

Systemic cryotherapy in rheumatoid arthritis

Zastosowanie krioterapii ogólnoustrojowej w reumatoidalnym zapaleniu stawów

Использование системной криотерапии при ревматоидном артрите

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SUMMARY

Introduction: Rheumatoid arthritis (RA) is a chronic autoimmune inflammatory systemic disease of the connective tissue. It involves nonspecific symmetrical inflammation of the joints, extra-articular lesions, and systemic complications and leads to various levels of disability. RA is found in 0.3-1.5% of the general population. Physical therapy and rehabilitation are an important part of the treatment.

Aim: The aim of the study was to analyse the influence of a systemic cryotherapy chamber on the patients' physical examination and history results.

Material and methods: The study involved 30 women undergoing a cycle of 10 systemic cryotherapy procedures followed by kinesiotherapy. The mean age of the participants was 60.3 years. The patients' clinical condition (pain intensity) was assessed with the use of the Laitinen questionnaire and the visual analogue pain scale (VAS). Stiffness of the joints was assessed with a scale prepared on the basis of the Rheumatoid Arthritis Disease Activity Index (RADAI) and the functional status was evaluated on the basis of the Health Assessment Questionnaire (HAQ). The strength of grip and the ranges of arm mobility were measured. The patients were examined before and after the procedures.

Results: After systemic cryotherapy procedures, the intensity of pain, periarticular oedema, and morning stiffness was decreased. A comparison with the baseline results revealed an improvement in the range of flexion and extension in upper limb joints (on average by 4.5 degrees) and increased grip strength in 95% of the participants.

Conclusions: Cryotherapy combined with kinesiotherapy is a basic part of RA treatment.

Key words: rheumatoid arthritis, cryotherapy

STRESZCZENIE

Wstęp: Reumatoidalne zapalenie stawów (rzs) jest przewlekłą, zapalną immunologicznie zależną układową chorobą tkanki łącznej, charakteryzującą się nieswoistym, symetrycznym zapaleniem stawów, występowaniem zmian pozastawowych i powikłań układowych, prowadzącą do niepełnosprawności i kalectwa. Częstość występowania rzs wynosi 0,3-1,5% populacji ogólnej.

Postępowanie fizykalnouslyprawniające jest istotnym elementem w leczeniu.

Cel: Celem pracy jest analiza wpływu kriokomory ogólnoustrojowej na stan podmiotowy i przedmiotowy chorych.

Materiał i metody: Badaniem objęto 30 kobiet poddanych cyklowi 10 zabiegów krioterapii ogólnoustrojowej, a następnie kinezyterapii. Średni wiek badanych wynosił 60,3 lat. Do oceny stanu klinicznego chorych wykorzystano: do oceny natężenia bólu kwestionariusz Laitinena oraz wzrokowo-analogową skalę bólu VAS. W ocenie sztywności stawów zastosowano skalę opracowaną na podstawie indeksu RADAI, stan funkcjonalny oceniono na podstawie kwestionariusza HAQ, wykonano pomiary siły chwytu i zakresy ruchomości rąk. Badanie przeprowadzono przed oraz po zabiegach.

Wyniki: Po zabiegach krioterapii ogólnoustrojowej zmniejszył się poziom bólu, obrzęków okołostawowych oraz sztywności porannej. W porównaniu ze stanem początkowym uzyskano poprawę w zakresie zgięcia i wyprostu

w stawach rąk (średnio o 4,5 stopnia), oraz siły chwytu rąk u 95% badanych.

Wnioski: Krioterapia w połączeniu z kinezyterapią jest podstawowym elementem w leczeniu chorych z rz.

Słowa kluczowe: reumatoidalne zapalenie stawów, krioterapia

РЕЗЮМЕ

Введение: Ревматоидный артрит (РА) это хроническое, воспалительное иммунологически зависимое системное заболевание соединительной ткани, с характерным неспецифическим, симметричным поражением суставов, возникновением внесуставных изменений и системных осложнений, приводящих к нетрудоспособности и инвалидности. Заболеваемость РА составляет 0,3-1,5% от общей популяции. Физиотерапевтические процедуры являются важной составляющей лечения.

Цель: Целью исследования является анализ системного влияния криокамеры на субъективное и объективное состояние больных.

Материал и методы: В исследование было включено 30 женщин, принявших цикл из 10 процедур криотерапии с последующей кинезитерапией. Средний возраст пациентов составил 60,3 года. Для оценки клинического состояния пациентов использовали: для оценки интенсивности боли опросник Laitinen и визуально-аналоговую шкалу боли VAS. При оценке тугоподвижности в суставах применяли шкалу, разработанную на основе индекса RADA1, функциональное состояние оценивали согласно опроснику HAQ, измеряли силу захвата и объем движений рук. Исследование было проведено до и после процедур.

Результаты: после криотерапевтического лечение уменьшился уровень боли, околосуставных отеков и утренней скованности. При сравнении с исходным уровнем было достигнуто улучшение в объеме сгибаний и разгибаний в суставах рук (в среднем на 4,5 градуса), а также силы захвата у 95% пациентов.

Выводы: Криотерапия в сочетании с кинезитерапией является важным элементом в лечении пациентов с РА.

Ключевые слова: ревматоидный артрит, криотерапия

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INTRODUCTION

Rheumatoid arthritis (RA) is a great and increasing social and clinical problem. In the USA and Western Europe, RA is found in 0.5-2% of the population. The disease is significantly less widespread in Southern than in Northern Europe. The incidence is reported at 16.5 per one million population in Southern Europe, 29 in Northern Europe, and 38 in the USA. In Poland, rheumatoid disorders concern approx. 5 million people in whom articular lesions often lead to disability. Krawczyk-Wasilewska and Bobrowska-Snarska report [1] that in Poland RA can be found in 400,000 – 600,000 people and there are 800-16,000 new cases annually.

The data on RA, presented by Koligat [2], indicate that the disease increasingly often develops in young and potentially professionally active people. It has been estimated that in the first 10 years of the disease duration at least 50% of the patients below the age of 65 are unable to work professionally. Treatment of patients with RA is a difficult task.

RA is an immunologically-dependent process which initially concerns the synovial membrane of the joints. Its aetiology has not yet been determined.

According to many authors, the disease is caused by such factors as: viral and bacterial infections, starvation, significant physical effort, injury, smoking, stress, hormones, and genetic factors. In response to these factors, Th1 lymphocytes, which have immunological memory, release interleukin-2 (IL-2) and interferon-gamma (INF-gamma). The

lymphokines activate monocytes and macrophages, which leads to the secretion of pro-inflammatory cytokines, i.e. interleukins-1 (IL-1), tumour necrosis factor (TNF-alpha), granulocyte-macrophage colony-stimulating factor (GM-CSF), and growth factor (GF).

All these factors cause chronic inflammation and damage to the tissues.

A study conducted by Detert in 2010 [4] stresses the role of an infection of the oral cavity with bacteria causing parodontosis and indicates the importance of *Porphyromonas gingivalis*. Numerous clinical studies show that smoking is the best documented environmental factor which increases the risk of RA development.

Mackiewicz [3] points out that in many cases the influence of stress on RA is underestimated.

RA development is also influenced by environmental factors and hormones. Oestrogens and prolactin stimulate the immune system while androgens have an opposite, inhibitory effect.

A Silman's study [5] shows that RA exacerbation is five times greater during the first three months after labour. According to Lard et al. [6], progression and joint damage in the course of the disease are closely connected to the presence of HLA class II antigens.

In the course of rheumatoid arthritis, the synovial tissue contains large numbers of activated B cells and plasma cells. Moreover, it shows the expression of the Fas ligand system.

Pro-inflammatory cytokines overproduction is especially significant in the direct or indirect influence on the damage processes. These include interleukins 1, 6, 12, 15, 18 and tumour necrosis factor (TNF-alpha). Another important factor in RA pathogenesis is interleukin-6 (IL-6), which is produced by monocytes, endothelial cells, fibroblasts, and T cells and stimulates the production of immunoglobulins and acute-phase proteins.

Another important cytokine significant for the pro-inflammatory cascade is interleukin-15, produced by monocytes and fibroblasts.

Kuligowska [7] focuses on the role of interleukin-17. In the course of the disease, disturbances of the subsynovial microcirculation and proliferation of the synovial lining cells take place. Fassbender considers the proliferation of submucosal cells to be characteristic of synovitis in the course of RA.

The next step is proliferation and hypertrophy of villi and the development of infiltrates (fibrillary granulation tissue). Cytokines produced in the area of the granulation tissue disturb the metabolism of the neighbouring tissues. The granulation tissue has a damaging influence on the cartilage and epiphyses. It separates them from the synovial fluid, thus inhibiting their normal metabolism. Erosions appear on the articular surfaces and geodes (inflammatory infiltrates) develop in the subchondral layer.

Rheumatoid arthritis is a progressive and chronic systemic disease which requires comprehensive treatment: pharmacotherapy, physical therapy, walking aids, surgical treatment, occupational therapy, health resort treatment, and patient education [8,9,10].

PHYSICAL THERAPY AND REHABILITATION

Pain, experienced by patients throughout their lives, is the main RA symptom. It results from an on-going inflammatory process and abnormal joint biomechanics. Irritated A and C fibre nerve endings, found in the synovial membrane, articular capsule, ligaments, tendons, and periosteum, cause pain. Consequently, muscle tone increases, overloading the active and passive parts of the joint. This leads to tissue damage and intensifies the inflammatory process. The physical therapy and rehabilitation focus on physiotherapy and kinesiotherapy procedures, massage, and balneological treatment. Studies on the assessment of selected RA activity indices after sulphide and hydrogen-sulphide baths were conducted by Kuliński et al. The authors [9] confirmed the effectiveness of the procedures, noting an improvement in the patients' clinical status.

Cryotherapy is one of the most common forms of therapy. Procedures with the use of low temperatures are applied in the acute phase of rheumatoid arthritis. In response to the local cold, blood vessels are narrowed, metabolism is slowed down, and nerve conduction velocity decreases, which results in an analgesic effect in the patient.

Systemic cryotherapy is used in order to obtain a long-lasting analgesic and immunomodulating effect.

Authors such as Waworska, Yamauchi, and Zagrobelny studied the influence of cryotherapy on selected biochemical blood parameters. Applying cold on the entire body resulted in increased levels of adrenalin, noradrenaline, ACTH, cortisol, testosterone (in men) in the serum, leukocytes, platelets, creatinine, blood glucose, and haemoglobin as well as a decrease in inflammation parameters, including: ESR, Waaler-Rose test, and seromuroid.

An important part of rheumatoid arthritis pathogenesis is disturbed cytokines production, due to which pro-inflammatory cytokines dominate over anti-inflammatory cytokines and factors. A positive influence of cryotherapy on pain results in activation of antinociceptive, central, and peripheral mechanisms.

Applying temperatures below -100 degrees Celsius results in active hyperaemia of the skin, which decreases oedema, improves metabolism, and eliminates waste products. Circulation in lymphatic vessels is improved, decreasing the oedema.

The use of low temperatures leads to the relaxation of tense muscles due to inhibition of stimuli sent to the spinal cord, inhibited stimulation of gamma-motoneurons in segments, and decreased nerve conduction velocity.

AIM OF THE STUDY

The aim of the study is to assess the influence of 10 procedures with low temperatures (-130 degrees Celsius) on RA patients.

Research problems: assessment of the procedures' influence on RA symptoms, periarticular oedema, duration of the morning stiffness, pain, and everyday activities on the basis of the HAQ index and the influence on the patients' physical and mental state.

MATERIAL AND METHODS

The study involved 30 women with diagnosed RA. The subjects' age ranged between 40 and 82 years and the mean age was 60.03 years (SD=10.67). The mean duration of the disease was 9.9 years (SD=6.84). The study was conducted from January to May 2013 in the Division of Rehabilitation of the Central Clinical Hospital of the Ministry of Interior in Warsaw. We used a questionnaire prepared for the purpose of this study, which was filled in by the patients before and after completion of the therapy.

The questionnaire included questions concerning the assessment of oedema, pain, physical and mental state, duration of the morning stiffness, and the degree of functional capacity.

Oedema assessment was based on the visual analogue scale (VAS).

The duration of the morning stiffness was evaluated with a 7-point scale based on RADAI. The patients' physical and mental state was assessed with a visual analogue scale and the Laitinen questionnaire, which evaluated pain intensity and frequency, the use of analgesics, and the influence on movement limitation.

The degree of disability was assessed with the HAQ. The literature assumes that HAQ ≥ 1 is a clinical marker of disability while HAQ ≥ 2.25 indicates a high degree of disability.

Muscle strength of the hand was assessed on the basis of the so-called grip strength.

Joint mobility was measured on active flexion and extension in both radiocarpal joints. The mobility was measured twice with a goniometer (orthopaedic protractor).

All measurements were conducted immediately before and after the series of procedures.

A treatment cycle lasted two weeks and involved cryotherapy as well as individually planned kinesiotherapy.

The statistical analysis was based on the Statistica 6 PL for Windows software. Descriptive statistics indices were determined for each parameter (mean and standard deviation). The normality of distribution was assessed by the Shapiro-Wilk test. The non-parametric Wilcoxon signed rank test and the sign test for independent variables were used for the assessment of the differences in values of the parameters before and after the systemic cryotherapy procedures. The significance level was set at $p < 0.05$.

RESULTS

The tables and figures presented below show mean results obtained before and after therapy.

Study group description

The analysis involved 30 women. The mean age of the patients was 60.37 years (SD=10.77 years).

Table 1. Age of the study group

Variable	Descriptive statistic (examination result)				
	N Valid	Mean	Minimum	Maximum	SD
Age	30	60.36667	40.00000	82.00000	10.77188

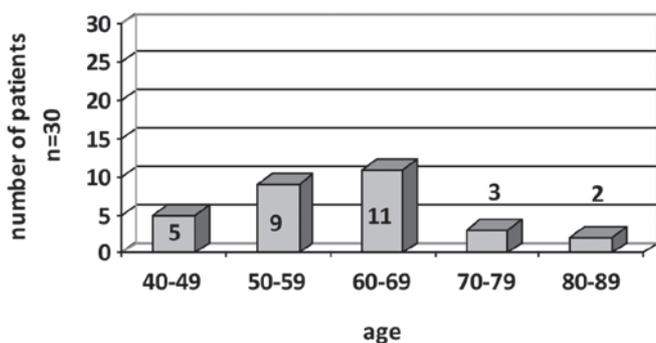


Figure 1. Study group in terms of age.

Table 2. Duration of the disease

Variable	Descriptive statistic (examination result)				
	N Valid	Mean	Minimum	Maximum	SD
RA duration	30	9.933333	2.000000	25.00000	6.761623

MEAN DURATION WAS 9.93 YEARS (SD= 6.76 YEARS)

Division of the study group according to RA duration is presented in Fig. 2.

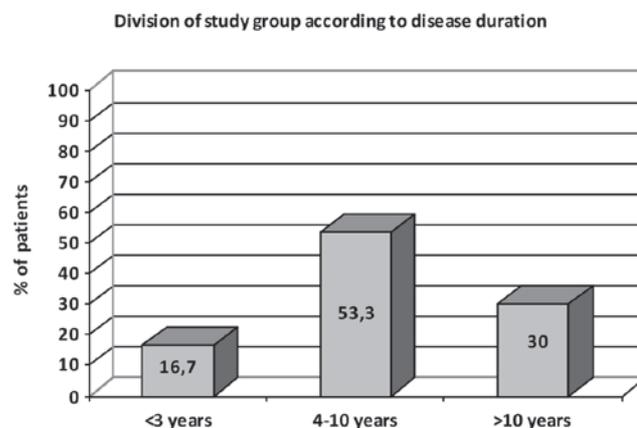


Figure 2. Division of study group according to disease duration.

MEASUREMENT OF GRIP STRENGTH

Mean values of grip strength were compared for the study group before and after treatment. Mean right hand strength was 62.87 (± 15.23) mmHg before treatment and 71.26 (± 15.49) mmHg after treatment. Following the procedures, the grip strength increased by 8.39 mmHg (improvement by 13.34%).

Table 3. Grip strength of the right hand in the study group.

Variable	Descriptive statistic (measurement result)				
	N Valid	Mean	Minimum	Maximum	SD
RH strenght before	30	62.86667	24.00000	90.00000	15.23773
RH strenght after	30	71.26667	28.00000	95.00000	15.49178

The Wilcoxon signed rank test allows for concluding that the difference in grip strength of the right hand before and after treatment was statistically significant.

Table 4. Wilcoxon signed rank test for grip strength of the right hand.

Pair of variables	Wilcoxon signed rank test (measurement results)		
	T	Z	p
RH strenght before & after	000	4.782139	0.000002

Mean left hand grip strength was 56.53 (± 15.34) mmHg before treatment and 64.97 (± 16.95) mmHg after treatment. Following the procedures, the grip strength increased by 8.44 mmHg (improvement by 14.93%).

The Wilcoxon signed rank test allows for concluding that the difference in the grip strength of the right hand before and after treatment was statistically significant.

Table 5. Grip strength of the left hand in the study group

Variable	Descriptive statistic (measurement result)				
	N Valid	Mean	Minimum	Maximum	SD
LH strenght before	30	56.53333	23.00000	84.00000	15.33698
LH strenght after	30	64.96667	25.00000	92.00000	16.94918

Assessment of the right and left hand grip strength with a dynamometer after the cryotherapy procedures showed an improvement. The strength was significantly increased in both hands in 95% of the patients.

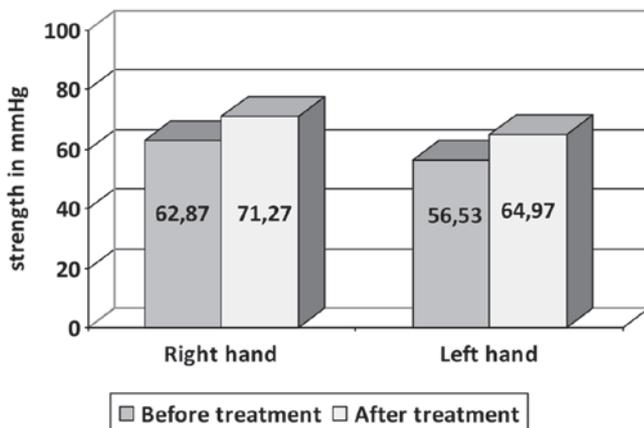


Figure 3. Grip strength in the study group – results before and after treatment.

Measurement of the range of motion in the radiocarpal joint

Mean range of flexion in the right wrist was 63.73 (±22.65) before treatment and 66.7 (±21.47) after treatment. Following the procedures, the range of movement increased by 2.97 degrees (improvement by 4.66%).

Table 6. Sign test – Range of flexion in the right wrist.

Pair of variables	Sign test (measurement results) Results included are significant at p<.05000		
	Percent v < V	Z	p
Right extension before & Right extension after	100.0000	4.477215	0.000008

Table 7. Sign test – Range of extension in the left wrist.

Pair of variables	Sign test (measurement results) Results included are significant at p<.05000		
	Percent v < V	Z	p
Left extension before & Left extension after	100.0000	4.902903	0.000001

Table 8. Range of flexion in the right wrist.

Variable	Descriptive statistic (measurement result)				
	N Valid	Mean	Minimum	Maximum	SD
Right flexion before	30	63.73333	20.00000	90.00000	22.65625
Right flexion after	30	66.70000	24.00000	90.00000	21.46874

The Wilcoxon signed rank test allows for concluding that the difference in the range of flexion in the right wrist before and after treatment was statistically significant.

Table 9. The Wilcoxon signed rank test – Range of flexion in the right wrist.

Pair of variables	Wilcoxon signed rank test (measurement results) Results included are significant at p<.05000		
	T	Z	p
Right flexion before & right flexion after	0.00	4.106905	0.000040

The mean range of extension in the right wrist was 48.20 (±18.81) before treatment and 53.63 (±18.59) after treatment. Following the procedures, the range of motion was increased by 5.43 degrees (improvement by 11.36%).

Table 10. Range of extension in the right wrist.

Variable	Descriptive statistic (measurement result)				
	N Valid	Mean	Minimum	Maximum	SD
Right extension before	30	48.20000	10.00000	90.00000	18.81196
Right extension after	30	53.63333	20.00000	90.00000	18.58714

The Wilcoxon signed rank test allows for concluding that the difference in the range of extension in the right wrist before and after treatment was statistically significant.

Table 11. Wilcoxon signed rank test – Range of extension in the right wrist.

Pair of variables	Wilcoxon signed rank test (measurement results) Results included are significant at p<.05000		
	T	Z	p
Right flexion before & right flexion after	0.00	4.457345	0.000008

The sign tests allow for concluding that the difference in the range of motion in the left wrist before and after treatment is statistically significant.

The mean range of flexion in the left wrist was 63.13 (±21.50) degrees before treatment and 67.10 (±20.32) degrees after treatment. Following the procedures, the range was increased by 3.97 degrees (improvement by 6.29%).

The Wilcoxon signed rank test allows for concluding that the difference in the range of flexion in the left wrist before and after treatment was statistically significant.

Table 12. Sign test – Range of flexion in the left wrist.

Pair of variables	Sign test (measurement results) Results included are significant at p<.05000		
	Percent v<V	Z	p
Left flexion before & left flexion after	100.00	4.364358	0.000013

Table 13. Sign test – Range of extension in the left wrist.

Pair of variables	Sign test(measurement results) Results included are significant at p<.05000		
	Percent v<V	z	p
Left extension before & leftextension after	100.00	5.003702	0.000001

Table 14. Range of flexion in the left wrist.

Variable	Descriptive statistic (measurement result)				
	N Valid	Mean	Minimum	Maximum	SD
Left flexion before	30	63.13333	22.00000	90.00000	21.506559
Left flexionafter	30	67.10000	27.00000	90.00000	20.31706

Table 15. Wilcoxon signed rank test – Range of flexion in the left wrist.

Pair of variables	Wilcoxon signed rank test (measurement results) Results included are significant at p<.05000		
	T	Z	p
Left flexion before & leftflexion after	0.00	4.014509	0.000060

The mean range of extension in the left wrist was 47.33 (±19.01) degrees before treatment and 53.20 (±18.09) degrees after treatment. Following the procedures, the range was increased by 5.87 degrees (improvement by 12.40%).

Table 16. Range of extension in the left wrist.

Variable	Descriptive statistic (measurement result)				
	N Valid	Mean	Minimum	Maximum	SD
Left extension before	30	47.33333	12.00000	90.00000	19.00514
Left extensionafter	30	53.20000	21.00000	90.00000	18.09248

The Wilcoxon signed rank test allows for concluding that the difference in the range of extension in the right wrist before and after treatment was statistically significant.

Table 17. Wilcoxon signed rank test – Range of extension in the left wrist

Pair of variables	Wilcoxon signed rank test (measurement results) Results included are significant at p<.05000		
	T	Z	p
Left extension before & leftextension after	0.00	4.540725	0.000006

An analysis of the results of mobility in the radiocarpal joint showed an improvement with respect to flexion and extension on average by 4.56 degrees. The range of flexion was increased on average by 3.47 degrees while the range of extension was increased by 5.65 degrees. The improvement was larger in the left hand.

Results of the measurements of the range of motion in the wrist are presented in Fig. 5.

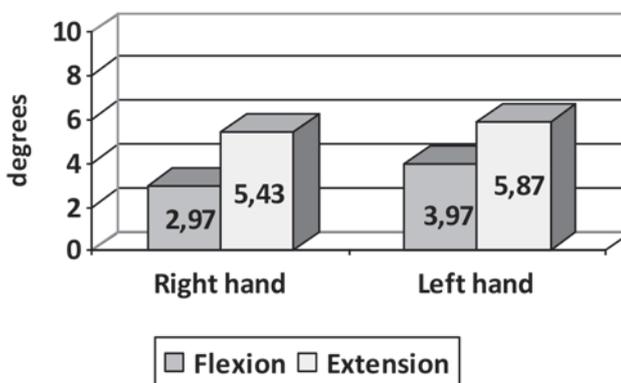


Figure 4. Mean improvements in the ranges of motion before and after treatment

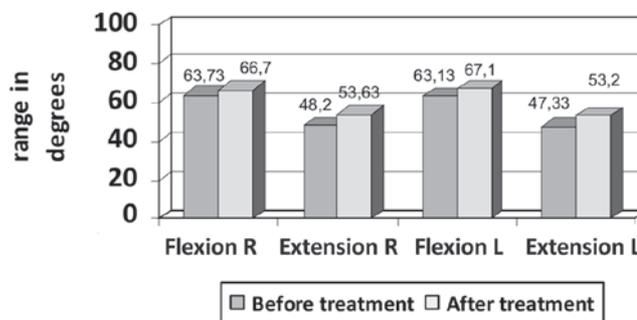


Figure 5. Mean ranges of motion in the wrist before and after treatment.

Oedema assessment according to a 10-point scale

The sign test allows for concluding that the difference in oedemas before and after treatment is statistically significant.

Table 18. Sign test – Periarticular oedema assessment

Pair of variables	Sign test(examination results) Results included are significant at p<.05000		
	Percent v<V	Z	p
Oedema before & oedema after	0.00	4.902903	0.000001

This is confirmed by the results presented below.

The patients assessed the oedema after treatment as smaller, compared to the state before treatment. Using a 10-point scale, we obtained a mean value of assessment of 4.10 (±1.79) points. Following the treatment, the result was lower by 2.77 points and reached 1.33 (±1.35). The improvement was 67.56% and is statistically significant (p=0.000006) with a significance level of 0.05 .

Table 19. Periarticular oedema assessment..

Variable	Descriptive statistic (examination result)				
	N Valid	Mean	Minimum	Maximum	SD
Oedema before	30	4.100000	0.00	7.00000	1.787890
Oedema after	30	1.333333	0.00	5.00000	1.347625

The Wilcoxon signed rank test allows for concluding that the use of a systemic cryotherapy chamber decreases periarticular oedema.

The results are presented in Fig. 6.

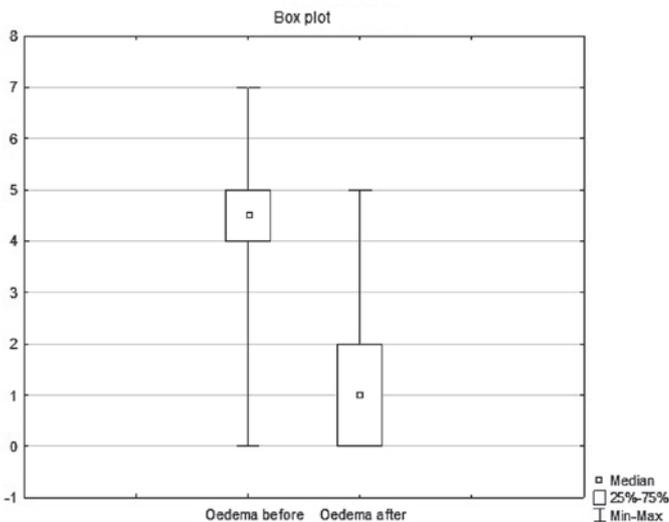


Figure 6. Assessment of oedema before and after treatment.

The patients assessed the morning stiffness on a 10-point scale.

Before the procedures, morning stiffness was found in 27 (90%) RA patients and ranged between 1 and 4 hours.

The patients assessed the morning stiffness on a 10-point scale as 1.76 points (±1.18 points).

Table 20. Wilcoxon signed rank test – periarticular oedema assessment.

Pair of variables	Wilcoxon signed rank test (examination results)		
	T	Z	p
Oedma before & Oedmaafter	0.00	4.457345	0.000008

Following the procedures, the mean was decreased to 0.77 points (± 0.86 points). The improvement reached 64.73% and is statistically significant (p=0.000040) with a significance level of 0.05 .

Morning stiffness fully regressed in 9 (33.33%) patients while in 15 (55.56%) patients it lasted less than 30 minutes and only in 2 (7.41%) patients it lasted up to an hour.

The results show that the use of a systemic cryotherapy chamber decreases or eliminates morning stiffness. The results are presented in Fig. 7.

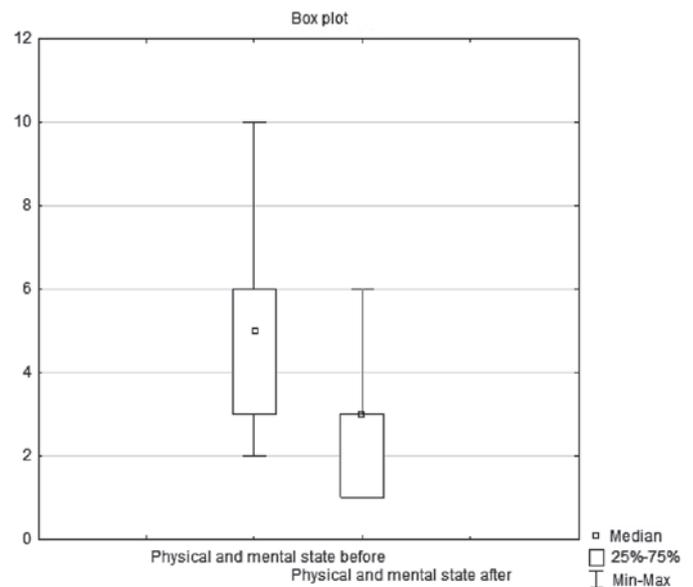


Figure 7. Assessment of morning stiffness duration before and after treatment.

Assessment of physical and mental state

The sign tests allow for concluding that the difference in the physical and mental state assessment before and after treatment is statistically significant.

Table 21. Assessment of morning stiffness duration.

Variable	Descriptive statistic (examination result)				
	N Valid	Mean	Minimum	Maximum	SD
Stiffness before	30	1.766667	0.00	4.00000	1.135124
Stiffnessafter	30	0.766667	0.00	4.00000	0.858360

A group of 30 patients participating in the study assessed their current physical and mental state after treatment as improved compared to the state before treatment.

Table 22. Sign test – assessment of physical and mental state.

Pair of variables	Sign test(examination results)		
	Percent v<V	Z	p
Phys. And mental state before & after	0.00	5.199469	0.000000

Table 23. Assessment of physical and mental state.

Variable	Descriptive statistic (examination results)				
	N Valid	Mean	Minimum	Maximum	SD
Phys. and mental state before	30	4.933333	2.000000	10.00000	2.116167
Phys. and mental state after	30	2.600000	1.000000	6.00000	1.452703

The mean assessment (according to VAS) for the women before treatment was 4.93 (±2.12) points. After its completion, the result decreased by 2.33 and reached 2.60 (±1.45) points. The improvement was 47.26% and is statistically significant (p=0.000003) with a significance level of 0.05.

The results suggest that the use of a systemic cryotherapy chamber improves the patients' physical and mental state. The results are presented in Fig. 8.

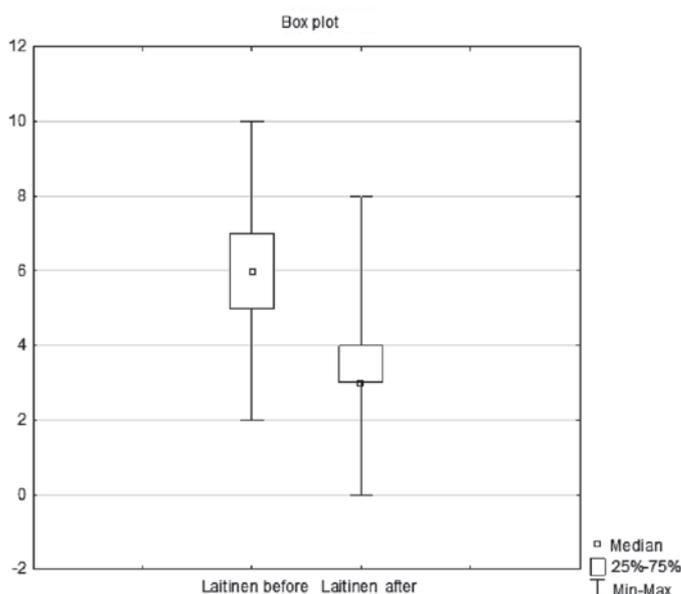


Figure 8. Assessment of physical and mental state

Pain intensity assessment according to the modified Laitinen questionnaire

The difference in pain assessment after treatment is statistically significant.

Table 24. Pain assessment according to Laitinen scale.

Variable	Descriptive statistic (examination results)				
	N Valid	Mean	Minimum	Maximum	SD
Laitinen before	30	5.733333	2.000000	10.00000	1.892514
Laitinenafter	30	3.333333	0.000000	8.00000	1.561019

The mean number of points per patient before treatment was 5.73 points (±1.89) and decreased after treatment to 3.33 points (±1.56). The difference in the results before and

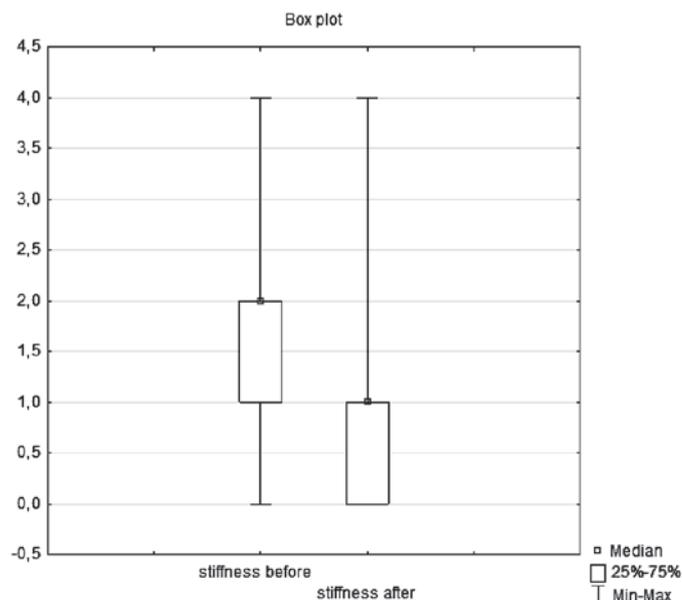


Figure 9. Pain assessment..

after treatment reached 2.4 points. The results confirm that the use of a systemic cryotherapy chamber decreases or eliminates pain in patients. The results are presented in Fig. 9.

Pain intensity assessment according to the visual analogue scale (VAS)

The sign tests allow for concluding that the difference in pain assessment using a 10-point visual analogue scale before and after treatment is statistically significant.

Table 25. Sign test- Pain assessment according to VAS.

Pair of variables	Sign test(examination results)		
	Results included are significant at p<.05000		
	Percent v<V	Z	p
VAS before & VAS after	0.00	5.102520	0.000000

The mean pain level was 4.33 (±2.39) before treatment and 1.97 (±2.03) after treatment. Following the procedures, the pain was decreased on average by 2.36.

Table 26. Pain assessment according to VAS .

Variable	Descriptive statistic (examination results)				
	N Valid	Mean	Minimum	Maximum	SD
VAS before	30	4.433333	1.000000	9.00000	2.387949
VASafter	30	1.966667	1.000000	8.00000	2.025413

The improvement obtained in the pain analysis reached 54.50% and is statistically significant (p=0.000003) with a significance level of 0.05 and confirms that the use of a systemic cryotherapy chamber decreases pain.

The results are presented in Fig. 10.

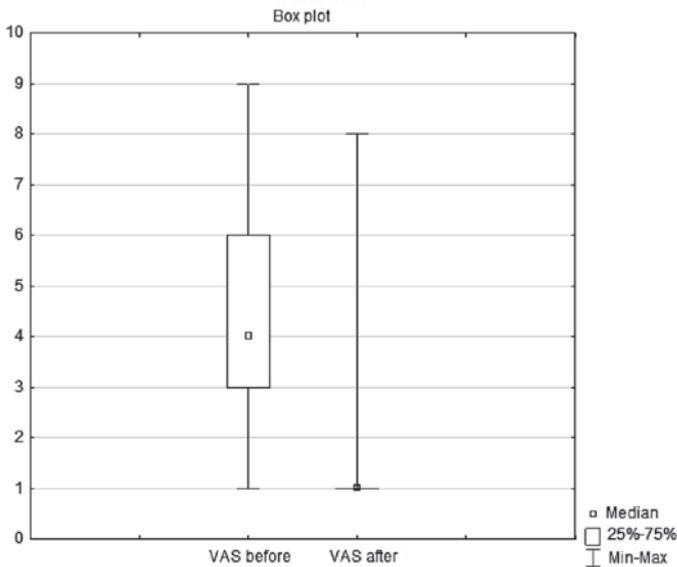


Figure 10. Pain assessment according to VAS before and after treatment.

Functional status assessment based on HAQ

Mean HAQ values were compared for the study group before and after treatment. The mean HAQ result of all patients was 0.91 (±0.92) before treatment and 0.56 (±0.73) after treatment. Following the procedures, the degree of disability was decreased by 0.35 points (improvement by 38.46%).

The data obtained are presented in Fig. 11.

Table 27. HAQ of study group.

Variable	Descriptive statistic (examination results)				
	N Valid	Mean	Minimum	Maximum	SD
HAQ before	30	0.912500	0.00	2.875000	0.917473
HAQ after	30	0.558667	0.00	2.625000	0.728823

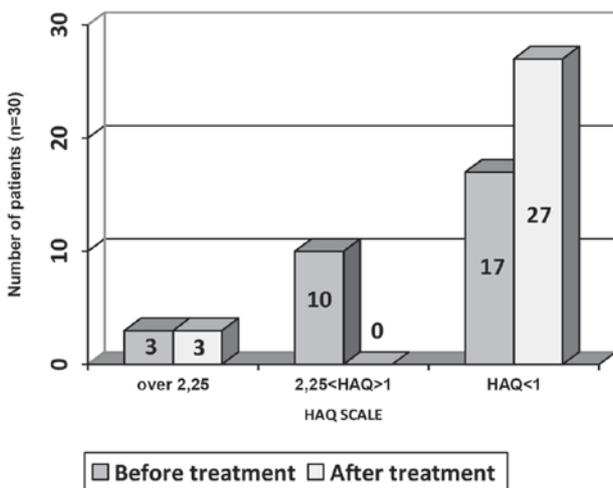


Figure 11. HAQ assessment before and after treatment.

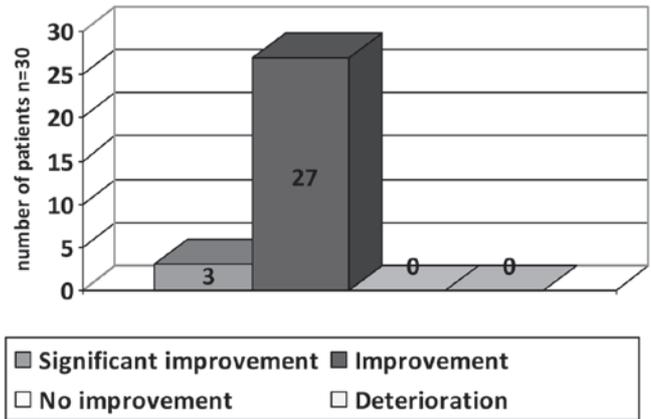


Figure 12. Subjective assessment of patients' health compared with the period before treatment.

The analysis allows for a conclusion that the disability level was decreased in the patients, which indicates a significant improvement in their functional capacity.

Procedure assessment

The study group was asked about their assessment of their ailments after systemic cryotherapy. All patients responded that they noticed an improvement; 3 patients reported a significant improvement.

Another question concerned the symptoms influenced by the cryotherapy.

The most significant improvement in the RA patients undergoing systemic cryotherapy concerned mainly a decrease in pain intensity and frequency as well as decreased or eliminated morning stiffness and improved physical and mental state.

The RA patients were asked whether the series of procedures met their expectations. The entire study group responded yes.

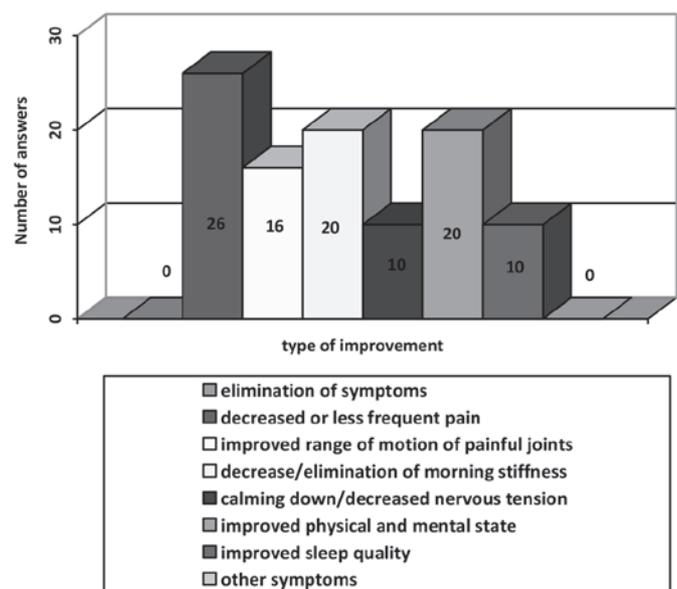


Figure 13. Improvement assessment.

DISCUSSION

The present results confirm the beneficial effect of systemic cryotherapy in RA patients. Many authors stress [8,9,10] that pain has a significant negative influence on the physical performance of RA patients and thus limiting or eliminating the pain improves general performance and increases the range of movements and muscle strength. Misztela and Kuliński [10] analysed changes in the range of movements in the most painful and oedematous joints as well as the grip strength with the use of a sphygmomanometer. After completion of ten cryotherapy procedures, they found an increase in the grip strength and a significant increase in the range of mobility. The improvement in the case of the grip strength was on average 31.32% in the right hand and 31.50% in the left hand.

The study results are similar to those obtained by the authors [10].

Systemic cryotherapy caused a marked and statistically significant ($p < 0.0001$) increase in muscle strength in both hands. The strength was improved in both hands in 95% of the patients.

A greater strength increase was noted in the left hand (14.93%) which was not the dominant hand in the majority of the patients.

A 13.34% improvement was noted in the right hand which was the dominant hand in the majority of the women.

This effect was accompanied by an improvement in the range of mobility. An average improvement of 4.56 degrees was reached in the range of active flexion and extension (on average by 3.47 and 5.65 degrees, respectively). A greater improvement was noted in the left hand.

The influence on periarticular oedema was significant. Active hyperaemia caused by a systemic cryotherapy chamber decreases oedema, improves metabolism, and eliminates waste products. The anti-oedema effect of cryogenic temperatures has been confirmed by numerous authors, including Kuliński [10]. The studies showed a high effectiveness of the treatment in decreasing or eliminating oedema. Morning stiffness in the patients lasted approx. 1 hour. After systemic treatment with low temperatures, morning stiffness was significantly decreased in 88% of the patients and eliminated in 20% of the study participants.

A positive effect of systemic cryotherapy was also observed in the mental state of the patients. After treatment, the feeling of fatigue was eliminated and the improvement in their physical and mental state reached 46.85%.

The procedures resulted in elimination or a very significant decrease in pain.

The mean HAQ result of all patients was 0.91 (± 0.92) before treatment and 0.56 (± 0.73) after treatment. Following the procedures, the degree of disability decreased by 0.35 points (improvement by 38.46%).

The physical therapy with the use of low temperatures resulted in a decrease in the degree of functional disability in the study group and an increase in independence and self-sufficiency among the RA patients.

Procedure assessment

All mechanisms causing elimination of the pain, local signs of inflammation, and increased muscle tone in the course of RA in the patients treated with low temperatures help improve physical capacity and performance. Consequently, the patients report a marked improvement in their mood and mental state.

Subjective effectiveness assessment showed that treatment with the use of low temperatures in a cryotherapy chamber results in a significant improvement and meets the patients' expectations.

CONCLUSIONS

The study results showed that the use of systemic cryotherapy decreases pain and oedema, relaxes skeletal muscles, increases the range of motion in the joints, and improves the patients' physical and mental state. It facilitates the kinesiotherapy increasing the strength of weakened muscles. Systemic cryotherapy is a basic physical therapy procedure in RA treatment.

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Ocena skuteczności leczenia uzdrowiskowego u kobiet z chorobą zwyrodnieniową stawów kolanowych

The assessment of spa treatment effectiveness in women with osteoarthritis of the knee

Анализ эффективности курортного лечения женщин с артрозными изменениями в коленных суставах

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STRESZCZENIE

Wstęp: Choroba zwyrodnieniowa stawów kolanowych związana jest z dolegliwościami bólowymi i czynnościowym upośledzeniem. Powoduje obniżenie jakości życia oraz zwiększa ryzyko innych chorób.

Materiał i metody: Badaniami zostało objętych 25 pacjentek z chorobą zwyrodnieniową stawów kolanowych. Przeprowadzono je dwukrotnie: przed dwutygodniowym leczeniem w sanatorium w Muszynie (badanie I) i po jego zakończeniu (badanie II). Za każdym razem pacjentki były poddane badaniu podmiotowemu (wywiad) i przedmiotowemu, które obejmowało: wysokość, masę ciała i wskaźnik wzrostowo-wagowy (BMI), obwód kolan, zakres ruchu zginania i prostowania, ocenę natężenia bólu wg skali VAS i sprawność funkcjonalną mierzoną testem „Wstań i idź”.

Wyniki: Na skutek przeprowadzonej kompleksowej rehabilitacji uzdrowiskowej, która obejmowała: laseroterapię, krioterapię, okłady borowinowe, kąpiel solankową i gimnastykę indywidualną nastąpiła znaczna poprawa zakresu ruchów i zmniejszenie dolegliwości bólowych w stawach kolanowych. Wszystko to wpłynęło korzystnie na sprawność funkcjonalną badanych pacjentek.

Wnioski: U pacjentek z chorobą zwyrodnieniową stawów kolanowych stwierdza się upośledzenie funkcji tego stawu z powodu znacznego ograniczenia zakresu ruchu zginania i wyprostu oraz dolegliwości bólowych. Kinezyterapia wraz z fizykoterapią oraz balneoterapią podczas kuracji sanatoryjnej wpływa korzystnie na sprawność funkcjonalną pacjentek i pozwala, nawet w tak krótkim czasie, na zmniejszenie obrzęków oraz dolegliwości bólowych, a co za tym idzie, poprawę zakresu ruchu w stawie kolanowym.

Słowa kluczowe: choroba zwyrodnieniowa stawów kolanowych, leczenie uzdrowiskowe

SUMMARY

Introduction: Osteoarthritis is associated with the pain and functional impairment. This reduces the quality of life and increases the risk of other diseases.

Material and methods: 25 patients were included with osteoarthritis of the knee. The examinations were carried out twice: before (study I) and after two weeks of treatment in a sanatorium in Muszyna (study II). Each patient was tested in the personal interview and an examination, which included: height, weight, and BMI, the measurement circumference of knees, the range of motion bending and straightening, VAS and functional capacity test called “Get up and go”.

Results: As a result of carried out comprehensive rehabilitation of the spa, which included: laser therapy, cryotherapy, mud treatment, brine bath and individual exercises, there was a significant improvement in the range of motion and reduce of pain. All this had a positive impact on the functional efficiency of the patients.

Conclusions: The patients with osteoarthritis of the knee have got joint dysfunction due to a significant reduction in range