

## **Effect of swimming and physiotherapy in patients with nephrolithiasis**

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### **Abstract**

**AIM:** This research aims to evaluate the effect of swimming and physiotherapy in a complex treatment of patients with nephrolithiasis treated under sanatorium conditions.

**MATERIAL AND METHODS:** Twenty patients with nephrolithiasis who can swim, were tracked and all of them were included in the experimental group (EG n=20). They performed swimming and physical therapy. Mean age of EG was 44.1 years. Swimming was not applied to another twenty-eight patients with the same disease, because they cannot swim. They were included in the control group (CG n=28). Mean age of CG was 49.5 years. For the purpose of the research changes in: body weight, vital capacity, abdominal muscle strength and elimination of the concretions visualized by ultrasound imaging were assessed. During their 15-day sanatorium stay, all patients performed daily physiotherapy for half an hour, tourist hikes and in addition patients of EG swim twice daily for 15 min.

**RESULTS:** Results revealed that the applied physiotherapy and swimming significantly improve the monitored indicators. Targeted physical exercises were effective for increasing the effect of balneological treatment, leading to clearly expressed positive changes in patients with nephrolithiasis.

**CONCLUSION:** The study revealed that the rehabilitation program consisting of therapeutic exercises and swimming benefit the patients of the experimental group.

### **KEYWORDS**

nephrolithiasis, swimming, physiotherapy, SPA, balneology

## **Introduction**

Nephrolithiasis is a common disease and represents about 40% of the patients in urological clinics. Our country is among the countries where it is widespread. By its importance, nephrolithiasis is not only a health problem, but also a social problem. Complex balneotherapy plays an important role in solving therapeutic problems of patients with nephrolithiasis and includes: medication, drinking mineral water, physiotherapy, swimming, SPA, underwater jet massage, fangotherapy (mineral-laden mud), lye saltwort-therapy, a vibrating belt, diet, and climatotherapy. Swimming and physiotherapy take an important place among the other methods in the complex treatment of patients with nephrolithiasis, both under balneo-sanatorial conditions, where medical results are optimal, and in terms of ambulant treatment and preventing kidney stone formation. The main goal of this study was to evaluate the effect of physiotherapeutic methods in complex treatment of patients with nephrolithiasis under sanatorium conditions.

## **Material and methods**

This research was conducted in "Kaleroya" in the town of Hissar, where twenty patients with nephrolithiasis were tracked. Their mean age was 44.1 years (30-59) and all of them were included in the experimental group (EG) which performed swimming and therapeutic exercise sessions. Swimming was not applied to another twenty-eight patients with the same disease, who refused to swim. They were included in the control group (CG) who participated in the physical therapy sessions, their mean age was 49.5 years (36-60). All patients from EG and CG were on standard analgesic and antispasmodic medication, that included the following medicaments: papaverine, atropine, santropine, spasmalgon, buscolysin and no-spa. In addition, drinking mineral water, in adequate intake, was administered to all patients of both groups (daily drinking mineral water from the spring "Momina banya" in amount 1500 ml-1800 ml, divided in 5-6 portions. The last portion was taken later, just before bedtime and even at night), water strikes twice a week, underwater jet massage and hydrotherapy (water temperature: 37°C - 38°C, duration of the procedure: from 5 to 15-18 min); fangotherapy or saltwort-therapy, a vibrating belt, and a diet.

Before starting the research and after its completion, in both groups changes were monitored in: body weight, strength of abdominal muscles, forced vital capacity and elimination of a concretion, which was visualized by ultrasound imaging and anamnestic.

Body weight was monitored by a medical scale with precision 50 gr, supports weight of 200 kg on standard method.

To assess the strength of abdominal muscles we used one of the test positions from the static part of the Krauss-Weber test. The retention time in the test position was recorded in seconds. Examination of the forced vital capacity was carried out using a Vitalograph Micro Spirometer, Vitalograph Ltd, Ireland and the measurement was repeated 3 times, but only the highest score was recorded [Dimitrova et al., 2016; Grigorova-Petrova et al., 2014; Dimitrova et al., 2014].

The size of the renal calculi in all patients was between 0.5 cm to 0.8 cm in diameter, which enables their spontaneous elimination. Medical ultrasound diagnostics is a noninvasive, accessible method of imaging, especially in establishing X-ray negative calculi. Commonly used are machines with dynamic scanning with transducers 3MHz and 5 MHz [Vasilev, 1990].

Physical therapy was applied to the patients from both groups during their 15-day sanatorium stay. The goals of physical therapy were to improve the renal function and general condition of the patients. For their implementation were determined these tasks: improving the general blood circulation, improving blood circulation in the kidneys, increasing the micturition, improving and strengthening the peristalsis of the ureters, weight reduction, strengthening abdominal wall muscles, inducing spontaneous migration of the concretions. Physiotherapeutic methods are divided into two parts: physical exercises with overall effect and specific physical exercises. Specific tools included: relaxation exercises, diaphragmatic breathing, running and jumping exercises, strengthening abdominal wall muscles, and emotional mobile games. The pace of implementation was slow to moderate intensity. In order to avoid sweating of the patients, the level of physical load was mild, and duration of sessions was 30 minutes daily. Physical therapy is divided into three basic periods. The preparatory period is 2-3 days, and it solves the following tasks: to introduce the patients to practicing exercises, determination of their individual motor capabilities, assessment of their functional status (mobility), and education in performance of some specific exercises. The tools of a complex physiotherapeutic treatment, included in this period, are mainly developing in those with emotional character exercises. Some specific exercises were given in small doses, such as jumping, shaking, "bear" walking exercise, etc. Moreover, the dosage of these exercises depended on the individual health condition of every patient. Special emphasis was placed on proper breathing, especially diaphragmatic breathing. The physiotherapeutic complex in this period mainly consisted of exercises for upper and lower extremities in full range of motion, avoiding strength training and exercises related to exertion. Emotional parts of a complex contained less mobile and semi-mobile games. After the 3rd-4th day, the main

period of treatment with physical therapy began. While in the preparatory period, special exercises occupied about 20%-25% of a whole complex, in a main period were included more complex and specialized exercises: stretching of the abdominal and chest muscles from different starting positions, mixed and free hanging of Swedish wall. The dosage of special exercises gradually increased to “bear” walking, shaking, jumping, exercises for lumbar region, flexion and extension of the lower limbs, trunk and pelvis combined with breathing exercises. During this period, the special exercises occupied 50% of the volume of the session. In order to avoid overload of the patients, which would be lead to increasing of muscle spasm around the ureters, relaxation exercises were generally given after jumps. Upon completion of the treatment course in the sanatorium (final period) a non-supervised rehabilitation program at home was recommended, as special exercises must occupy 25-35% of the daily session. Both groups took participation in tourist hikes with duration of 2-3 hours depends on their condition.

In addition for the patients of EG, swimming is always carried out after the physiotherapy, so as to be used for the relaxing effect of the mineral water on the muscles. Swimming was performed twice daily, duration of 15 min, without resting, freestyle, slow pace.

Statistical analysis was performed using SPSS 19.00 for Windows. Independent and paired sample *t* tests were conducted to determine effect of intervention. Statistical significance was set at  $p < 0,05$ .

## Results

We were interested in monitoring the changes in body weight of the patients, as above-average weight is one of the etiological factors for the nephrolithiasis. Changes in the average of this indicator are presented in table 1.

**Table 1. Changes in the mean values and standard deviations of body weight in the two study groups before and after treatment**

Parameter	Group	$X_1 \pm S_D$	$X_2 \pm S_D$	$X_2 - X_1$	P
Body weight (kg)	EG	67.35±10.06	66.30±9.92	- 1.05	<b>0.001</b>
	CG	77.71± 8.38	77.39±8.60	- 0.32	0.059
	p	<b>0.001</b>	<b>0.001</b>		

*EG-experimental group; CG-control group;  $X_1, X_2$  - mean values;  $S_D$  - standard deviation; P-significant difference compared with baseline values (Student t-test); p-significant difference between EG and CG(Student t-test)*

Before starting the treatment, the patients in EG had a lower average on this indicator. At the end of a treatment the reduction in body weight of 1.05 (from 67.35 kg. to 66.30 kg.) was significantly ( $p < 0.001$ ) in the EG, in contrast to CG at which changes are minimal with 0.32 kg ( $p > 0.05$ ).

Changes were monitored in the forced vital capacity of the patients. Improving respiratory function and general blood circulation respectively results in an improvement of the renal blood circulation (table 2).

**Table 2. Changes in the mean values and standard deviations of forced vital capacity in the two groups before and after treatment**

Parameter	Group	$X_1 \pm S_D$	$X_2 \pm S_D$	$X_2 - X_1$	p
Forced vital capacity (l)	EG	3,25 ± 0,6	3,38 ± 0,6	0,13	0.001
	CG	3,15 ± 0,6	3,18 ± 0,6	0,03	> 0,05

*EG-experimental group; CG-control group;  $X_1$ ,  $X_2$  - mean values;  $S_D$  - standard deviation; P-significant difference compared with baseline values for each group (Student t-test); p-significant difference between the EG and CG (Student t-test)*

Contractions of the abdominal muscles have mechanical effect on the ureteral peristalsis, which we can achieve with purposeful physical exercises on the abdominal wall, assists the spontaneous ejection of the stone. There are no significant differences in this indicator between the two groups at the start of the study. We notice the low starting values (EG - 25.10 sec and 30.43 sec - CG), which is associated with low daily activity in these patients. A significant positive effect was observed in all patients at the end of the observed period ( $p < 0.001$ ). Compared to the baseline data, the increase in muscle strength is greater for patients with EG with 3.55 sec.

**Table 3. Changes in the mean values and standard deviations of muscles abdomen strength in the two study groups before and after treatment**

Parameter	Group	$X_1 \pm S_D$	$X_2 \pm S_D$	$X_2 - X_1$	P
Strength of abdominal muscles (sec)	EG	25.10±11.48	28.65±12.60	3.55	<b>0.001</b>
	CG	30.43±15.07	31.96±15.74	1.54	<b>0.001</b>
	p	0.191	0.434		

*EG-experimental group; CG-control group;  $X_1$ ,  $X_2$  - mean values;  $S_D$  - standard deviation; P-significant difference compared with baseline values (Student t-test); p-significant difference between the EG and CG (Student t-test)*

These changes give us reason to assert that the exercises for abdominal muscles combined with swimming in EG patients are suitable, but a more prolonged period of time is likely to be needed for a more marked change.

Data regarding spontaneous elimination of a renal concretion was found in half of the patients from EG and in seven patients from control group, confirmed by ultrasonography and anamnestic.

## **Discussion**

Physiotherapy combined with swimming have a significant positive impact on the body weight, forced vital capacity, strength of abdominal muscles and elimination of the renal calculi.

We believe that the positive change in body weight in both groups can be attributed to increased daily physical activity and ongoing diet [Tashev, 1972]. Thus effectively combating obesity and sedentary lifestyle, which is typical of most of the patients and worsens their prognosis [Grigorova-Petrova et al., 2015].

The presented results give us reason to link the application of focused breathing exercises and swimming at EG with the clear result on forced vital capacity in these patients [Dimitrova et al., 2007; Grigorova-Petrova et al., 2014]. The usual daily physical activity in the sanatorium environment also has a positive impact, but the combination of swimming, physical therapy and SPA potentiate the effect and leads to better results [Lubenova, 2014; Tasheva, 2007]. Positive results of the renal calculi elimination, objectified by ultrasound examination in the patients from EG, compared to the patients from CG, is likely due to additive effect of swimming that further stimulates the general blood circulation and increases urine output. In turn, releasing of much urine leads to mechanical movement of concretion in the ureters and their elimination.

## **Conclusion**

Results of the present survey revealed that the applied swimming has an additive effect to physiotherapy and increase the effect of balneological treatment in patients with nephrolithiasis.

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