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ORIGINAL ARTICLE

Comparison Between Ai Chi and Stroke Mass Exercise for Dynamic Balance Improvement in Stroke Patient

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ABSTRACT

Objectives: To observe improvement of dynamic balance in stroke patients who get Ai chi exercise compare to stroke exercise in stroke patients with onset more than six months.

Methods: 30 subjects who met the inclusion criteria were divided into two groups, Ai chi and stroke mass exercise group. Each group got exercise three times a week for four weeks. A dynamic balance test with the four square steps test was conducted before exercise program and at the end of the exercise.

Results: FSST Ai Chi start 20.48 ± 10.86, FSST end 17.55± 12.24, (p = 0.05), stroke gymnastic start 23.98±9.41, stroke gymnastic end 18.24 ± 8.45 (p = 0.02). In the initial test for all subjects FSST results obtained mean 28.72 ± 37.25 seconds and the final test of 24.02 ± 35.16 seconds FTT start 29 (.443), FTT end 29(.957)

Conclusions: Ai chi and stroke exercise training improved dynamic balance of stroke patients with onset more than six months, and statistically there is no different balance dynamic improvement for both exercise.

Keywords: Stroke, Dynamic balance, The four square steps test, Stroke exercise (senam stroke), Ai chi.

INTRODUCTION

Stroke is one of the three leading causes of death with heart disease and cancer, is also a major cause of disability/long-term severe disability in world.¹² Seismic Health Statistic from 1991 to 1995 showed that stroke is the leading cause of death in Indonesia and disability in most adults. Stroke incidence and prevalence continues to be increased, but with advanced management of stroke, early detection and aggressive efforts of primary and secondary prevention will decrease mortality rate, this is then increasing disabilities.²³,⁴. Disability in stroke is resulting from disruption motor control, strength, coordination, balance, and spasticity which ultimately affect the motor, functional ability and quality of life.⁵,⁶ In Dr.Kariadi Hospital Semarang, stroke ranks at first of all patients treated in the neurological ward. In 1995 data recorded 614 patients of total 1003 patients (61.22%), and 265 of 894 patients was stroke patients in 2009.⁷

Balance is defined as the ability to maintain the body’s center of mass with limits determined by balance of the basic buffer. Balance limit is a place on a space in which body can maintain a position without change of the basic buffer. Limitations of this balance are changed with the task of individual biomechanical and environmental aspects. Standing balance is defined as the ability to stand unassisted without falling or changing the basis of a brace or using hand.³³ Physical balance divided into two types: static balance, ie balance to maintain position.
during the period, and dynamic balance which is the ability to maintain balance while performing movement.\textsuperscript{58} Balance isn depending on influence of visual, vestibular, tactile input proprioceptive and that will be processed in the central nervous system, which will be resulting in an effective muscle tone, muscle strength and joint flexibility. Biomechanical of balance may be changed as influenced by musculoskeletal and neuromuscular disorders, coordination disturbance and pain.\textsuperscript{59} Dorit et al. stated that stroke patients have a higher risk for falls in the community. Recurrent falls were resulting from a greater resistance of mobilization, reduced hand function and ability ADL.\textsuperscript{10} Shylie et al. Also concluded that fall is often experienced by people with stroke. Stroke patients who often fall have the characteristics of poorer balance, more slowly walking, less active and taking more medications.\textsuperscript{9} Indre et al concluded that increasing balance of stroke patients is not just simple exercise by strengthening the muscles of the lower limb because strengthen the muscles of lower extremity had little influence on dynamic balance of stroke patients.\textsuperscript{3}

Stroke patients who got exercise therapy may significantly have improved condition. Improving balance in stroke can be done on land-based exercise and water-based exercise. Ami et al in 2006 showed this evidence of exercises. There were improvement in walking speed and functional capacity in stroke patients who did treadmill exercise and overground walking for 30 minutes per session, three times a week for four weeks. Subjects who had treadmill exercise got more significant improvement\textsuperscript{11} J Kaur et al. also had a good improvement in cadence, step length and gait velocity in stroke patients who exercised for 40 minutes each session, three times a week for four weeks or twelve sessions.\textsuperscript{12}

Water-based exercise was proved giving better improvement than land-based exercise as showed by Chu et al. Their study showed that water-based exercise increased cardiovascular fitness by 22% in stroke patients. It also obtained an improvement in maximal workload, running speed and increase strength of affected side.\textsuperscript{13} Dong at al. had a good improvement in postural balance and knee flexion in provision exercises and hydrotherapy, referred to Halliwick Ai chi.\textsuperscript{14} Lee et al. also obtained significant improvements by hydrotherapy to walking speed, endurance running and balance in hemiplegia stroke patients.\textsuperscript{15}

Water has several properties like hydrostatic pressure, buoyancy and temperature that can be used for therapy, these make this kind of exercise is different from land-based exercise. Peripheral blood vessels get less pressure in water, water level as high as neck will result in 700 cc of blood returning from the peripheral to the main blood vessels, making a heart work due to a rapid increase of venous return. This is also slightly increasing intra-abdominal and intra-thoracic which then more load for respiratory rate. Water temperature has a lot of influence on the body. Cold water far below body temperature would lead to vasoconstriction of peripheral blood vessels resulting in increased blood pressure and increased venous return to the heart. Warmer water will lead to vasodilatation then gives effect of calming or relaxing, decrease muscle tone and relieve pain, such an effect resulting from other thermal modalities. Nature of buoyancy in water is also an advantage to train people who have weakness in lower extremities or have constrain in doing weight bearing exercise. Exercise in water as level as umbilicus supports 50% weight bearing and increasing by 75 % at chest level.\textsuperscript{42,43}

Therapeutic effects of hydrotherapy exercises for stroke patients with hemiplegia are reducing spasticity, improving and maintaining mobility, inhibiting abnormal motion patterns, re-educating in normal pattern of voluntary movement, improving balance and postural reflex re-education, improving independence and ability to swim and strengthening.\textsuperscript{42,43}

Ai chi is one type of exercise performed in water that can be used to train stroke patients. Ai chi is found by Jun Kunno in the early 1990's and was developed by Ruth Sova. Ai chi movements like Tai Chi, but Ai chi performed in the warm water pool with depth at shoulder level. Like tai chi, Ai chi combines slow movement, the movement of water and rhythmic movement with controlled breathing. Movement pattern involve large-muscle groups of the body, symmetric or asymmetrical movements, and a single-leg
stance, all of which can improve mobility and strength. When combined with diaphragmatic breathing, these movement patterns can increase relaxation and decrease pain. Deep breathing using the diaphragm breathing technique done here is to increase energy, stress reduction, increase caloric consumption and improve circulation.\cite{46,49,50} Ai chi is composed of several movements where every movement has a name and each of these movements can several times in accordance with the ability of the patient. To get good results, this exercise is done two to three times a week for 30 to 45 minutes each time.\cite{50}

Stroke exercise (senam stroke) is one type of training given to people with stroke at an advanced stage/chronic conditions at which time the patient is stable. Training methods of the underlying motion stroke exercise is based on normal infant development (Bobath method), then a motion close up hands to the body or vice versa (Brunnstrom method), followed by neck motion movement is symmetrical/asymmetrical movement, and based the brain's ability to recapture the events of the past (Janet and Roberta S method). The main purpose of the stroke exercise itself is: to train motor coordination, support the achievement of the rehabilitation program and to provide motivation for people in the form of exercise therapy and recreational therapy. There are three levels of stroke exercise, in which each level tailored to the condition of the patient. The first level is reserved for patients who have not been able to sit steady. The second level is reserved for stable patients who are able to sit in a chair with a backrest. The third level for people who can stand steady without a walker.\cite{45}

Four steps square test (FSST) is one measure of dynamic balance in which patients were instructed to move in different directions according to clockwise and vice versa. This measuring tool used by Wayne Dite et al. in 2002 to assess the dynamic balance in the elderly. The result is FSST has a sensitivity of 85%, specificity of 88-100% and a positive estimated value of 86%.\cite{47} In 2008 by Jannette MB et al. Conclude that FSST is an feasible and valid test of dynamic standing balance that is sensitive to change during stroke rehabilitation.\cite{46}

Based on the studies mentioned above, the writer wants to know improvement of dynamic balance in stroke patients who get Ai chi exercise compared to stroke exercise in stroke patients with onset more than six months.

Research Hypotheses are (1) there is a dynamic balance improvement of stroke patients with onset more than six months who had a stroke exercise three times each week for four weeks, (2) there is a dynamic balance improvement of stroke patients with onset more than six months of receiving Ai chi exercises three times each week for four weeks, (3) there is a more significant improvement balance dynamic in stroke patients who receive training Ai chi than stroke exercise

**METHODS**

Its a quasi-experimental study without control. The study was done in Kariadi Hospital Semarang with 15 samples (consecutive sampling) for each exercise type who met inclusion criteria such as age 45-60 years, more than 6 months stroke, cooperative, lower extremity strength of affected site at least 3, able to walk more than 2 minutes either independently or using a tripod, understand verbal or written instructions, willing to participate in the study and signed a informed consent. Subjects were excluded when met any criteria as: brain stem stroke, flaccid, have cardiopulmonary problems, cognitive impairment that can not follow orders, with neuromuscular/musculoskeletal and vision disorders that limit the exercise, bilateral hemiparesis, pain that could interfere with the exercise, incontinencia uri or alvi. Drop out criteria is applied when subject was unable to follow the practice of more than two times and subject withdrew from the study.

Every sample had received the information about exercise program, signed the informed consent and underwent physical examination. Half of the sample had Ai chi exercise and the rest had stroke exercise. The frequency of exercise was three times a week for four weeks. The pulse and blood pressure were monitored before and after exercise to evaluate the cardiorespiratory response to exercise. Examination balance dynamic test with FSST was performed before and after exercise period.
RESULTS

At the end of the study we had 30 stroke subjects who met inclusion criteria during April 2010 until July 2010. Age of subjects ranged from 45 to 60 years with a mean of 52.60 ± 4.17 year old. Subjects had suffered a stroke from 7 months to 10 years with a mean 30.67 ± 26.12 months. BMI as a whole range of research subjects at 20 to 28 with a mean 24.57 ± 2.54.

Table 1. Characteristics of subjects

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Types of exercise</th>
<th>Total</th>
<th>(%)</th>
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<tbody>
<tr>
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<td>Ai chi</td>
<td>Stroke exercise</td>
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<td>Gender</td>
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</tr>
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<td>Senior high school</td>
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<tr>
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Table 2. Physical characteristics of subjects

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<td></td>
<td>Ai chi</td>
<td>Stroke exercise</td>
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<td>3</td>
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<tr>
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<td>1</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

In the initial test for all subjects FSST results obtained mean 28.72 ± 37.25 seconds and the final test of 24.02 ± 35.16 seconds. In the exercise group there was one sample that had an extreme value on the FSST testing, then the extreme value out for the last calculation. In the FSST results obtained from both groups as shown in Table 3.
FSST distribution of test data before and after training after the extreme value exclude is a normal (Kolmogorov-Smirnov test), then performed using t paired test.

DISCUSSION

Thirty patients were recruited to undergo rehabilitation programs in Medical Rehabilitation Department, Dr. Kariadi Hospital, Semarang with the largest gender was male 21 people (70%) and female 9 people (30%). These results are consistent with Petrea findings (2009) that 45 to 74 year-old male suffered a stroke more often than female. Average age of stroke in this study was 52.60 ± 4.17 years. With the onset mean 30.67 ± 26.12 months. These results are more likely to the results of research conducted by Siddique et al in 2009. Level of education was mostly scholar (33.3%), followed by diploma at 26.7% and 23.3% high school. It is different to the results of Loewen et al in 1990 that had the highest level of education was high school (55%).

Most subjects in this study had right hemiparesis (60%). It is not different to Siddique finding. Hypertension (56.7%) was the most risk factor of stroke event, consistent with findings of Siddique et al (80% in haemorrhagic stroke and 86.25% in ischemic stroke). BMI was 24.57 ± 2.54, which is similar to findings of Zhou et al in China that found approximately 52 years of age have a BMI.

There were significant improvements in dynamic balance on both group of exercise (p 0.005 for Ai chi and p < 0.005 for stroke exercise (table 3). There was also no statistically difference between both kinds of dynamic balance exercises, p > 0.005 (table 4). These results are different to study of Dong and Chu. Dong compared conventional therapy group and aquatic therapy group where both attained significant improvements in Berg Balance Scale scores, forward and backward weight-bearing abilities of the affected limbs, and knee flexor strength. Chu study showed significant improvements on trial group in cardiovascular fitness, maximal workload, gait speed and muscle strength of affected lower extremity. The trial group exercised in chest-level water exercise on targeted heart rates and the control group performed arm and hand exercises while sitting.

The different result of this study perhaps due to difference in exercise duration. Dong and Chu performed exercises for an hour each time, three times a week for 8 weeks, whereas our study was only half an hour each time, three times a week, for 4 weeks. Water-based exercises in Dong study were Ai Chi and Halliwick methods, which focused on balance and weight-bearing exercise. Subjects in that study got more balance and more trunk control training, while we did only Ai chi.

Effect of water buoyancy helps reducing 50% of weight bearing exercise performed in water with level of umbilicus and reducing 75% of at chest level. Ai chi exercise conducted in this study was at chest level caused strengthening

<table>
<thead>
<tr>
<th>Types of exercise</th>
<th>Start (seconds)</th>
<th>End (seconds)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ai chi</td>
<td>20.48 ± 10.86</td>
<td>17.55± 12.24</td>
<td>.005</td>
</tr>
<tr>
<td>Stroke gymnastic</td>
<td>23.98±9.41</td>
<td>18.24 ± 8.45</td>
<td>.002</td>
</tr>
</tbody>
</table>

$P < 0.005$ is significant

This study showed an significant improvement of dynamic balance but also had no significant difference between both group.

<table>
<thead>
<tr>
<th>FSST test</th>
<th>$N$</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Start</td>
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<td>.443</td>
</tr>
<tr>
<td>Final</td>
<td>29</td>
<td>.957</td>
</tr>
</tbody>
</table>

$P < .005$ is significant. $P > .005$ is not significant

Table 3. FSST test measurement results

Table 4. Comparison of initial and final test FSST for a given subject Ai chi exercises and stroke exercise
of lower limb and had lower impact compared to full weight bearing of land-based exercise. Nevertheless, a short duration of training in this study might cause an insignificant difference in dynamic balance in both groups.

CONCLUSIONS

Both Ai chi and stroke exercise training improve dynamic balance in stroke patients with onset more than six months, however there is no statistically difference of balance dynamic improvement between both groups. This is a preliminary study that needs further research within larger sample size and longer period to get better results. Further research is also needed to assess the variables had been accessed in this study, such as fitness, static balance, muscle strength, spasticity and coordination.

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