 62, 5% of the total sample. Meanwhile, respondent who were more than 65 years old were only three individuals. Table 1 also shows that more than a half of our respondent were male. Numerous studies have found that male are at high risk for stroke compared to pre menopause female (Förster et al. 2009; Haast, Gustafson & Kiliaan 2012; Watila et al. 2011)

Table 2. Mean grip strength of the affected hand pre and post interventions based on age and gender

Age-group (years)	36-45		46-55		56-65		> 65	
	pre	post	pre	post	pre	post	pre	post
Male	27,4	28,6	26	28,1	26,1	27,3	21,1	22,7
Female	13,6	14,2	12,2	13,5	10,8	12,7	8,6	10,6

Note: Handgrip strength is measured in mmHg using handgrip dynamometer

Table 2 shows that the highest increase in grip strength was found in men at the age of 46-55 years old. The handgrip strength increases by 2.1 mmHg.

Table 3. Mean handgrip strength of the affected hand pre and post intervention

Mean grip strength	Pre	Post
	19,6	21,4

Statistical analysis using Wilcoxon signed ranks test was carried out to evaluate the effect of hand exercise using a rubber ball on hand grip strength:

Table. 5 Comparison of handgrip strength before and after intervention

	N	Mean	Std. Deviation	Z	Asymp. Sig.(2 tailed)
Grip strength before intervention	40	19, 625	7, 4777	-5, 513b	0, 000
Grip strength after intervention	40	21, 423	7, 6045		

($\alpha = 0, 05$)

Table 5 shows the 2 tailed value is $0, 000 < 0, 05$ meaning that there is a significant difference of the hand grip strength before and after intervention given.

Discussion

Risk factors for stroke includes older age, smoking, high blood pressure, family history of stroke, ischaemic heart diseases, and consumption of birth control pills (Kelly-Hayes 2010). Furthermore, as the incidence of metabolic disorders and cardiovascular diseases increase with age, the incidences of stroke will also increase after the age of 55 years old, and the risk is double every ten years after that ages. However, stroke may also occur in all age groups (Michael & Shaughnessy 2006; Suiraoka 2012). Indeed the majority of our respondents were 45 – 55 years old and most of them have history of hypertension and smoking.

Studies have reported that handgrip strengths correlates with gender, dominant hands, age and also height and weight of the individuals (Agnew & Maas 1982; Kamarul, Ahmad & Loh 2006; Petersen et al. 1989). Measuring handgrip strengths using handgrip dynamometer can be used to predict the muscle strength. Handgrip strength test need only a simple handgrip dynamometer and minimal effort from individuals, such as post-stroke patients who might be unable to carry out the other heavy and complex test (Trosclair et al. 2011).

The value of handgrip strength as an indicator for arm recovery in post stroke patients have been studied and found that handgrip strength can be used to reflect the functional

integrity of the upper extremity (McAniff & Bohannon 2002; Sunderland et al. 1989). Our study found that simple hand exercise at home could increase grip strength on the affected hand in post stroke patients. Decreased handgrip strength may reduce the ability to perform activity daily living (ADL) and therefore, affect the individuals' quality of life. A study also found that handgrip strength is associated with social and psychological functions (Taekema et al. 2010).

Hand strength may be improved by resistance training, such as grasping elastic ball weight-bearing training, medicine balls, and many others. In our study, we asked the individuals to squiz a ragged rubber ball for five seconds then relaxed for five seconds. This procedure was repeated for seven time in 10 minutes twice a day for fourteen days. Grasping and releasing a ragged rubber ball for a certain period may stimulate acupressure points at the palm, which then activate the sensory neurons to send the impulse to the sensory areas of the affected hemisphere. Furthermore, squizzing a rubber ball with varied grip strength will train the muscles as well as the brain. Repeated hand exercise using a rubber ball or other tools such as cylindrical grips may help to increase muscles tones in several studies (Chaidir & Zuardi 2014; Irfan 2012; Lindberg et al. 2004; Mardati, Setyawan & Kusuma 2014).

Physical training for stroke patients is to be initiated within 2 weeks because hand exercise very early within 24 hour of stroke attack may be harmful for the patients. All of the respondents in our study were in the rehabilitation phase, which was more than four week after stroke. Our study found that an increase of handgrips strange is higher in men than in women. The highest increase was found in men at the age group of 46 to 55 years old. Family support is one of the contributing factors to the training outcomes. Therefore, every step of the treatment given for patients with stroke should involve their next of kin or

close family members. The family involvement is mostly crucial in the rehabilitation phase as wells as the stroke preventions programs (Rahmawaty et al. 2019).

Conclusion

Physical rehabilitation after stroke is an integral part of the stroke management and should be initiated early. Hand exercise using a rubber ball can be utilized as an alternative physical rehabilitation as it is cheap, simple, and easy to perform at home. The success of this exercise might be affected by several factors including the age of the responded and support from the family members.

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