For your postmenopausal osteoporosis (PMO) patients with difficulty taking oral Bisphosphonate : the First Quarterly Bisphosphonate for PMO

Choose BONVIVA quaterly IV injection ....

- provides proven clinical efficacy[1-3]
- brings the benefits of bisphosphonate treatment to more PMO patients
- is well tolerated[1,2,3]
- is the only bisphosponate that can be administered via short (15 - 30 second) IV injection[3,5]
- provides better compliance

References:

1. Chesnut CH et al. J Bone Miner Res 2004; **19** :1241-1249.
2. Delmas P.D, et al. Arthritis Rheum 2006 ; **54** : 1838-1846
3. Eisman JA, et al. J Rheumatol 2008 ; **35** : **488-497**
4. Delmas P.D, et al. Osteoporosis Int (2008) 19 (Suppl 1) : S 194
5. Bonviva IV Injection : Summary of Product Characteristics

For further information :
PT. Roche Indonesia
Artha Graha Building, 21st & 22nd Floor
Sudirman Central Business District – Lot 25
Jl. Jend. Sudirman Kav. 52-53
Jakarta 12190, Indonesia
Phone +62 21 3041 3000
Fax +62 21 515 2066
Mobile +62 815 580 88131
www.roche.co.id

QUARTERLY
Bonviva®
ibandronic acid
IV INJECTION IN A PREFILLED SYRINGE
The new way
to manage osteoporosis

ORIGINAL ARTICLE

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

Junita Siusanti[1], I Made Widagda[2], Dodik Pramono[3]
[1] Department of Physical Medicine and Rehabilitation, Medical Faculty of Diponegoro University, Dr. Kariadi General Hospital, Semarang.
[2] Department of Public Health, Medical Faculty of Diponegoro University, Semarang.

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 inclution criterias 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.005), stroke gymnastic start 23.98±9.41, stroke gymnastic end 18.24 ± 8.45 (p.002). 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 FFT 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.[1,2] Seasmic 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.[2,3,4]. Disability in stroke is resulting from of 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

Received in March 2012 and accepted for published in April 2012.
Correspondence address : Junita Siusanti, Email : j.siusanti@gmail.com

during the period, and dynamic balance which is the ability to maintain balance while performing movement.[58] Balance isn depending on influence of visual, vestibular, tactile input propioseptif 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.[3] 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.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.[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.[3]

Stroke patient 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[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.[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.[13] Dong at.al had a good improvement in postural balance and knee flexion strength in provision exercises and hydrotherapy, refereed to Halliwick Ai chi.[14] Lee et.al also obtained significant improvements by hydrotherapy to walking speed, endurance running and balance in hemiplegia stroke patients.[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 harder 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.[42,43]

Therapeutic effects of hydrotherapy exercises for stroke patients with hemiplegi 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.[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 pattern 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.[48,49,50] Ai chi is composed of several movements where every movement has a name and each of these movements can several times in accordance with 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.[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 (Brunnstom 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 trin 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 stable. 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.[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%.[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.[46]

Based on the studies mentioned above, the writer wants to know 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

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 criterias 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, incontinentia 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 cardio-respiratory 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 ± 4:17year 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

Characteristics	Types of exercise		Total	(%)
	Ai chi	Stroke exercise		
Gender				
Male	11	10	21	70
Female	4	5	9	30
Marital status				
Married	15	14	29	96.7
Not married	0	1	1	3.3
Education level.				
Not educated	1	0	1	3.3
Junior high school	2	1	3	10.0
Senior high school	2	5	7	23.3
Diploma	3	5	8	26.7
Scholar	6	4	10	33.3
Post graduate	1	0	1	3.3
Work status				
Working	10	9	19	63.3
Not working	5	6	11	36.7
Payment				
Askes	10	10	20	66.7
Independent	5	5	10	33.3

Table 2. Physical characteristics of subjects

Characteristics	Types of exercise		Total	(%)
	Ai chi	Stroke exercise		
Hemiparese side				
Right	10	8	18	60
Left	5	7	12	40
Transquilizer				
Used	1	3	4	13.3
Not	14	12	26	86.7
Comorbiditity				
None	0	3	3	10
Hipertension	6	11	17	56.7
DM	1	0	1	3.3
Hypercholesterolemia	1	0	1	3.3
Hipertension and DM	5	0	5	16.7
DM and hypercholesterolemia	1	0	1	3.3
DM. hipertension and hypercholesterolemia	1	1	2	6.7

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.

Table 3. FSST test measurement results

Types of exercise	Start (seconds)	End (seconds)	P
Ai chi	20.48 ± 10.86	17.55± 12.24	.005
Stroke gymnastic	23.98±9.41	18.24 ± 8.45	.002

P< 0.005 is significant

FSST distribution of test data before and after training after the extreme value exclude is a normal (Kolmogoroz-Smirnov test), then performed using t paired test.

Table 4. Comparison of initial and final test FSST for a given subject Ai chi exercises and stroke exercise

FSST test	*N*	*p*
Start	29	.443
Final	29	.957

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

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

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.[53] 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.[54] 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%) .[55]

Most subjects in this study had right hemiparesis (60%). It is not different to Siddique finding.[54] 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).[54] 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 [23.56]

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.[13,14] 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.[14] 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.[13]

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.[42] Ai chi exercise conducted in this study was at chest level caused strengthening

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.

REFERENCES

1. 1. Roth EJ, Harvey RL. Rehabilitation of Stroke Syndrome. In: Braddom RL, editors.Physical Medicine and Rehabilitation. 4th edition. Philadelphia: WB Saunders company; 1996.p.1118-53.
2. Brammer CM, Herring GM. Stroke Rehabilitation. In: Brammer CM, editors. Manual of Physical Medicine and Rehabilitation. First edition. Philadelphia: Hanley & Belfus Inc; 2002.p.139-66.
3. Joesoef AA. Penanganan Stroke Komprehensif Terkini. Disampaikan dalam PKB Rehabilitasi Medik. Surabaya; 2005 August 6-7th.p.1-23.
4. Andwerson T. Completed Rehabilitation of Patients with Stroke. In: Kottke FJ, editors.Krusen's Handbook of Physical Medicine & Rehabilitation. 3rd Edition . Philadelphia: WB Saunders Co; 1982.p.583-603.
5. Noerjanto. Diagnosis Stroke. In: Proceeding of Simposium Penanganan Stroke Komprehensif Menyongsong Milenium Baru; 2000 November 4th. Semarang.p.33-46.
6. Roth EJ, Harvey RL. Rehabilitation of Stroke Syndrome. In: Braddom RL, editors.Physical Medicine and Rehabilitation. 4th edition. Philadelphia: WB Saunders company; 1996.p.1053-85.
7. Medical Record. Semarang: Dr. Kariadi Hospital;1996 and 2009
8. Brandstater ME. Stroke Rehabilitation. In: DeLisa JA, Gans BM, editors. Physical Medicine & Rehabilitation. Principles and Practice. 4th edition. Philadelphia: Lippincott Williams & Wilkins; 2005: 1655-76.
9. Shylie FM, Keith DH, Karen JD, Patricia AG, Elsie GC. Balance Score and a History of Falls in Hospital Predict Recurrent Falls in the 6 Months Following Stroke Rehabilitation. Arch Phys Med Rehabilitation. 2006;87:1583-8.
10. Dorit H, Ann A, Emma S. Fall Events Among People Living with Stroke in the Community: Circumstances of Falls and Characteristics of Fallers. Arch Phys Med Rehabilitation. 2002; 83:165-70.
11. Ami Rahmi. Pengaruh Latihan Treadmill dan Program Overground Walking terhadap Kecepatan dan Kapasitas Berjalan Pasien Stroke. Jakarta [Thesis]; 2006.
12. Kaur J, Kumar A. Effect of Task-specific training on gait Parameters in Hemiparetic Stroke Patients. IJPMR. 2009; 20: 23-6.
13. Kelly SC, Janice J.E, Andrew SD, Jocelyn EH, Atila O, Gylfadottir S. Water-Based Exercise for Cardiovascular Fitness in People With Chronic Stroke: A Randomized Controlled Trial. Arch Phys Med Rehabilitation. 2004;85: 870-4.
14. Koog DN, Lim JY, Shin HI, Paik NJ. The Effect of Aquatic Therapy on Postural Balance and Muscle Strength in Stroke Survivors-a randomized controlled pilot trial. Clinical Rehabilitation. 2008;22: 966-76.
15. Lee YH, Kim, JH, Yu YJ; Kang JS. The Effect of Aquatic Rehabilitation Exercise on Maximal Walking Velocity, Endurance gait and Balance in Male Hemiplegia Patients After Stroke. Medicine & Science in Sports & Exercise. 2008;40: S64.
16. Noerjanto. Management of Acute Stroke. Masalah – masalah dalam stroke akut. Semarang: Badan Penerbit Universitas

Diponegoro; 2002.
17. Sjahrir H. Stroke Iskemik. Yandiro Agung. Medan; 2003.
18. Gilroy J. Basic Neurology. 3rd Edition. New York:McGraw Hill; 2000.
19. Lamsudin R. Profil Stroke di Yogjakarta. In: Lamsudin R, editor. Manajemen Stroke Mutakhir. Suplemen BKM XIV(1) 1998. Yogjakarta: Program Pendidikan Kedokteran Komunitas FK UGM; 1998.p.9-14.
20. Bartels M. Pathophysiology and Medical Management of Stroke. In: Gillen G, Burkhardt A, editors. Stroke Rehabilitation, a Function-based Approach. 1st edition. St. Louis: Mosby; 1998.p.1-46.
21. Cailliet R. The Shoulder in Hemiplegia. Philadelphia: F.A Davis Company; 1980.
22. Lamsudin R. Analisis Keputusan Klinik pada Penderita Stroke. In: Soetedjo, editor. Materi Lokakarya Stroke. Semarang: Bagian / SMF Ilmu Penyakit Saraf FK UNDIP; 1996.
23. WHO. Disability, Prevention and Rehabilitation; 1981.
24. Setiawan. Haemorrhagic Stroke. In: Hadinoto S, Setiawan, Soetedjo, editors. Stroke: Management of Advanced. Semarang: Publisher body Diponegoro University; 1992.p.47-61.
25. Sullivan SB . Stroke. In: Sullivan SB, Schmitz TJ, editors. Physical Rehablitation: Assessment and Treatment. 4th edition. Philadelphia: FA Davis Co; 2001.p.20-32.
26. Nuhonni SA. Asesmen dan Diagnosis Fungsional. In: Konsensus Nasional Rehabilitasi Stroke. Jakarta: Perhimpunan Dokter Spesialis Rehabilitasi Medik Indonesia (PERDOSRI); 2004.
27. Barton LA, Black KS. Treatment Learning Strategies Applied to Stroke rehabilitation. In: Gordon WA, editor. Advances of Stroke Rehabilitation. Boston: Butterworth-Heinemann; 1993.p. 63-77.
28. Basmajian JV. Therapeutic Exercise for Stroke Patient. In: Basmajian JV, Wolf SL, editors. Therapeutic Exercise. 5th edition. Philadelphia: William & Wilkins Co;1990.p.207-30.
29. Levin HS. Neuroplasticity and Brain Imaging Research: implication for rehabilitation.Arch Phys Med Rehabilitation. 2006; 87:1.
30. Carr JH, Shepherd RB. Neurological Rehabilitation: optimizing motor performance. Oxford: Butterworth-Heinemann; 1998.p. 3-10.
31. Liss SE. Stroke. In: Halstead LS, Grabois M, Howland CA, editors. Medical Rehabilitation. New York: Raven Press; 1985.p.193-208.
32. Tan JC, Horn SE. Functional Assessment Instruments. In: Tan JC, Horn SE, editors. Practical Manual of Physical Medicine and Rehabilitation. New York: Mosby Year Book Inc; 1998.p. 95-8.
33. Cook AS, Woolcoat MH. Motor Control Theory and Practical aplications. Baltimor: Lippincott Williams & Wilkins. A. Wolters Kluwer Company; 2001.p.223-47.
34. Hadi HM, Darmojo RB. Olah Raga dan Kebugaran pada Usia Lanjut. In: Martono HH, Pranarka K, editor. Buku Ajar Boedhi Darmojo. Geriatric (Ilmu Kesehatan Usia Lanjut). 4th Edition. Jakarta: Balai Penerbit Fakultas Kedokteran Universitas Indonesia; 2009.p.105-14.
35. Martono HH. Penderita Geriatri dan Assessmen Geriatri. In: H.Hadi Martono, Kris Pranarka, penyunting. Buku Ajar Boedhi Darmojo. Geriatric (Ilmu Kesehatan Usia Lanjut). 4th edition. Jakarta: Balai Penerbit Fakultas Kedokteran Universitas Indonesia; 2009.p.115-30.
36. Kligytė I, Ekman LL, Medeiros JM. Relationship Between Lower Extremity muscle strength and dynamic balance in people post stroke. Medicina. 2003; 39(2): 122-8.
37. Zorowitz R, Baerga E, Cucurullo S. Stroke. In: Cuccurullo S, editors. Physical Medicine and Rehabilitation Board Review. New York: Demos; 2004.p. 1-44.
38. Bruno A. Motor Recovery in Stroke. Downloaded from: www.emedicine.medscape.com / article / follow-up.
39. Subagjo. Permasalahan Dan Rehabilitasi

Medik pada Stroke dengan Gangguan Neuromuskuler. Disampaikan dalam PKB Rehabilitasi Medik, Surabaya, 2005 August 6-7.p. 15-30.
40. Maxim BY. Balance training for stroke - family / patient information. Available from URL: http://www.strokengine.ca/.
41. Suzie M, Alan B, Susan S. Circuit-Based Rehabilitation Improves Endurance gait walking but Not Usual Activity in Chronic Stroke: A Randomized Controlled Trial. Arch Phys Med Rehabill. 2009;90:1989-96.
42. Kirk J. Cureton. Physiologic Responses to Water Exercise. In: Richard G Ruoti, David M. Morris, Andrew J. Cole, editors. Aquatic rehabilitation. Philadelphia: Lippincott;1997.p.39-56.
43. Physiological and therapeutic effects of exercise in warm water. In: Skinner AT, Thomson AM, editor. Duffield's Exercise in Water. 3rd edition. London: Bailliere Tindall; 1983.p.39-42.
44. Indications and Advantages, Disadvantages and Contraindications. In: Skinner AT, Thomson AM, editor. Duffield's Exercise in Water. 3rd edition . London: Bailliere Tindall; 1983: 43-6.
45. Soeparman. Senam Stroke. Jakarta: Puspa Warna; 2004.
46. Jannette MB, Victoria MJ. The Four Square Step Test is a Feasible and Valid Clinical Test of Dynamic Standing Balance for Use in Ambulant People Poststroke. Arch Phys Med Rehabilitation. 2008;89: 2156-61.
47. Geriatric Assessment Tool Kit. Available from URL : http://www.cher.brown.edu/Geriatric_Assessment_Tool_Kit.pdf
48. Ai Chi. Available from URL : http://www.InnerIdea.com / aichi.htm
49. What is Ai chi. Available from URL : http://www.wisegeek.com / what-is-ai chi.htm
50. Ruth S. Ai chi. In: Lori TB, Paula RG, editors. Aquatic Exercise for Rehabilitation and Training. Human Kinetics. 2009: 101-16.
51. Lwanga SK, Leneshow S. Sample size determination in health studies. Geneva: WHO; 1991:1-15.
52. Elisabeth B. Diana G. An Introduction to Pool Exercises. The third edition. Edinburgh: E.&S. Livingstone Ltd;1967.p.16.
53. Petrea RE, Beiser AS, Sesdhari S, Kelly HM, Kase CS, Wolf PA. Gender Differences in Stroke Incidence and Poststroke Disability in the Framingham Heart Study.Stroke. 2009; 40: 1032-7.
54. Siddique AN , Nur Z, Mahbub S, Alam B, Miah T. Clinical Presentation and Epidemiology of Stroke - A Case of 100 Cases. J Medicine. 2009; 10: 86-9.
55. Loewen SL , Anderson BA. Predictors of stroke outcome using objective measurement scales. Stroke. 1990; 21: 78-81.
56. Zhou M, Offer A, Yang G, Smith M, Hui G, Whitlock G. Body Mass Index, Blood Pressure and Mortality From Stroke: A Nationally Representative Prospective Study of 212 000 Chinese Med. Stroke. 2008; 39: 753-9.
57. Napitupulu R. Karakteristik Penderita Stroke Haemoragik Yang Dirawat Inap Di Rumah Sakit Santa Elisabet Medan Tahun 2004-2008. Diunduh dari : www.Library.usu.ac.id.
58. Nasher LM. Physiology of balance with special reference to the healthy elderly. In: Masdeu JC, Sudarsky L, Wolfson L. Gait disorder of aging falls and therapeutic strategies. New York: Lippincot-Raven; 1997.p.37-53.