Effect of Home-Based Rehabilitation Exercise Program for Elderly Patients with Femoral Neck Fracture after Bipolar Hemiarthroplasty

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ABSTRACT

Objective: This study aimed to investigate the effectiveness of a home-based rehabilitation program by examining recovery time, the risk of falling, improvement in mobility, and improvement in quality of life.

Methods: This prospective cohort study included elderly patients who sustained a primary femoral neck fracture that required cement less bipolar hemiarthroplasty using posterior approach at the Department of Orthopaedic Surgery, Faculty of Medicine Siriraj Hospital, Mahidol University, Bangkok, Thailand. Time to return to pre-injury status was the primary outcome. Patient quality of life was evaluated using Short Physical Performance Battery (SPPB) and EQ5D-5L at three and six months after surgery.

Results: Forty-one patients were included in the final analysis. All patients could return to pre-injury ambulatory status within six months. The mean SPPB score at six months was significantly higher than the mean score at three months after surgery. The results of EQ5D-5L showed that quality of life improved from three to six months after surgery. No postoperative complications were observed, including infections, secondary fractures, or hip dislocations.

Conclusion: The home-based rehabilitation program evaluated in this study was found to be safe and effective for improving recovery, physical performance, and quality of life. All participating patients could return to their pre-injury ambulatory status within six months.

Keywords: Femoral neck fracture; bipolar hemiarthroplasty; home-based rehabilitation exercise program; short physical performance battery (SPPB); EQ5D-5L (Siriraj Med J 2020; 72: 315-320)

INTRODUCTION

Since the proportion of elderly population continues to increase, the issues that affect aging and aged societies are attracting attention in many countries around the world. In 2015, 15.8 percent of Thai population were people aged 60 years and over. That number is projected to increase to 23.1% by 2025, and 37.1% by 2050.[1] Accordingly, Thailand has one of the fastest growing older adult populations in Asia.[2] Health and healthcare are major concerns of older people. Consistent with that, osteoporosis has been raised as one of the most important diseases because it occurs in most elderly people. Osteoporosis associates with a decrease in muscle strength and an increase in fall risk, which increases the risk of osteoporotic fractures.[3] The literature shows that approximately 20 percent of elderly people could experience a femoral neck fracture, which

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can cause serious health consequences with approximately 10 to 20% mortality within six months and significant loss of mobility.[4,5] A standard of treatment that is now used to treat displaced osteoporotic femoral neck fracture is bipolar hemiarthroplasty.[5]

After undergoing this surgical procedure, patients have to attend a rehabilitation program to improve their ability to physically perform daily activities to the same level they did prior to their fracture, and to minimize their risk of falling and mortality.[6,7] General resistance exercise and aerobic practice can improve patient mobility.[8] However, participation in a rehabilitation program may be inconvenient for some patients for several possible reasons. For instance, most rehabilitation programs require a patient to travel to the hospital or rehabilitation center, and this involves higher cost of rehabilitation, travel-related expenses, the inconvenience of travel, and often the need for a caregiver. Home-based exercise programs were established to reduce the cost of rehabilitation, and to help patients regain physical functions.[9,10] Many studies support the benefit of having exercise at home – particularly for patients with femoral neck fractures.

In Thailand, various exercise programs have been implemented. A few studies have evaluated the effectiveness of home-based rehabilitation for stroke patients.[11,12] For patients with knee osteoarthrosis, Chaipinyo and Karoonsupcharoen studied home-based strength and balance training.[13] Our review of the literature revealed that no studies have assessed the effectiveness of home-based program for elderly patients with femoral neck fracture who received bipolar hemiarthroplasty. Accordingly, the aim of this study was to investigate the effectiveness of a home-based rehabilitation program for elderly patients with femoral neck fracture who received bipolar hemiarthroplasty by examining recovery time, the risk of falling, improvement in mobility, and improvement in quality of life.

MATERIALS AND METHODS

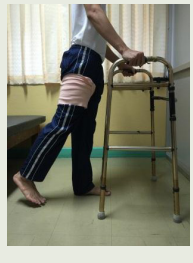
This study was approved by Human Research Protection Unit, Faculty of Medicine Siriraj Hospital, Mahidol University (Si 400/2016). Patients aged from 60 to 85 years who required treatment for primary femoral neck fracture and who underwent cementless bipolar hemiarthroplasty using posterior approach were enrolled starting in January 2016. Included patients had to have had the ability to walk independently or walk with a gait aid for at least 10 meters prior to sustaining their fracture. Patients were excluded from this study if they had a disease that affects exercise, such as severe cardiovascular disease, severe respiratory disease, psychiatric disease, dementia, or cognitive impairment. Patients with post-operative complications that adversely affect the ability to exercise were also excluded.

Before undergoing surgery, all patients were instructed in how to perform a home-based rehabilitation program for femoral neck fractures by a physiotherapist. The program was designed to help patients recover and to improve their mobility so they can return to their pre-fracture status. Each patient had to perform the postoperative exercise once a day for six months. The rehabilitation program includes both lying and standing exercises. Lying exercises consisted of hip abduction and hip flexion. Standing exercises included hip abduction, hip extension, and hip flexion.[14] Patients were advised to perform each exercise 10-15 reps/set, 2 sets/time, 3 times per day (Table 1). Each patient received an exercise booklet and daily record sheet. From six weeks to the three month after surgery, participants would receive a phone call every week to encourage the rehabilitation program and to assess their pain level and their ability to walk. From the three months to the six months after surgery, patients would get a phone call once every two weeks.

Data collection

Demographic and clinical data of recruited patients were collected, including age, gender, side, number of days before surgery, weight, height, and body mass index (BMI). Patients were appointed for follow-up at six weeks, three months, and six months after receiving the operation. At follow-ups, postoperative complications, such as fracture, dislocation, and wound complication, were investigated. Time to return to pre-injury ambulatory status was measured as the primary outcome. Time to return to pre-injury status was indicated as six weeks, three months, or six months after the operation date. Physical performance and quality of life was assessed using Short Physical Performance Battery (SPPB) and EQ5D-5L, respectively. The SPPB test consists of three sections, including the ability to rise from sitting on a chair, standing balance test, and walking speed test, with scores that range from 0 (worst performance) to 12 (best performance).[15] The EQ5D-5L is a standardized tool used for describing health-related quality of life. It consists of two parts associated with health status: EQ5D and a visual analogue scale (EQ-VAS), which range from 0 to 100. The maximum score indicates the best health status.[16,17] This tool was proven to be reliable and valid for assessing the health status of elderly patients with femoral neck fractures.[18]

TABLE 1. The rehabilitation program for patients with femoral neck fracture after bipolar hemiarthroplasty

Lying position · Repeat 10-15 reps/set, 2 sets/time, and 3 times per day	Hip abduction exercise	Move your leg out to the side as far as you can and then back to the starting position.  
	Heel slide	Bend your knee while keeping your heel on the bed. Do not let your knee roll inward or bend over 90˚.  
Standing position · Repeat 10-15 reps/set, 2 sets/time, and 3 times per day	Hip flexion exercise	Lift your operated leg toward your chest. Do not lift your knee higher than your hip.  
	Hip abduction exercise	Keep your body straight and lift your leg out to the side.  
	Hip extension exercise	Lift your operated leg backward slowly, keep your body straight and then return your foot.  

Statistical analysis

Patient demographic and clinical characteristics were summarized using descriptive statistics. Continuous variables are expressed as mean ± standard deviation, and categorical variables are presented as frequency and percentage. Chi-square test was used to compare time to return to pre-injury ambulatory status. Paired *t*-test was used to compare the results of SPPB, EQ5D, and EQ-VAS. All data was analyzed using SPSS Statistics (SPSS, Inc., Chicago, IL, USA). A *p*-value less than 0.05 was considered statistically significant.

RESULTS

There were 53 patients with femoral neck fracture who underwent cementless bipolar hemiarthroplasty, as shown in Fig 1. The first patient was recruited in January 2016, and the last followed-up patient visited our clinic in April 2018. Eleven patients were excluded due to one of the following reasons: age over 85 years, conservative treatment, or inability to walk more than 10 meters. One patient was withdrawn from the study because two follow-up visits were missed.

Patient demographic and clinical characteristics are shown in Table 2. The mean age of participants was 76.4 ± 8.4 years, and 34 patients (82.9%) were women. Average BMI was 22.2 ± 3.2 kg/m^2. No patients had postoperative complications, including infections, secondary fractures, or hip dislocations.

After evaluating the outcome parameters, the proportion of participants who returned to pre-injury ambulatory status within six weeks, three months, and six months after surgery was 24.4%, 82.9%, and 99.9%, respectively (Table 3). As a result of this rehabilitation program, all included patients were able to return to their pre-injury ambulatory status within six months.

As shown in Table 3, the mean SPPB scores was 6.7 ± 1.3 at three months, and 8.5 ± 1.9 at six months ($p < 0.000$). According to the EQ5D questionnaires, health-related quality of life was improved from the three months to the six months. EQ-health state scores were 0.9 ± 0.0 and 1.0 ± 0.0 at three and six months ($p < 0.000$), respectively. For the pain scores, the average of EQ-VAS was 69.4 ± 12.1 at three months, which was improved to 85.9 ± 8.5 at six months ($p < 0.000$). At six months, 39 patients (95.1%) had an EQ-VAS score of zero on the prosthesis side. No patients experienced any limitations of physical function after six months.

DISCUSSION

Bipolar hemiarthroplasty is a conventional surgery for treating elderly people with femoral neck fracture.[19] After undergoing this procedure, all patients need to participate in a rehabilitation program to leverage their recovery. Home-based exercise programs were developed to reduce the cost of treatment and improve the effectiveness of patient rehabilitation.[9,10]

This prospective cohort study showed the recovery of patient functions following bipolar hemiarthroplasty to be improved after performing the recommended rehabilitation program for six months. Patient physical functions, quality of life, and time to return to pre-injury status were evaluated using SPPB and EQ5D-5L. Similar to previous studies, we found the SPPB scores at six months to be significantly higher than the scores at three months after surgery.[10,20]

Several studies have evaluated new rehabilitation programs that associated with intensive supervision, equipment, and progressive resistance exercises at hospitals. Those programs were found to have improved the capacity of conventional rehabilitation.[21-23] In contrast, the present study evaluated a newly designed home-based rehabilitation program that involved patients following a prescribed program and three physical therapist follow-up visits within six months. The advantages of this home-based rehabilitation program are lower cost and no requirement for the patient to travel to the hospital.

Although older patients with femoral neck fractures had asymmetric strengths of lower extremities and impaired postural balance[24,25], the program evaluated in this study included standing exercises to improve strength and balance in elderly patients. The efficacy of this program was demonstrated by improvement in SPPB scores.

The results obtained from the EQ5D-5L show that quality of life was improved from three months to six months. Moreover, 39 participants in this study had an EQ-VAS score of zero at six months. Neither recurrent fracture nor dislocation occurred during the rehabilitation period. No evidence of falling case found in this study. Thus, it can be concluded that this home-based rehabilitation program could safely and effectively promote health-related quality of life.

The key limitation of this study is that although patients were instructed in the exercises to perform and when and for how long, there is no way to know for certain that the exercise program was strictly followed. To enhance the likelihood of compliance, we provided each patient with a logbook so they could record their daily rehabilitation exercises and activities. The strengths of this study are its prospective design, the six months duration of rehabilitation, and the fact that validated assessment tools were used to evaluate recovery.

In conclusion, the home-based rehabilitation program

TABLE 2. Patient demographic and clinical characteristics

Characteristics	Mean ± SD or % (n)
Age, year	76.4 ± 8.4
Gender, % (n)	
Male	17.1 (7)
Female	82.9 (34)
BMI, kg/m^2	22.2 ± 3.2
Affected side, % (n)	
Right	43.9 (18)
Left	56.1 (23)
ASA	
2	56.1 (23)
3	43.9 (18)
Days before surgery, day	10.3 ± 11.3

Abbreviations: ASA = American Society of Anesthesia Score, BMI = body mass index

TABLE 3. Results of the rehabilitation program

Variables	Mean ± SD or % (n)	*P*-value
Patients returned to pre-injury ambulatory status, % (n)		
Within 6 weeks	24.4 (10)	
Within 3 months	**58.4 (24)**	
Within 6 months	17.1 (7)	
Mean SPPB scores		
At 3 months	6.7 ± 1.3	<.000
At 6 months	8.5 ± 1.9	
EQ-health state scores		
At 3 months	0.9 ± 0.0	<.000
At 6 months	1.0 ± 0.0	
EQ-VAS scores		
At 3 months	69.4 ± 12.1	<.000
At 6 months	85.9 ± 8.5	

p-value < 0.05 indicates statistical significance

Abbreviations: SPPB = Short Physical Performance Battery; EQ5D-5L questionnaire = EQ-health state score and EQ-VAS score

evaluated in this study was found to be safe and effective for improving patient recovery, physical performance, and quality of life. All participating patients were able to return to their pre-injury ambulatory status within six months. The results of this study suggest that exercise program can be used as a standardized rehabilitation protocol for elderly patients with femoral neck fracture following bipolar hemiarthroplasty.

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