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ORIGINAL ARTICLE

Balneotherapy in the Treatment of Knee Osteoarthritis: A Controlled Study

Şule ŞAHİN-ONAT,[1] Özlem TAŞOĞLU,[1] Zuhal ÖZİŞLER,[1] Fulya DEMİRCİOĞLU GÜNERİ,[2] Neşe ÖZGİRGİN[1]

[1]*Department of Physical Medicine and Rehabilitation, Ankara Physical Medicine and Rehabilitation Training and Research Hospital, Ankara, Turkey*

[2]*Department of Medical Ecology and Hydroclimatology, Ankara Physical Medicine and Rehabilitation Training and Research Hospital, Ankara, Turkey*

ABSTRACT

Objectives: This study aims to evaluate the efficacy of combined balneotherapy and physical therapy compared to physical therapy alone in the treatment of patients with knee osteoarthritis.

Patients and methods: Forty-six patients (10 males, 36 females; mean age 70.82±7.78 years; range 57 to 85 years) with knee osteoarthritis were included in this study. Patients were assigned as group 1 and 2. Patients in group 1 (n=27) were treated with physical therapy alone, while patients in group 2 (n=19) were treated with balneotherapy combined to the same physical therapy protocol. All patients had physical therapy consisting of hot pack, transcutaneous electrical nerve stimulation, and ultrasonography for knee region, 45 minutes per day, five days a week for a total duration of three weeks. On the other hand, patients in group 2 also had daily balneotherapy sessions lasting 20 minutes, five days a week, again for three weeks duration. The demographic data and clinical features of the patients were recorded. Sickness impact profile was used for the evaluation of disease severity. Evaluation parameters also included visual analog scale, Western Ontario and McMaster Universities Arthritis Index, 10-meter walking test, and the use of analgesic drugs. Tests were performed both at baseline before treatment and at the end of the third week after treatment.

Results: There were no significant differences between the two groups in terms of socio-demographic features. In both groups, significant improvements were observed for all of the measured variables (all p values <0.01). Moreover, group 2 had significantly superior improvements in all of the parameters compared to group 1 (all p values <0.05).

Conclusion: Combined balneotherapy and physical therapy seems to be more effective in advanced knee osteoarthritis for improving pain, physical function and walking speed, compared to physical therapy alone.

Keywords: Balneotherapy; functional outcome; knee osteoarthritis; physical therapy.

Knee osteoarthritis (OA), one of the most frequent forms of musculoskeletal disorders, is a major cause of disability.[1] Its treatment necessitates relieving pain, maintaining or improving mobility, and minimizing disability. Guidelines about knee OA treatment are commonly based on the evidence of the various interventions such as education of the patient, pharmacological and non-pharmacological therapy, and surgery. Apart from these, balneotherapy is also accepted as an effective alternative in the treatment guidelines of the European League Against Rheumatism for knee OA.[2]

Balneotherapy is being used in the management of chronic musculoskeletal diseases for a very long time.[3] It means bathing in thermal or mineral waters. Balneotherapy in musculoskeletal diseases is used to improve the range of joint movements, strengthen muscles, relieve muscle spasms, and maintain or improve functional mobility. Balneotherapy can also be combined with other treatments; such as exercise, physical therapy, hydrotherapy, and mud packs.[4] Despite its popularity, literature about the practice and efficacy of balneotherapy is limited. In the past decade, several randomized controlled trials have

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Correspondence: Şule Şahin Onat, MD. Ankara Fizik Tedavi ve Rehabilitasyon Eğitim ve Araştırma Hastanesi, Fizik Tedavi ve Rehabilitasyon Kliniği, 06560 Sıhhiye, Ankara, Turkey. Tel: +90 505 - 313 68 48 e-mail: sahinsulester@gmail.com

studied the effects of balneotherapy in knee OA.[5-7] The authors of a recent systematic review about the effects of balneotherapy in rheumatoid arthritis and OA stated that making a definite judgment about its efficacy is impossible because of the methodological flaws in these studies.[8] In another Cochrane review published in 2008; the authors claimed that balneotherapy has 'silver level evidence' in the treatment of OA.[9] As it can be understood from these conflicting results, balneotherapy is still situated among the traditional treatments that should prove their worth. Therefore, in this study, we aimed to evaluate the efficacy of combined balneotherapy and physical therapy compared to physical therapy alone in the treatment of patients with knee OA.

PATIENTS AND METHODS

Forty-six patients (10 males, 36 females; mean age 70.82±7.78 years; range 57 to 85 years) with knee OA were consecutively enrolled in this study according to the order of application. Knee OA diagnosis was made based on American College of Rheumatology criteria.[10] The patients, whose radiological manifestations considering Kellgren and Lawrence criteria were consistent with grade 3 and 4 knee OA, were included in the study.[11] Patients who had a history of knee surgery, major trauma, any kind of intra-articular knee injection within the last six months, balneotherapy treatment within the past year, disabling arthritic changes in other joints of lower extremity, secondary knee OA, serious valgus/varus deformity of the knee, or intra-articular knee effusion were excluded. Patients with classical contraindications for balneotherapy such as organ failure, bleeding disorders, active neoplasia, active infection, cardiac failure, stroke, severe osteoporosis, central or peripheral nervous system disorders were also excluded. Written informed consents from all of the study participants and the local ethical committee approval were obtained.

Patients were consecutively assigned to two groups as group 1 and 2. Patients in group 1 (4 males, 23 females; mean age 70.6±7.3 years; range 61 to 85 years) were treated with physical therapy alone, while patients in group 2 (6 males, 13 females; mean age 71.0±8.2 years; range 57 to 85 years) were treated with combined balneotherapy and physical therapy.

All the patients were hospitalized. Pre-treatment workup included complete blood count, erythrocyte sedimentation rate and C-reactive protein level analyses, hepatic/renal function tests, urine analysis and knee X-ray examinations (standing anterior-posterior and non-standing lateral views). The patients were allowed to take their routine medications for their systemic diseases.

The study comprised a three-week intervention. The same physician evaluated patients before (at baseline) and after (three weeks later) the treatment protocol. Also, daily control visits for both groups were held and the complaints of patients were taken into consideration.

Patients in both groups had physical therapy including hot pack; 20 minutes/day, transcutaneous electrical nerve stimulation (50-100 Hz); 20 minutes/day, and ultrasonography (frequency: 1 MHz, intensity: 1 Watt/cm^2); 5 minutes/day for five days a week with a total duration of three weeks. The patients in group 2 also had balneotherapy treatment concomitantly. Balneotherapy sessions lasting 20 minutes were performed daily, at the same time of the day, in a provisional pool equipped with a filtering and water re-circulation system for five days a week, again with a total duration of three weeks. The water contained sodium bicarbonate, fluoride and chlorine with a total mineral solute content of 2,595 mg/L and an original temperature of 78 °C. Water quality, tested by the National Public Health and Medical Officer Service, did not reveal microbiological or chemical contaminants. The water was cooled to 38 °C for balneotherapy. A standardized exercise program was given to each patient by an experienced physiotherapist. The exercise program for knee consisted of range of motion exercises, stretching and isometric-isotonic strengthening exercises for the hamstring and quadriceps muscles. The patients were instructed to perform each exercise two times a day with ten repetitions for three weeks. Both treatment protocols were well tolerated by the patients and no adverse effects were observed.

The patients were instructed not to use non-steroidal anti-inflammatory drugs during the treatment period. They were allowed to take

only acetaminophen up to 3,000 mg/day for the control of pain.

The demographic data of the patients (age, sex, occupation, marital status, cigarette smoking, height, weight, body mass index, number of comorbid conditions, and chronic drug use were recorded. Patients were assessed for the presence of articular gelling and the duration of knee stiffness/pain. Knee X-rays were scored according to the Kellgren and Lawrence score.[11] Sickness impact profile was used for the evaluation of disease severity.[12] Final score is between 0 and 100 interval with higher scores meaning greater dysfunction. It was performed only at the baseline. A 10 cm visual analog scale (VAS) was used in the evaluation of daytime and night pain. Western Ontario and McMaster Universities Arthritis Index (WOMAC) was used in the evaluation of pain, stiffness, and physical function. It consists of three subdivisions as WOMAC total pain score (0 to 20), WOMAC total stiffness score (W-TSS; 0 to 8), and WOMAC total physical function score (0 to 68) that are scored individually. Higher scores mean worse health status.[13,14] 10-meter walking test (10-MWT) (m/s) was used in the evaluation of walking speed.[15] VAS, WOMAC and 10-MWT were performed both at baseline and at the end of the third week.

Statistical analysis

All statistical analyses were performed using the SPSS Statistics version 16.0 for Windows software program (SPSS Inc., Chicago, IL, USA). Normal distribution of the results was tested by using Kolmogorov-Smirnov test. Student's t-test was performed for the comparison of the continuous variables. The Chi-square or Fisher's exact test was used to compare the distribution of the categorical variables. Statistical tests were applied to answer the following questions:

1. Are the post-treatment results different from the pre-treatment results? Paired Student's t-test was used.

2. Are percentage changes different in two groups? Student's t-test was used. Significance level was set at $p<0.05$.

RESULTS

The marital status, occupational characteristics, and smoking habits of patients in both groups were similar (all p values >0.05). In addition, baseline clinical characteristics of patients were similar between the two groups (Table 1).

Pre- and post-treatment VAS, WOMAC scores (total pain score, W-TSS, total physical function score), 10-MWT, and daily acetaminophen usage were demonstrated in Table 2. In comparison to baseline; significant improvements were observed in all variables within both groups (all *p* values <0.01).

Changes in pre- to post-treatment scores within each group were measured for the following parameters: daytime and night VAS, WOMAC total pain score, total physical function score, and 10-MWT (Table 3). When compared with group 1, group 2 had significantly superior improvements for all measured parameters (all *p* values <0.05).

DISCUSSION

According to our results, combined balneotherapy and physical therapy is more effective than physical therapy alone in improving pain, disability, and walking speed in the treatment of patients with advanced knee OA.

Table 1. Comparison of baseline clinical characteristics of groups

	Group 1 (n=27)			Group 2 (n=19)			
	Median	Min.-Max.	Mean±SD	Median	Minimum-Maximum	Mean±SD	*p*
Number of comorbid conditions	1	0-2		1	0-3		0.849
Number of drugs chronically used	2	0-5		2	0-5		0.346
Body mass index (kg/m^2)			26.7±1.9			26.6±1.8	0.782
Duration of knee pain (year)			9.1±7.7			6.7±7.7	0.304
Kellgren Lawrence score	3	3-4		3	2-4		0.564
Sickness Impact Profile			19.3±3.6			12.7±17.4	0.447

Min.: Minimum; Max.: Maximum; SD: Standard deviation.

Table 2. Baseline ve post-treatment evaluation within groups

	Group 1 (n=27)			Group 2 (n=19)		
	Baseline	Post-treatment	*p*	Baseline	Post-treatment	*p*
Daytime VAS	8.6±0.9	6.8±1.4	0.001	7.5±1.3	1.8±0.6	0.001
Night VAS	7.2±1.4	5.7±1.6	0.001	5.9±1.5	1.5±0.6	0.001
W-TPS	17.8±3.0	14.4±2.6	0.001	17.3±4.0	9.4±3.7	0.001
W-TSS	6.7±1.3	3.8±0.8	0.01	5.3±2.9	3.1±1.3	0.01
W-TPFS	59.0±6.0	45.4±9.2	0.001	56.8±11.3	32.2±12.9	0.001
10-MWT	9.8±1.2	7.5±1.1	0.001	10.2±1.2	5.2±1.3	0.001
Daily acetaminophen usage	4.2±1.2	2.0±0.0	0.001	2.0±0.8	1.0±0.0	0.001

VAS (0-10 cm): Visual analog scale; W: WOMAC (Western Ontario and McMaster Universities Arthritis Index); TPS: Total pain score; TSS: Total stiffness score; TPFS: Total physical function score; 10-MWT: 10-meter walking test.

The effectiveness of balneotherapy in the treatment of patients with knee OA can be explained by several mechanisms. The most emphasized ones are the thermal, mechanical, and chemical effects. Thermal effect is a consequence of heat. Heat application causes increased blood flow and vasodilatation, resulting in fresh blood supply and removal of the nociceptive elements and free oxygen radicals. As a result, heat enhances the repair of the inflamed tissue.[3] Thermal stimuli also effect the pain sensation over the Melzack and Wall's gate control theory. In addition, hot bath causes elevation of beta-endorphin and stress hormone levels, exerting a direct analgesic effect.[16-18] Heat induces sedation and muscle relaxation and increases mobility. Maintenance of the analgesic effect is also due to muscle relaxation.[19]

On the other hand, immersion of body parts in mineralized water allows mobilization of joints more easily, and facilitates muscle strengthening.[20] This mechanical effect increases as the water gets more concentrated. Besides, hydrostatic pressure generates movement of fluids from the extremities to the trunk, causing hemodilution and diuresis.

The chemical effect is explained by the absorption of the trace elements from the mineralized water through the skin, modulating the immune system.[21] Mineral elements which accumulate in various layers of the skin while bathing are thought to release slowly into circulation to play role in systemic actions.

In our study, while the positive results obtained in both treatment groups may be explained by thermal effects, when compared to the physical therapy alone treatment, the superiority of balneotherapy combined physical therapy group may be attributed to the mechanical and chemical effects. The insignificant difference of pre- and post-treatment W-TSS scores between the groups was also attributed to the effect of heat in both groups.

In the literature, there are different studies supporting our results about the effectiveness of balneotherapy in knee OA treatment. Pain relief is a common finding in many observational[7,18,22,23]

Table 3. Comparison of post-treatment changes in clinical parameters according to baseline values

	Group 1 (n=27)	Group 2 (n=19)	
	Mean±SD	Mean±SD	*p*
Δdaytime VAS	1.8±1.2	5.6±1.2	0.001
Δnight VAS	1.5±0.9	4.4±1.3	0.001
ΔW-TPS	3.4±2.5	8.2±2.3	0.001
ΔW-TSS	2.8±1.2	2.3±2.3	0.317
ΔW-TPFS	13.5±7.5	25.2±6.8	0.001
Δ10-MWT (m/s)	2.2±0.8	4.9±0.9	0.001

SD: Standard deviation; Δ: Changes in parameters (fourth week vs. baseline); VAS (0-10 cm): Visual analog scale; W: WOMAC (Western Ontario and McMaster Universities Arthritis Index); TPS: Total pain score; TSS: Total stiffness score; TPFS: Total physical function score; 10-MWT: 10-meter walking test.

and randomized controlled studies.[24-28] Our study is also in accordance with previous balneotherapy studies in terms of improved clinical criteria such as pain, functional outcome, and walking speed.[16,26,28] Improved WOMAC scores were also similar with other studies.[29,30] On the other hand, Bálint et al.[27] reported that the W-TSS did not improve and concluded that this was a result of the insensitivity of W-TSS to change. In our study, W-TSS improved in both groups, but there was no significant difference between the two groups. Nevertheless, results of Bálint et al.[27] did not make a contribution to our findings since they did not compare the results of the groups.

In another randomized double blind study on 58 patients with knee OA, balneotherapy was performed with spa and tap water.[26] The signs and symptoms of the patients in both groups progressed but the progress in balneotherapy group was superior and this was attributed to balneotherapy scenery, absence of housework, non-competitive atmosphere, being together with similar patients, and physical and mental relaxation.[26] However, in our study, the patients in both groups were under similar social and environmental conditions, so the positive effect of balneotherapy over pain and functional outcomes cannot be explained only by these factors. Further, a randomized controlled study with a follow-up period of six months in patients with OA showed that balneotherapy is superior to usual therapy at home with regard to pain, functional impairment, and quality of life.[6]

Limitations of our study include evaluations of long-term effects and quality of life. Moreover, the patients included in the study were all Kellgren and Lawrence grade 3 and 4 patients. This is because the patients who are willing to take an inpatient physical therapy program are the ones with advanced OA. This is also an unavoidable limitation of our study and the results cannot be generalized to all knee OA patients, but only to the ones with advanced disease.

In conclusion, when compared with physical therapy alone, combined balneotherapy and physical therapy seems to be more effective to improve pain and functional capacity in the treatment of advanced knee OA. Still, further studies with better methodological quality, longer follow-up periods, and larger patient groups are needed.

Declaration of conflicting interests

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