

The Effectiveness of High-intensity Pulsed Magnetic Therapy in Rehabilitation of Servicemen with Post-traumatic Osteoarthritis of Knee Joints

Skuteczność magnetoterapii pulsacyjnej o wysokiej intensywności w rehabilitacji żołnierzy z pourazową chorobą zwyrodnieniową stawów kolanowych

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SUMMARY

Aim: To increase the effectiveness of complex rehabilitation of servicemen with PTO by using high-intensity pulse magnetic therapy (HIP MT).**Materials and Methods:** The study design included 62 patients with PTO of stage I-III who were divided into: – control group (32 patients) received rehabilitation complex (RC) №1, which included: climatotherapy, kinesiotherapy, massage and balneotherapy; – main group (30 patients) received RC №2 with adding of HIP MT on the affected joints. The analysis of the effectiveness was performed using an algometric clinical examination, Lequesne's algo-functional index (AFI), WOMAC, visual analog pain scale (VAS), HAQ questionnaire.**Results:** It was shown reliable benefits of RC № 2: the intensity of pain by VAS decreased by 3,1 times, according to the AFI gonarthrosis was assessed as mild, the value of the total WOMAC index was 20.2% better than in control group ($p < 0.05$). The HAQ index showed a significant improvement in 41.3% (1.5 times better than in patients of control group). During long-term observation (3 months) after rehabilitation improvement was observed in 96.6% of patients of main group.**Conclusions:** The use of HIP MT in the complex rehabilitation of patients with PTO has significantly reduced the manifestations of pain, increase functioning of joints and restore combat readiness.**Key words:** post-traumatic osteoarthritis, servicemen, knee joints, high-intensity pulse magnetic therapy, rehabilitation**Słowa kluczowe:** pourazowa choroba zwyrodnieniowa stawów, żołnierze, stawy kolanowe, magnetoterapia pulsacyjna o wysokiej intensywności, rehabilitacja

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INTRODUCTION

One of the features of the defeat of servicemen with modern weapons is severe injuries as a result of mine injuries [1, 2]. That is why the share in the structure of sanitary costs during hostilities is occupied by injuries of the musculoskeletal system [2, 3], most often – various injuries of the lower extremities (58.8%), including intra-articular fractures of large joints of the lower extremities, accompanied by trauma of musculoskeletal system, cartilage, and subsequently leads to the development of post-traumatic osteoarthritis (PTO) with a violation of the recovery and destruction of all joint tissues.

The severity of the medical and social consequences of PTO is due to the chronic progressive course and limitation

of joint function, which is accompanied by a high risk of loss of combat capability of the serviceman and disability [2].

The leading complaint and the earliest symptom in patients with PTO is pain, which is characterized by heterogeneity and multimodality, and is an important multidisciplinary problem in the treatment of this group of patients [4-6]. Trauma-induced damage to the structures of the joint leads to a prolonged inflammatory process, which is characterized, inter alia, by pain of varying intensity [7-9], which leads to a lack of function.

The main goal of treatment of patients with PTO is to reduce the manifestations of pain, improve the functional activity of the joints, improve the quality of life of patients, prevent disability [5,10-12].

Usually, analgesic drugs are used to control the pain syndrome in patients with PTO, which have long-term side effects and are limited to certain comorbid diseases [13-15].

Therefore, the concept of pain control in PTO should be comprehensive and aimed at prescribing effective analgesic factors that have the greatest analgesic and anti-inflammatory potential. An important role is played by modern physical modalities methods, in particular, high-intensity pulsed magnetic therapy (HIP MT).

High-intensity pulsed magnetic therapy (HIP MT) uses a unique high-intensity electromagnetic field with a magnetic induction of 1.5-3 T. The analgesic effect of HIP MT is due to a decrease in the excitability of afferent fibers with a decrease in the level of histamine in the nervous system and anti-edema effect with a decrease in histamine in tissues (antihistamine effect) [16]. Induced eddy currents of very low frequency generated by HIP MT, due to the activation of weakly myelinated A σ and C-fibers are able to block the afferent impulse from the pain cell [16,17]. According to the degree of analgesic, anti-inflammatory, muscle-stimulating effect, HIP MT exceeds the known types of low-frequency magnetic therapy [16,18]. In addition, HIP MT helps to reduce the muscular-tonic syndrome, improve regenerative-reparative processes [16].

AIM

To increase the effectiveness of rehabilitation of servicemen with PTO by using HIP MT to reduce pain syndrome, restore the functional activity of knee joints, increase quality of life and prevent disability, restore combat readiness.

MATERIALS AND METHODS

The study design included 62 servicemen with PTO, all men, the average age was (34 \pm 5.8) years. The diagnosis of osteoarthritis of knee joints was established according to the classification of I. Kellgren, I. Lawrence. Confirmation of the traumatic origin of osteoarthritis was mandatory, with a period of three to six months after injury. The majority of patients had PTO of stage II – 36 (58.1%), the rest had stage I – 21 (33.9%) and stage III – 5 (8.1%), patients with stage IV were not included in the study. 46 (74.2%) patients had monoosteoarthritis of knee joint, bilateral lesions were observed in 16 (25.8%) cases. Patients were under observation in the Odesa military rehabilitation center of Ministry of Defence of Ukraine. Depending on the type of treatment all patients were divided into two groups: control (32 patients (51.6%)) and main (30 patients (48.4 %)) groups.

Patients of the control group received rehabilitation complex №1 (RC №1), which included: climatotherapy, kinesiotherapy, massage and balneotherapy.

Kinesiotherapy consists of physical exercises with a choice of starting position without axial load on the knee joints (in a sitting or lying position): passive, active exercises for the affected limb; three times a week, lasting 30-40 minutes. Balneotherapy was used in the form of sodium chloride general baths of medium concentration (20-40 g/l), every other day, with a course of 10 procedures. Massage (therapeutic classical and segmental-reflex) was applied to the affected limb

and the corresponding segmental area, course consisted of 10 procedures, daily or every other day. The massage procedure was aimed at normalizing the tone, increasing the contractility of weakened muscles, improving blood and lymph circulation, trophic and regenerative processes, correction of concomitant neurological manifestations, normalization of the patient's emotional state.

Patients of the main group received rehabilitation complex №2, in which to rehabilitation complex №1 were added HIP MT procedures on the affected joints. HIP MT procedures were performed on a HIP MT Zimmer emField Pro, program 3 (anesthesia for chronic pain), the duration of the procedure was 10-15 minutes. During the procedure patient was in a supine position, the intensity of exposure was adjusted during therapy individually. Patient was warned about the possibility of feeling moderate discomfort in the affected area, in this regard the first procedures were performed with an intensity of 5-10%. With a comfortable perception of the effect of the procedure, the intensity was increased to 40-50%. The course consisted of 8-10 procedures every other day.

Analysis of the effectiveness of treatment was performed using algometric clinical examination (severity of pain on palpation, active and passive movements, signs of inflammation, defiguration and deformation of joints), assessment of quality of life by Lequesne's algo-functional index (AFI) for knee joints, visual-analog scale of pain (VAS), Stanford Health Assessment Questionnaire (HAQ), Western Ontario and McMaster Universities osteoarthritis Index (WOMAC), coefficient of saturation of symptoms (CS).

In order to determine the severity of osteoarthritis of the knee joint, the Lequesne's algo-functional index (AFI) was used, which was a questionnaire for self-completion of patients and has three sections: characteristics of pain, maximum distance when walking without pain and functional activity. The assessment was performed on a scale, where 1-4 points – mild gonarthrosis, 5-7 points – gonarthrosis of moderate severity, 8-10 – severe gonarthrosis, 11-13 – more severe gonarthrosis, 14 points or more – very severe gonarthrosis [5].

The Stanford Health Assessment Questionnaire (HAQ) was used to assess quality of life. The questionnaire consists of 20 questions divided into 8 categories (dressing, getting up, eating, walking, hygiene, achievable range, hand function, mobility), which assess the ability to perform certain actions on a 4-point scale. The HAQ index was calculated as the average of the highest scores for each category [10,12].

The effectiveness of the treatment was assessed using Western Ontario and McMaster Universities osteoarthritis Index (WOMAC). The self-administered WOMAC questionnaire has questions regarding pain severity, stiffness, and functional capacity. The total WOMAC index [10, 12] was calculated.

The analysis of the study results was also performed by calculating the coefficient of saturation of symptoms (CS) – the ratio of the actual number of patients with characteristic symptoms (joint pain: at rest, when moving, at night, on palpation, restricted movement, fatigue in the lower extremities, reduced walking distance) to the number of examined patients in each clinical observation group.

In the long-term period (after 3 months) the effectiveness of rehabilitation was performed using the test “Evaluation of the effectiveness of treatment by the patient” on a scale of “significant improvement”, “improvement”, “good”, “satisfactory” and “unsatisfactory” results.

RESULTS AND DISCUSSION

The analysis of the results of the study showed the reliable advantages of the rehabilitation complex № 2, in which physical modality HIP MT was additionally used.

According to the algometric clinical examination, patients of both groups showed a reliable improvement in the clinical condition. The majority of patients in the main group showed a marked reduction in pain when performing active and passive movements, at rest, at night, as well as a significant improvement in functional activity in the joints. In main group of patients with the use of rehabilitation complex №2 CS decreased almost 4.6 times ($p < 0.05$), while in the control group – only 1.6 times. Evaluation of the severity of pain by VAS in patients of control group showed an improvement of 1.6 times, whereas in main group the intensity of pain decreased by 3.1 times (Table 1).

Evaluation of the Lequesne’s algo-functional index (AFI) at the beginning of treatment revealed significant pathological changes in patients of both observation groups. However, after the use of rehabilitation complex №2, which included HIP MT procedures, gonarthrosis was assessed as mild (3.7 ± 1.2) points, whereas in the control group – as moderate (7.4 ± 1.2) points. In patients of main group a significant reduction

of pain at night, after prolonged standing, increasing the maximum distance when walking without pain and improving functional activity were determined (Table 2).

According to WOMAC index in patients of both groups decrease in the intensity of pain and manifestations of stiffness, improved functional activity were also observed. However, in patients of the main group the value of the total WOMAC index was 20.20% better than in patients of the control group ($p < 0.05$). Reliable changes related to pain during prolonged standing, at night, when moving and walking upstairs, stiffness during the day, functional limitations during squats (Figure 1).

Assessment of the quality of life of patients was performed on the HAQ scale. Patients in both groups noted the presence of moderately severe physical dysfunction in all categories of the questionnaire before rehabilitation. Thus, in the control group, the HAQ index was (1.41 ± 0.36), in main group – (1.38 ± 0.31) points. After rehabilitation patients in main group improved HAQ index by 41.3% to (0.81 ± 0.32) points, which is 1.5 times better than in patients of control group, where HAQ index remained at the level of (1.24 ± 0.25) points and the improvement was only 12.1% ($p > 0.05$). The most significant improvements were observed in the categories of getting up, walking and mobility (other actions).

Evaluation of the long-term effectiveness of rehabilitation was performed 3 months after rehabilitation. Improvement and stabilization of the physical conditions were noted by almost all patients of the main group (96.6%). Of these, the assessment of “significant improvement” and “improvement” had more than half of patients, unsatisfactory results were not observed. In the

Table 1. Dynamics of algometric clinical examination of patients with post-traumatic osteoarthritis of knee joints, $n=62$, (%)

Clinical symptom	Control group, $n=32$		Main group, $n=30$	
	Before rehabilitation	After rehabilitation	Before rehabilitation	After rehabilitation
Pain at rest, n (%)	26 (81,3)	18 (56,3)	24 (80,0)	4 (13,3)
Pain during passive movements, n (%)	30 (93,8)	14 (43,8)	27 (90,0)	3 (10,0)
Pain during active movements, n (%)	32 (100)	24 (75,0)	29 (96,7)	6 (20,0)
Pain on palpation, n (%)	32 (100)	24 (75,0)	30 (100,0)	8 (26,7)
Pain at night time, n (%)	22 (68,8)	11 (34,4)	20 (66,7)	4 (13,3)
Restriction of movements, n (%)	24 (75,0)	10 (31,3)	21 (70,0)	7 (23,3)
Feeling tired while walking, n (%)	26 (81,3)	18 (56,3)	25 (83,3)	6 (20,0)
Reducing walking distance, n (%)	18 (56,3)	12 (37,5)	19 (63,3)	4 (13,3)
VAS, points ($M \pm \sigma$)	$6,7 \pm 0,2$	$4,3 \pm 0,2$	$6,9 \pm 0,2$	$2,2 \pm 0,2^*$
CS, ($M \pm \sigma$)	$6,6 \pm 0,2$	$4,1 \pm 0,1$	$6,5 \pm 0,1$	$1,4 \pm 0,1^*$

Note: * data reliability ($p \leq 0,05$) in comparison between groups after rehabilitation

Table 2. Dynamics of Lequesne’s algo-functional index in patients with post-traumatic osteoarthritis of knee joints, $n=62$, ($M \pm \sigma$)

Data groups	Control group ($n=32$)		Main group ($n=36$)	
	Before rehabilitation	After rehabilitation	Before rehabilitation	After rehabilitation
Characteristics of pain or discomfort, ($M \pm \sigma$)	$5,7 \pm 1,2$	$2,9 \pm 1,2$	$5,6 \pm 1,2$	$1,2 \pm 1,2$
The maximum distance when walking without pain, ($M \pm \sigma$)	$1,9 \pm 1,1$	$1,7 \pm 1,1$	$1,9 \pm 1,02$	$0,8 \pm 1,1$
Functional activity, ($M \pm \sigma$)	$5,1 \pm 1,2$	$2,8 \pm 1,01$	$5,2 \pm 1,2$	$1,7 \pm 1,01$
Total points, ($M \pm \sigma$)	$12,7 \pm 1,2$	$7,4 \pm 1,2$	$12,7 \pm 1,2$	$3,7 \pm 1,2^*$

Note: * data reliability ($p \leq 0,05$) in comparison between groups after rehabilitation

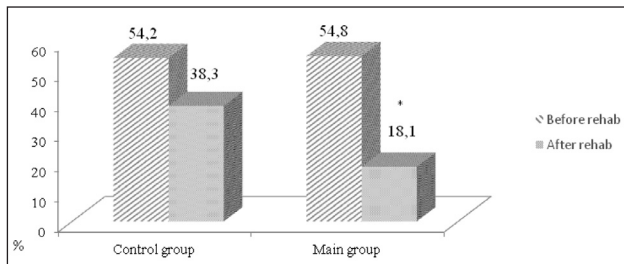


Figure 1. Dynamics of the effectiveness of treatment of patients with post-traumatic osteoarthritis of knee joints according to the questionnaire WOMAC (*data reliability $p \leq 0,05$)

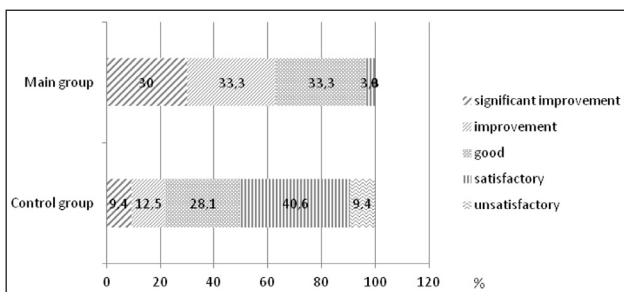


Figure 2. Evaluation of the effectiveness of rehabilitation of patients with post-traumatic osteoarthritis of knee joints after 3 months

control group the assessment of “significant improvement” and “improvement” was noted by 21.9% of patients, most patients rated their condition as satisfactory (40.6%), 9.4% of patients remained unsatisfactory (Figure 2).

Thus, the use of high-intensity pulsed magnetic therapy in the complex rehabilitation of patients with post-traumatic osteoarthritis of the knee joints makes it possible to effectively control the manifestations of pain due to the impact on all pathogenetic links of its formation. It leads to increase of functional ability and quality of life, restore of combat readiness of servicemen. This effect remains in long observation period (3 months after rehabilitation).

CONCLUSIONS

1. The use of High-intensity pulsed magnetic therapy (HIP MT) in servicemen with post-traumatic osteoarthritis of the knee joints reliably reduces the manifestations of pain according to VAS by 68.1%, decreasing of pain and increasing of functional ability according to Lequesne's algo-functional index and WOMAC index by 70.9 % and 20.2% respectively. This improves the effectiveness of rehabilitation of patients, elimination of deficit of functions, restore of combat readiness.
2. Patients who received High-intensity pulsed magnetic therapy (HIP MT) in the complex rehabilitation determined a significant improvement in quality of life according to the HAQ questionnaire.
3. Evaluation of the long-term effectiveness of rehabilitation (3 months after rehabilitation) showed improvement and stabilization of the physical conditions in almost all patients of the main group (96.6%).

4. Usage of high-intensity pulsed magnetic therapy in the complex rehabilitation of servicemen with post-traumatic osteoarthritis of the knee joints makes manage the manifestations of pain syndrome, increase of functional ability and quality of life, restore of combat readiness.

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The Authors declare no conflict of interest

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Info

IV EDYCJA OGÓLNOPOLSKIEJ KONFERENCJI NAUKOWO-EDUKACYJNEJ SENIOR CARE 2022 8 PAŹDZIERNIKA 2022 R., WROCŁAW

Konferencja jest dedykowana kadrze zarządzającej oraz pracownikom placówek świadczących całodobową opiekę długoterminową/domom seniora. Ta kolejna już edycja, cieszącego się bardzo dużą frekwencją wydarzenia, odbędzie się w tym roku 8 października 2022 roku we Wrocławiu (Congress Center Haston City Hotel****) i zgromadzi przedstawicieli prawie 200 placówek senioralnych z całej Polski, reprezentowanych przez ponad 450-osobową kadrę zarządzającą i opiekuńczą. Do udziału w konferencji zaproszeni zostali przedstawiciele instytucji oraz firm których działalność, usługi oraz produkty dedykowane są szeroko rozumianej branży opieki senioralnej.

Wydarzenie to będzie miało szczególny wymiar, bowiem poprzedzone zostanie w dniu 7 października 2022 r. spotkaniem organizacyjnym Krajowej Izby Domów Opieki KIDO, zrzeszającej wiodące placówki opiekuńcze z obszaru całego kraju. Izba pełni rolę rzecznika oraz reprezentanta placówek opieki długoterminowej wobec urzędów i organów administracji państwowej a także opiniuje i przeprowadza audyty produktów oraz usług kierowanych do tej grupy odbiorców. Idea utworzenia Izby spotkała się z bardzo pozytywnymi reakcjami środowiska holistycznie pojętej opieki senioralnej a jej dotychczasowe dokonania potwierdzają słuszność podjęcia tej inicjatywy.

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