Aquatic exercises versus land based exercises for elderly patients after a total hip replacement

Hidrokinezioterapija v primerjavi s kinezioterapijo pri starejših osebah po vstavitvi totalne endoproteze kolčnega sklepa

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Ključne besede:
vstavitev totalne endoproteze kolčnega sklepa, terapevtske vaje, rehabilitacija

Key words:
total hip joint replacement, therapeutic exercises, rehabilitation

Citirajte kot/Cite as:
Zdrav Vestn 2011; 80: 240–5

Izvleček

Izhodišča: Hidrokinezioterapija omogoča varno izvajanje aktivnih vaj z zmanjšanjem bolečine, pri čemer izkorišča vzgon, hidrostatski tlak, upor in toploto. Starejši ljudje po vstavitvi totalne endoproteze kolčnega sklepa lahko s hidrokinezioterapijo dosežejo več pozitivnih učinkov kot s kinezioterapijo. Z raziskavo smo želeli ugotoviti uporabnost hidrokinezioterapije v procesu rehabilitacije pri bolnikih po vstavitvi totalne endoproteze kolčnega sklepa.

Metode: V raziskavo je bilo vključenih 24 starejših oseb iz dveh domov za starejše občane v Sloveniji. Razdeljeni so bili v kontrolno skupino (N = 12) in eksperimentalno skupino (N = 12). Eksperimentalna skupina je izvajala program rehabilitacije, ki je vključeval hidrokinezioterapijo, kontrolna skupina pa je izvajala program rehabilitacije, ki je vključeval samo kinezioterapijo. Pri ocenjevanju funkcijskih sposobnostih preiskovancev smo uporabili t. i. Harrisov točkovalnik za kolk in časovno merjeni test »vstani in pojdi«. Funkcijske sposobnosti smo ocenili pred začetkom rehabilitacijskega programa ter dva in štiri tedne po začetku rehabilitacijskega programa. Podatke smo analizirali s pomočjo dvosmernega mešanega modela analize varianc, pri čemer smo ugotavljali razlike med preiskovanci in razlike med skupinami.

Rezultati: Obe skupini sta ne glede na program rehabilitacije (hidrokinezioterapija ali kinezioterapija) dosegli statistično značilno izboljšanje funkcijskih sposobnostih, ocenjenih s pomočjo Harrisovega točkovalnika za kolk in časovno merjenega testa »vstani in pojdi«. Eksperimentalna skupina je v primerjavi s kontrolno skupino ob koncu ocenjevalnega obdobja dosegla značilno boljše rezultate.

Zaključki: Hidrokinezioterapija ima podobne pozitivne učinke kot kinezioterapija po vstavitvi totalne endoproteze kolčnega sklepa.

Abstract

Background: Aquatic therapy allows secure, active exercise with pain reduction using a combination of the water's buoyancy, hydrostatic pressure, resistance and warmth. By aquatic therapy, elderly patients after total hip replacement can achieve more positive effects than by land-based exercise. The aim of the study was to investigate the use of aquatic-based exercises in the rehabilitation programme after a hip fracture surgery in elderly adults.

Methods: Subjects (N = 24) were recruited from two nursing homes in Slovenia and were divided into 2 groups (control (N = 12) vs experimental (N = 12)). The experimental group received rehabilitation programme which included aquatic-based exercises and the control group received rehabilitation program which included land-based exercises. Harris hip score and Timed "Up & Go" test were used to asses subject's function ability prior to rehabilitation, as well as two and four weeks afterwards. The data were analyzed using two-way mixed-model analysis of variance with time (1st, 2nd, 3rd measurement) as within-

Prispelo: 1. feb. 2010,
Sprejeto: 5. dec. 2010

subject effect and group as between-subjects effect.

Results: Both groups, regardless of the type of exercises, improved statistically significantly in all parameters assessed by Harris Hip Score and Timed "Up & Go test", when baseline and final measurements were compared. The group with aquatic-based exercises scored significantly better in Harris Hip Score ($p < 0.05$) and experienced significantly less pain ($p < 0.05$) as compared to the subjects in the land-based exercise group.

Conclusions: Aquatic exercises have similar benefits as land-based exercises after a total hip replacement.

Introduction

Hip fractures are a major public health problem with devastating consequences for elderly adult persons, their families and the health care system. Gallagher et al[1] reported that by the age of 90, 32 % of women and 17 % of men have suffered hip fracture. As proposed by Gullberg et al,[2] by the year 2050 there will be 2.3 million annual hip fractures globally. One of the surgery options after hip fracture is a total hip replacement. Recovery after a hip fracture followed by a total hip replacement is facilitated with participation in rehabilitation programmes.[3,4,5] Unfortunately, outcomes after hip fracture are often poor.[6] If more effective rehabilitation programmes could be developed for the rehabilitation after total hip replacement, longer-term outcomes may also be improved.

Despite the potential benefits of exercise, it is difficult to get elderly to initiate exercise activity and helping them adhere to an exercise regimen is even more challenging. Using a combination of the water's buoyancy, resistance and warmth, the patient can typically achieve more in the aquatic environment than is possible on land.[7] It have been widely used in rehabilitation programmes, especially when exercising under normal conditions of gravity is difficult and painful,[8,9] which is characteristic for older patients after total hip replacement.[10] Compared with land-based exercise aquatic exercise may be performed in a variety of positions including erect position. The water is most often heated to temperature ranging from 30 °C to 36 °C. Buoyancy reduces weight that joints, bones and muscles have to bear. Furthermore, the warmth and pressure of water also reduce swelling and increase blood circulation.[11] Consequently, the aquatic environment allows early active mobilisation and dynamic strengthening.[12,13]

Comparing benefits of therapeutic aquatic exercise and land-based exercise in healthy subjects, aquatic exercise enhances functional capacity,[9] improves the static and dynamic torque of the knee extensors and flexors, and stimulates an increase in muscle activity and a gain in the lean muscle mass of the quadriceps femoris and hamstring muscles.[14] Contrary, in patients with hip osteoarthritis addition of aquatic exercises is of no further benefit[12] or have some beneficial short-terms effects.[15] In the recently published randomised control trial by Rahmann et al,[16] authors concluded that a specific inpatient aquatic physiotherapeutic program has a positive effect on early recovery of hip strength after joint replacement surgery. Therefore, the aim of the present study was to investigate the use of aquatic exercises versus land based exercises in the rehabilitation program in Slovenia after total hip replacement. The hypothesis was that the experimental group, performing aquatic exercises, will have a better outcome as compared to the control group performing land-based exercises.

Methods

Twenty-four subjects after total hip replacement were recruited from two nursing homes in Slovenia. The first inclusion criterion was a score of 24 points or more on the Slovenian version of Mini Mental State Examination.[17] Scores of 24–30 were defined as normal.[18,19] This examination is a well established, reliable, valid and brief cognitive instrument that has a high intra-rater reliability and is easy to administer.[20] The second inclusion criterion was urinary conti-

nence. The experimental group (N = 12) was recruited in a nursing home (NH Idila, Jarenina, Slovenia) with therapeutic pool, while the control group (N = 12) was matched and recruited in a nursing home (NH dr. Jože Potrč, Poljčane, Slovenia) without therapeutic pool. Characteristics of both groups are presented in Table 1. The groups differed only in body height. Both groups started with the rehabilitation program two to three weeks after surgery. All the subjects used walking aids immediately after surgery, either a walking frame or crutches. The study was approved by the National Medical Ethics Committee, and informed consent was obtained from all participants.

The experimental group received a rehabilitation program with aquatic exercise and the control group received a rehabilitation program with land-based exercises. Water temperature in the pool was 30 °C. All subjects from the experimental as well as control group were treated simultaneously. Subjects in both control and experimental groups performed exercises for 45 minutes, three times per week for a period of 8 weeks.

Prior to the treatment as well as two weeks and four weeks after the beginning of treatment, subjects were assessed by Harris Hip Score (HHS)[21] and Timed "Up & Go" test (TUG).[22] The HHS can be used by a physician or a physiotherapist to study the clinical outcome of hip replacement.[23] The HHS has a maximum of 100 points (no disability), covering pain (0–44 points), function (0–47 points), and range of motion and absence of deformity (0–9 points). Frihagen et al[24] assumed that a difference in the HHS of 5–10 points is clinically relevant. Timed "Up & Go" test is a reliable and valid test for quantifying functional mobility that may also be useful in following clinical change over time.[22] The test is quick, requires no special equipment or training, and is easily included as part of the routine medical examination. It requires a subject to stand up, walk 3 m, turn, walk back, and sit down. Time taken to complete the test is strongly correlated to the level of functional mobility.

The data were analyzed using two-way mixed-model analysis of variance, with time (1st, 2nd, 3rd measurement) as within-subject effect and group as between-subjects effect. Given the significant effect of time, differences between adjacent time points were tested using within-subject contrasts. Before performing the analyses, model assumptions were checked using Box's test of equality of covariance matrices and Levene's test of equality of error variances, and were found to be met for all variables. To obtain a simple and more easily interpretable, yet also more powerful test of possible differences in time-course between the groups,

Table 1: Characteristics of whole group (N=24), experimental group (N=12) and control group (N=12).

	Group		
	Whole	Experimental	Control
Gender ratio F/M	20/4	10/2	10/2
Age(years) Mean (SD)	82.0 (6.8)	83.7 (6.7)	80.2 (7.2)
Height (cm) * Mean (SD)	158.0 (5.4)	154.0 (5.2)	162.0 (5.8)
Weight (kg) Mean (SD)	68.8 (13.1)	67.8 (14.6)	69.8 (12.3)
BMI (kg/m^2) Mean (SD)	28.1 (4.1)	28.3 (3.9)	27.9 (4.2)
MMSE (points) Mean (SD)	25.8 (2.7)	26.0 (2.7)	25.5 (2.8)

*Legend: F = female; M = male; SD = standard deviation; BMI = Body Mass Index; MMSE = Mini Mental State Exam; * = p< 0.05*

we calculated differences (time-point 3–1 for TUG and time-point 1–3 for all other variables, to obtain positive differences) and compared them between the groups using t-test. Analysis was performed using SPSS (SPSS 10, for Windows).

Results

During the eight weeks of the physiotherapy program, there was no case of hip joint dislocation. Descriptive data and the results of statistical analysis are presented in Table 2. For all variables, the comparison between time-points 2 and 1, as well as the comparison between time-points 3 and 2 showed statistically significant differences in mean values ($p < 0.001$). T-tests confirmed the statistically significant interactions for HHS ($p = 0.032$) and pain ($p = 0.043$).

Discussion

During the eight weeks of the physiotherapy program, there was no case of hip joint dislocation, which indicates that the program was adequate and physiotherapists controlled the movements of hip adduction with external or internal rotation and hip flexion, which can provoke hip dislocation. The rates of dislocation are highest during the index hospitalization (3.9 %), and are diminished considerably in the period from discharge to four weeks postoperatively, and continu to drop in the periods from five to thirteen and fourteen to twenty-six weeks postoperatively.[25] Risk factors for the incidence of dislocation are mainly surgical approach, combined cup and stem positioning, and femoral head size.[26] Both groups, regardless of the type of rehabilitation, improved statistically significantly in all parameters assessed by HHS and TUG test, when baseline and final measurements were compared. Furthermore, the group with aquatic-based exercises scored significantly better in HHS, and subjects in the aquatic-based exercise group experienced significantly less pain as compared to the subjects in the land based exercise group.

TUG values from our subjects are greater than the ones reported in the recent review, however, since the rehabilitation of these subjects does not end at 8 weeks, it is difficult if not impossible to compare our values with the values from subjects in the community. In Slovenia, typically, rehabilitation after total hip replacement lasts from 6 to 9 months and therefore, in order to compare the values of our subjects with normative values and to conclude whether these interventions helped subjects moved substantially toward minimum TUG scores needed to return to community, TUG test should be performed when rehabilitation is finished. Our average changes in HHS were greater than 10 points and it was indicated by Frihagen et al[24] that a

Table 2: Average values of TUG and HHS for both groups (experimental and control).

	Control Group			Experimental Group			Change over time	Time 1–3 Difference Scores
	Time 1	Time 2	Time 3	Time 1	Time 2	Time 3	ANOVA	t-test
Variable	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	p value	p value
TUG(s)	76 (55)	48 (31)	38 (27)	96 (56)	57 (36)	40 (29)	< 0.001	0.270
Total HHS	39 (18)	55 (16)	68 (14)	30 (20)	52 (18)	70 (15)	< 0.001	0.032
HHS Pain	19 (9)	28 (8)	33 (6)	14 (12)	24 (10)	35 (9)	< 0.001	0.043
HHS Function	12 (9)	20 (9)	27 (9)	9 (9)	20 (9)	27 (8)	< 0.001	0.272
HHS Motion	3 (1)	4 (1)	4 (1)	3 (1)	4 (1)	5 (1)	< 0.001	0.236

Legend: TUG = Timed "Up and Go" test; HHS = Harris Hip Score; Time 1 = prior to rehabilitation program; Time 2 = 2 weeks after the beginning of rehabilitation program; Time 3 = 4 weeks after the beginning of rehabilitation program

difference in the HHS of 5–10 points is clinically relevant.

The results of our study indicated some advantages of aquatic exercises as compared to land-based exercises, particularly in pain reduction and therefore, physiotherapists working with elderly adult patients after total hip replacement should consider using aquatic exercises whenever possible. Similar results were reported in a recent randomised control trial where authors concluded that an aquatic physiotherapy program has a positive effect on early recovery of hip strength after joint replacement surgery.[16] Patients' perception of pain most notably influences the time which takes them to regain mobility. In the early period after surgery, physical functioning may be diminished compared with that before surgery, because patients have just undergone surgery and usually walk with crutches in the first few weeks after surgery.[27] Self-report measures of physical functioning are influenced by pain more than are performance-based measures.[28] In Slovenia, after discharge from hospital, patients continue their rehabilitation at home, spa (health resort), and rehabilitation institute or at nursing home. Since only the most disabled patients are usually transferred to a nursing home,[29] where normative staffing for physical therapists is 150 residents per one physical therapist, it is important for physical therapists working in nursing homes to use effective but less time-consuming approaches for managing nursing home residents, and when elderly adults patients after total hip replacement are considered, the promising solution is aquatic exercise.

There are several limitations that need to be pointed out when interpreting the results of this study. Firstly, the groups were not randomly assigned to the control and experimental groups and this could influence the results. Secondly, treatment protocols in terms of weights used and number of repetitions were not based on a maximum number of repetitions and this could influence the results as well. Finally, the treatment was not performed with the patients individually and group treatment was used instead; this could mean that less motivated patients, who would require individual encouragement, did not perform exercises with their maximum strength and consequently, which could influence the outcome results.

Since this was a pilot study it was not possible to conclude whether different types of exercises have any impact on a length of stay in the nursing home. Further well-controlled and randomised studies with longer follow up are needed in order to provide further recommendations regarding the effectiveness of water-based exercises.

Acknowledgements

The authors acknowledge the help of physiotherapist Tamara Kostić for data collection and statistical help and advice from Dr. Gaj Vidmar, University Rehabilitation Institute, Republic of Slovenia.

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