

Effects of Home-based Exercise Program Using Thai-style Braided Rubber Rope on Blood Pressure, Muscle Strength and Quality of Life in Patients on Continuous Ambulatory Peritoneal Dialysis

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ABSTRACT

Objectives: A purpose of this study was to investigate effects of home-based exercise program using a Thai-style braided rubber rope on blood pressure (BP), muscle strength and quality of life of (QOL) in patients on continuous ambulatory peritoneal dialysis (CAPD).

Study design: A pretest-posttest design.

Setting: Department of Physical Medicine and Rehabilitation, Faculty of Medicine, Srinakharinwirot University.

Subjects: Thirty patients on CAPD.

Methods: After training and receiving a Thai-style braided rubber rope together with a brochure and an instructional rubber rope exercise video, all participants were asked to perform home-based exercise 3 times per week for 12 weeks. BP, hand compression and leg and back muscle force were assessed, and SF-36 health survey questionnaire was completed prior to the study as baseline and during follow-up visits at the end of 4th, 8th and 12th week of exercise. The baseline and the follow-up data were compared and analyzed with one-way ANOVA.

Results: There were 6 males and 14 females. Mean age was 51.6 years (SD 11.8) and mean duration of CAPD was 21.5 months (SD 19.1). When comparing data between the baseline and at the end of the 4th week, systolic and diastolic BP declined significantly ($p < 0.05$); hand, leg and back muscle strength increased; and the SF-36 scores of social functioning, bodily pain, emotional role functioning, and vitality, and the total score, increased significantly ($p = 0.030$, $p = 0.009$, $p = 0.001$, $p = 0.000$, $p = 0.003$, respectively).

Conclusion: After 4 weeks of home-based exercise with a Thai-style braided rubber rope, patients on CAPD had a decline in blood pressure, an increase in muscle strength, and a better quality of life especially vitality and emotion function

Keywords: home-based exercise, blood pressure, muscle strength, quality of life, continuous ambulatory peritoneal dialysis

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Introduction

In Thailand during the year 2008-2011, there were 12,753 cases with the end stage of renal disease (ESRD) who were on

continuous ambulatory peritoneal dialysis (CAPD).⁽¹⁾ These patients often suffer from muscle wasting and excessive fatigue,⁽²⁾ poor physical strength, malnutrition, and lack of energy.⁽³⁾ Inactivity is regarded as a major factor leading to impaired physical condition, reduced physical capacity and muscle wasting.⁽⁴⁾ They also have poor quality of life (QOL) which is related with being female, older, less educated and divorced/widowed.⁽⁵⁾

A systemic review showed meta-analytic evidence that resistance exercise could improve QOL in older adults⁽⁶⁾ and body functions of those with chronic kidney disease (CKD).⁽³⁾ However, their skeletal muscle functions and structures are abnormal as a result of impaired protein synthesis and increased protein degradation.⁽²⁾ Therefore, to benefit these patients, exercise programs should be tailored to their limitations.⁽⁶⁾ Low volume of exercise seems sufficient and is recommended for those with poor physical fitness.⁽⁷⁾

According to our observation, many patients could not remember and/or follow steps of exercises due to ageing and lack of interest. However, when exercising with a simple and inexpensive equipment, older adults could exercise regularly (2-3 days per week). These exercises could build not only muscle strength and mass but also preserve independence and vitality.⁽⁸⁾

Recently in Thailand, instead of using a commercial resistive/elastic exercise band, a Thai-style braided rubber rope has been introduced for strengthening or resistance exercise in elderly,⁽⁹⁾ but there has been no evidence of its benefits and safe for patients on CAPD. We therefore investigated whether performing a home-based exercise program with this simple Thai-style braided rubber rope was practical for patients with ESRD and on CAPD, and had effects on blood pressure (BP), muscle strength and quality of life (QOL).

Methods

Participants

Patients visiting the kidney disease clinic at the HRH Princess Maha Chakri Sirindhorn Medical Center were invited to the study. Inclusion criteria were ESRD, on CAPD for at least 3 months, being able to follow the exercise program and to read and understand Thai, having good standing balance, and having a family member who could facilitate the patients to perform the exercise program at home. If patients had any contraindication

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to exercise or did not provide an informed consent, they were excluded.

Materials

A Thai-style braided rubber rope (Figure 1) was provided to each patient. It was made of 45 loops of household rubber bands simply braided together by hands, and each loop consisted of six large size rubber bands, except the middle part of the rope that each loop consisted of 8-9 rubber bands.⁽¹⁰⁾ At the beginning and at the end of the middle part, some rubber bands were inserted so that during exercise they were used to fix the resistive rubber rope with stationary objects or to body parts such as a big toe. One short piece of plastic (PVC) pipe with a diameter of 1 cm as a handle was attached to each end of the rubber rope.⁽¹⁰⁾

A mixed media of a 10 exercises program was given to the patients. It consisted of a brochure and a video tape showing how to exercise with the braided rubber rope.

A digital hand dynamometer (Grip-D T.K.K 5401) for hand compression force and a digital leg dynamometer (Back-D T.K.K 5402) for leg and back stretching force were used to measure muscle strength of both hands and leg and back.

A digital sphygmomanometer (Omron HEM-8712) for BP measurement

Short Form 36 Health Survey (SF-36) (Thai version) questionnaire for assessing quality of life.⁽¹¹⁾

Steps of the study

This research project (SWUEC/EX number 17/2012) was conducted after receiving an approved by the Human Research Ethics Committee at the Faculty of Medicine, Srinakharinwirot University.

One of the researchers explained the purpose of the study and unwanted events that might occur to the patients who fulfilled the screening criteria. After signing a written consent, personal information such as gender, age, and medical conditions such as duration of CAPD were recorded.

After taking a rest for 15 minutes, BP was measured three times in sitting position. Hand compression force was measured three times in a standing position with fully extended elbow at the side of the body. Leg and back stretching force was also measured three times in a standing position.⁽¹²⁾ All measured data were averaged for further data analysis. In addition, each patient was asked to complete the SF-36 (Thai version) questionnaire for assessing QOL.

The patients as well as their family members/caregivers, were asked to read the brochure, watched the video of 10 different types of exercise with the braided rubber rope (Figure 2). Thereafter, they were asked to perform the exercises at least 3 times per week at home if possible. Their family members/caregivers were asked to facilitate and guide the patients to exercise. During the study period, a research assistant contacted the patients weekly to check their exercise frequency, unwanted events relating with exercises such as falls, and remind them to attend the clinic for follow-up.

All measurements were repeated at the end of the 4th, the 8th, and the 12th week after training.

Statistical analysis

Data were described as number, percentage, mean and standard deviation (SD). One-way ANOVA was used for comparing between the baseline and each follow-up data.



Figure 1. A Thai-style braided rubber rope: left – the whole length of the rubber rope consisting of braided rubber bands loops, middle - big toes were inserted into the extended rubber bands for anchoring the rubber rope during exercise, and right – a handle at the end of the rope



Figure 2. Three examples of the home-based exercise program with the Thai-style braided rubber rope

Results

There were 30 patients (16 males and 14 females) with age between 23-69 years old (mean 51.6, SD 11.8). The duration of CAPD ranged between 3-72 months (mean 21.5, SD 19.1). When compared with the baseline BP (Table 1), systolic BP significantly decreased at the 4th and the 8th week whereas diastolic BP significantly decreased at the 4th week after exercise.

Table 2 shows comparison of the right-hand compressing force, the left-hand compressing force and the legs and back stretching force between baseline and the 4th, the 8th and the 12th week after exercise. The results show increases in force measured but such increases were not statistically significant.

When compared with the baseline scores of SF-36 (Table 3), the scores of overall dimensions, the role-emotional and the vitality increased with statistical significance at every follow-up visit. The bodily pain score increased at the end of the 4th and the 12th week of exercise, the social functioning score increased significantly only at the end of the 4th week whereas the scores of the physical functioning, the general health, the mental health and the health transition increased but not reached statistical significance.

Average exercise frequency was 2.6 (SD 0.85) times per week. A reason of not being able to perform the exercises as requested was fatigue after dialysis. There was no reported unwanted event during the study.

Discussion

The results of this study showed that the home-based exercise program using the Thai-style braided rubber rope had positive effects on BP, muscle strength and QOL of patients on CAPD. Both systolic and diastolic BP declined whereas the hand compression, the leg and back stretching force and the SF-36 scores increased from baseline at every follow-up visits.

According to a review, more than 80% of patients on dialysis had hypertension.⁽¹³⁾ At baseline of this study, the recruited patients had hypertension with average systolic BP above 160 mm Hg. After commencing the home-based exercise program with the Thai-style braided rubber rope, a decline of both systolic and diastolic BP was found at the first follow-up visit, at the end of 4th week, and a significant decline was in systolic BP. Thereafter the BP maintained throughout the study. However, one may question whether this home-based exercise program

Table 1. Comparison of systolic and diastolic blood pressure (BP) of all patients at baseline, at the end of the 4th, the 8th, and the 12th week of exercise

	Baseline	4 th week	8 th week	12 th week
Systolic BP (mmHg)	162.6 (22.4)	146.2 (20.2)*	147.6 (17.2)*	148.2 (20.0)
Diastolic BP (mmHg)	94.2 (13.3)	85.4 (12.3)*	87.7 (7.9)	87.9 (11.1)

Mean (SD), Using one-way ANOVA to compare data between baseline and at each follow-up

* Statistical significance at $p < 0.05$

Table 2. Comparison of the compression and the stretching force between baseline and at the end of the 4th, the 8th, and 12th week of exercise

	Baseline	4 th week	8 th week	12 th week
Right hand compression force (kg)	21.6 (8.5)	23.9 (9.2)	25.2 (9.4)	25.1 (9.6)
Left hand compression force (kg)	20.7 (7.6)	23.9 (8.5)	23.9 (8.7)	23.9 (8.7)
Leg and back stretching force (kg)	57.5 (35.5)	65.7 (33.3)	67.3 (34.8)	67.9 (35.9)

Mean (SD), Using one-way ANOVA to compare data between baseline and at each follow-up

* Statistical significance at $p < 0.05$

Table 3. Comparison of SF-36 scores in various dimensions between baseline and at the end of the 4th, the 8th, and the 12th week of exercise

	Baseline	4 th week	8 th week	12 th week
Physical component summary				
- Physical functioning	83.1 (13.2)	89.6 (9.7)	88.3 (9.3)	87.0 (10.2)
- Role-physical	73.8 (22.6)	85.0 (19.5)	81.3 (20.7)	77.1 (21.6)
- Bodily pain	74.2 (17.9)	86.4 (12.8)#	84.9 (13.8)	85.1 (16.6)#
- General health	63.8 (14.9)	71.2 (15.6)	68.8 (16.1)	69.5 (16.7)
Mental component summary				
- Vitality	60.9 (16.3)	75.4 (16.8)#	75.6 (15.1)#	74.3 (16.5)#
- Social functioning	83.3 (19.2)	94.0 (11.9)*	92.7 (13.1)	90.3 (14.0)
- Role-emotional	70.0 (24.1)	84.4 (20.0)#	88.3 (17.0) #	83.9 (16.7)#
- Mental health	75.9 (19.9)	88.2 (15.9)	86.7 (15.2)	85.9 (13.7)
Health transition	68.7 (31.8)	86.0 (25.3)	83.3 (27.3)	79.3 (27.5)
Overall	72.4 (12.6)	83.3 (9.1)†	82.1 (9.9)†	80.9 (10.2)†

Mean (SD), Using one-way ANOVA to compare data between baseline and at each follow-up

Statistical significance with * $p < 0.05$, # $p < 0.01$, † $p < 0.000$

with a frequency of exercise less than 3 times per week could really decrease BP as in this study BP was measured during follow-up visits at the clinic, not 1-week average predialysis measurement or ambulatory BP measurement as recommended.⁽¹³⁾

Regarding the muscle strength, this study measured the hand compression force and the leg and back stretching force to reflect muscle strength. The increase in hand compression force and leg and back stretching force in this study was consistent with of other studies showing increasing thigh muscle strength after exercising with an elastic band in elderly individuals.^(9,12,14,15) However, the increases did not reach statistical significance. This might be due to fatigue after dialysis causing inability to perform exercises 3 times per week as recommended. However, there was no report of unwanted event during the study period. This means that this home-based exercise with the Thai braided rubber rope is safe for these patients on CAPD who have poor physical fitness but the infusion of dialysis fluid into the peritoneal cavity does not affect physical work capacity.⁽¹⁶⁾

Besides the positive effects on BP and muscle strength, this resistance exercise with the Thai-style braided rubber rope showed positive effect on QOL. The SF-36 scores increased significantly especially in vitality, role-emotional and bodily pain after 4 weeks of exercise. These increases reflected better QOL which was consistent with the study of Lo et al. reporting a better QOL after entering an exercise program in those on peritoneal dialysis.⁽¹⁷⁾

Limitations of this study were a small population and a pretest-posttest design, no control group. In the future a larger population with a control group and blinded assessor, and using home BP recording or interdialytic ambulatory BP recording, should be conducted to confirm its benefits of this long-term home-based exercise with a Thai-style braided rubber rope in patients with CAPD.

Conclusively, a long-term (12 weeks) home-based exercise program using a Thai-style braided rubber rope was safe for patients on CAPD and had positive effects on blood pressure, muscle strength and quality of life especially in the mental components.

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Disclosure

The researchers have no conflict of interest to declare.

References

1. Dhanakijcharoen P, Sirivongs D, Aruyapitipan S, Chuengsaman P, Lumpaopong A. The "PD First" policy in Thailand: three-year experiences (2008-2011). *J Med Assoc Thai*. 2011;94:S153-61.
2. Kosmadakis GC, Bevington A, Smith AC, Clapp EL, Viana JL, Bishop NC, Feehally J. Physical exercise in patients with severe kidney disease. *Nephron Clin Pract*. 2010;115:7-16.
3. Luan X, Tian X, Zhang H, Huang R, Li N, Chen P. Exercise as a prescription for patients with various diseases. *J Sport Health Sci*. 2019;8:422-41.
4. Tawney KW, Tawney PJ, Kovach J: Disablement and rehabilitation in end-stage renal disease. *Semin Dial*. 2003;16:447-452.
5. Theofilou P. The role of sociodemographic factors in health-related quality of life of patients with end-stage renal disease. *Int J Caring Sci*. 2011;4:40-50.
6. Hart PD, Buck DJ. The effect of resistance training on health-related quality of life in older adults: Systematic review and meta-analysis. *Health Promot Perspect*. 2019;9:1-12.
7. Warburton DER, Nicol CW, Bredin SSD. Health benefits of physical activity: the evidence. *Can Med Assoc J*. 2006;174:801-9.
8. Seguin R, Nelson ME. The benefits of strengthen training for older adults. *Am J Prev Med*. 2003;25:141-9.
9. Asawakosinchai S, Sangpetch J, Rungsai W. Effects of health promotion with elastic band exercise on static balance and functional mobility in elderly people. *J Prapokklao Hosp Clin Med Educat Center*. 2011;28:110-24.
10. Krabuanpatana C. Yangyaedpichitrok. Department of Physical education, Faculty of Education, Kasetsart University [Internet]. [cited 2012 June 15]. Available from http://pr.ku.ac.th/pr_news/headnews/stick/Acrobat/p01.pdf
11. Leurmarnkul W, Meetam P. Development of a quality of life questionnaire: SF-36 (Thai Version). *Thai J Pharm Sci*. 2000; 2:92-111
12. Poomsalood S, Pakulanon S. Effects of elastic exercise program on balance in the elderly [Internet]. [cited 2012 June 15]. Available from http://researchconference.kps.ku.ac.th/article_9/pdf/p_sci_sport01.pdf.
13. Agarwal R, Flynn J, Pogue V, Rahman M, Reisin E, Weir MR. Assessment and management of hypertension in patients on dialysis. *J Am Soc Nephrol*. 2014;25:1630-46.
14. Paksa W. Effects of body weight and elastic trainings on elderly's leg strength [Internet]. [cited 2012 June 15]. Available from http://thesis.swu.ac.th/swuthesis/Spo_Coa/Wilailak_P.pdf.
15. Kerbs DE, Jette AM, Assmann SF. Moderate exercise improves gait stability in disabled elders. *Arch Phys Med Rehabil*. 1998;79:1489-95.
16. Beasley CR, Smith DA, Neale TJ. Exercise capacity in chronic renal failure patients managed by continuous ambulatory peritoneal dialysis. *Aust N Z J Med*.1986;16:5-10.
17. Lo CY, Li L, Lo WK, Chan ML, So E, Tang S, et al. Benefits of exercise training in patients on continuous ambulatory peritoneal dialysis. *Am J Kidney Dis*. 1998;32:1011-8.