Wpływ głębokiej stymulacji elektromagnetycznej na poziom odczuwanego bólu u pacjentów z reumatoidalnym zapaleniem stawów

Impact of the deep electromagnetic stimulation on the level of the pain sensation in patients with the rheumatoid arthritis

Agnieszka Przedborska[1(A, B, D, E, F)], **Małgorzata Misztal**[2(C, D, E)], **Jan W. Raczkowski**[1(G)]

[1]Oddział Kliniczny Rehabilitacji Pourazowej Uniwersytetu Medycznego w Łodzi, Polska/The Post-Traumatic Rehabilitation Clinical Unit of the Medical University of Łódź, Poland
[2]Katedra Metod Statystycznych Uniwersytetu Łódzkiego, Polska/Faculty of Statistical Methods of the University of Łódź, Poland

Streszczenie:

Wstęp. Leczenie reumatoidalnego zapalenia stawów obejmuje jednoczesne działanie przeciwbólowe, przeciwzapalne i regulujące napięcie mięśni. Wciąż poszukiwane są nowe, skuteczne metody terapeutyczne. Głęboka stymulacja elektromagnetyczna jest nową metodą fizykalną. Celem pracy jest ocena skuteczności leczenia bólu w reumatoidalnym zapaleniu stawów głęboką stymulacją elektromagnetyczną.
Materiał i metody. Badania przeprowadzono na grupie 50 pacjentów z reumatoidalnym zapaleniem stawów, których poddano serii 10 zabiegów głębokiej stymulacji elektromagnetycznej na najbardziej bolesny staw. Ocenę efektywności i skuteczności zastosowanej terapii przeprowadzono na podstawie skali VAS, skali Laitinena, oceny czasu trwania sztywności porannej i subiektywnej oceny wyniku leczenia dokonanej przez pacjenta.
Wyniki. Po serii zabiegów stwierdzono istotne statystycznie (p<0.0001) zmniejszenie nasilenia dolegliwości bólowych mierzonych skalą VAS i Laitinena (odpowiednio mediana (IQR): 8 (7-8) przed terapią vs 4 (3-5) po terapii dla skali VAS i 10 (8-12) przed terapią vs 6 (4-8) po terapii dla skali Laitinena). Zaobserwowano również istotne statystycznie (p<0.0001) zmniejszenie czasu trwania sztywności porannej, odpowiednio 108±27 minut przed terapią vs 67±34 minut po terapii.
Czynnikami wpływającymi w sposób istotny na efekt leczenia są: wiek, BMI oraz stopień zaawansowania zmian chorobowych.
Wnioski. Głęboka stymulacja elektromagnetyczna jest skuteczną metodą terapeutyczną u pacjentów z reumatoidalnym zapaleniem stawów, w sposób istotny zmniejszającą nasilenie dolegliwości bólowych, ilość przyjmowanych leków przeciwbólowych oraz czas trwania sztywności porannej.

Słowa kluczowe:
reumatoidalne zapalenie stawów, ból, głęboka stymulacja elektromagnetyczna

Abstract

Introduction. Treatment of the rheumatoid arthritis includes the simultaneous actions against the pain, the inflammation and to regulate the muscle tension. The search for new and effective methods of treatment is continuously under way. There appeared this new physical method of deep electromagnetic stimulation. The objective of this study is to evaluate the effectiveness of the treatment of pain with the deep electromagnetic stimulation method, in the rheumatoid arthritis disorder cases.
Materials and Methods. The research has been conducted on a group of 50 patients with the rheumatoid arthritis, who have undergone a series of 10 deep electromagnetic stimulation treatments, applied to the most painful joints. Evaluation of the effectiveness and efficiency of the therapy has been done on the basis of the VAS scale, the Laitinen scale, the assessment of duration of the morning stiffness, and the subjective assessment of the result of the treatment made by the patients.
Results. After the series of treatments, the statistically significant (p <0.0001) reduction of the pain intensity has been found, measured with the VAS and the Laitinen scale (the respective median (IQR): 8 (7-8) before the treatment vs 4 (3-5) after the treatment in the VAS scale, and 10 (8-12) before the treatment vs 6 (4-8) after the treatment in the Laitinen scale. Also observed, has been the statistically significant (p <0.0001) reduction of the duration of the morning stiffness, respectively 108±27 minutes before the treatment vs 67±34 minutes after the treatment.
The factors significantly affecting the result of the treatment were: age, BMI and the severity of the disorder.
Conclusions. Deep electromagnetic stimulation is an effective therapy method in patients with the rheumatoid arthritis, it significantly reduces the intensity of pain, the amount of painkiller medications being taken, and the duration of the morning stiffness.

Key words:
rheumatoid arthritis, pain, deep electromagnetic stimulation

Introduction

Rheumatoid arthritis (RA) is a chronic systemic disease of the connective tissue, with the autoimmune background. In the course of the disease we observe the non-specific inflammation of the symmetrical joints, the extra-articular changes and the systemic complications.

The predominant symptoms of the RA are pain and morning stiffness. These symptoms arise from the arthritis, as the inflammatory mediators are also the mediators of pain.

Pain is the reason for the increased reactive muscle tension, which leads to the overload of the passive elements of joints, their damage and deformation of the locomotor system. The resulting distortions intensify the inflammation process and pain and disrupt the biomechanics of a joint, making it difficult for the patient to function and reducing his/her activity. Chronic and oppressive ailments affect the psychology of patients, causing bad mood and depression [1, 2, 3, 4].

According to the opinion of the Expert Team of the National Consultant for the Rheumatology, the treatment of RA requires a comprehensive approach, which would include: pharmacological therapy, physiotherapy, orthopedic devices, occupational therapy and psychotherapy. The aim of all of the above is to arrest and to control the disease [5].

Effective treatment involves the simultaneous actions reducing the pain, inflammation process, regulating the muscle tension and relieving the strain. The basis for the improvement is the interruption of the so-called vicious circle, where the pain in the joint causes increase of the muscle tension, which in turn closes the damaged joint surfaces and further increases the pain [2, 3].

The basic form of the treatment in patients with the rheumatoid arthritis is the pharmacological therapy. High doses of medicines, and their long-term use, bring about a number of the unwanted symptoms, mainly in the digestive tract, liver and kidneys. Introduction of the physical therapy procedures allows to limit the amount of the administered medications [6]. In the professional medical literature, there are many reports confirming the beneficial effects of cryotherapy, laser, ultrasounds, various types of currents and a magnetic field [7, 8, 9, 10, 11]. But still, the new and more effective methods of treatment bringing relief to the suffering patients, are being looked for.

One of the newest physical therapy methods, currently being introduced, is the deep electromagnetic stimulation. It uses the variable magnetic field, with frequencies from 1 to 50 Hz and the magnetic induction of up to maximum 2.5 T [12]. The new magnetic field therapy method, with such a high induction value, can be distinguished by the tingling sensation and the vibrating tissues, clearly felt during the procedure. The actual mechanism of this, rather not widely applied therapy method, has not yet been fully explained. Lack of the studies on the impact of the deep electromagnetic stimulation on the status of the RA patients, has prompted the authors to take on this research.

Our objective has been to evaluate and compare the intensity of pain, measured with the VAS and the Laitinen scales, and the duration of the morning stiffness, before and after the treatments, in patients with the rheumatoid arthritis.

Materials and Methods

The research has been conducted in the Post-Traumatic Rehabilitation Clinical Unit of the University Hospital Clinic of WAM - CSW in Łódź. In the study participated 50 patients (37 women and 13 men), 50 to 80 years old (mean age 64,9±6.6 years), with the pain sensation accompanying the rheumatoid arthritis. The most painful joints have been treated – 26 knee joints, 13 hand joints, 11 feet joints. The average duration of the pain sensation has been 13±6 years, and in half of the patients, the maximum of 13.5 years (interquartile range IQR: 8-17 years). The shortest reported period has been 3 years and the longest 28 years. The majority of the patients were either overweight or obese (respectively: 27 (54%) and 20 (40%)). Only 3 persons (6%) were of normal weight.

In the first stage of the disease (according to the Steinbrocker's classification) there had been 18% of the patients, in the second – 76%, and in the third – 6%.

The exclusion criteria were: pain in the acute phase and the application of other physiotherapy procedures within the previous 3 months.

To carry out the research, the consent no. RNN/768/12/KB, dated 20.11.2012, has been obtained from the Bioethics Commission. All of the patients have been informed about the principles of the application of the deep electromagnetic stimulation, and have signed a written consent, agreeing to apply the treatment and to participate in the research. The patients had received 10 deep electromagnetic stimulation treatments, with the use of the Salus-Talent therapeutic device, manufactured by the BTL company. Following the manufacturer's recommendations, the automatically programmed mode A1 have been applied for the therapy.

The A1 mode uses the low frequency stimulation, as well as the frequency modulation and the amplitude modulation. Frequency modulation works in the different lengths modes, within the range from the lowest of 3 Hz to the highest of 15 Hz. Amplitude modulation works always at the constant frequency and vice versa (12). The first two treatments lasted 5 minutes, the following 8 treatments 10 minutes, and had been carried out daily. The applicator was placed at a standard distance of 1 cm from the treated area. In order to evaluate the results, the patients were examined according to the prepared research protocol, before and after the series of treatments. The examination included the assessment of the pain intensity with the VAS scale and the Laitinen scale, the assessment of the duration of the morning stiffness and the subjective evaluation of the result of the treatment by a patient.

Statistical analysis

For calculations, the statistics software package STATISTICA PL 10.0. has been used.

For the qualitative variables there has been noted the number of observations with the given quality (N), and the corresponding percentage value (%). The variables measured with the range scale have been noted with the mean value, the standard deviation (SD), the median (Me), the interquartile range (IQR) and the maximum and minimum values. For the variables measured with the ordinal scale, there have been noted the median and the interquartile range, and the minimum and maximum values.

Normality of the variables have been verified with the Shapiro-Wilk test of normality.

Due to the lack of normality in the distribution of the examined variables, to compare the intensity of pain, before and after the treatment, the non-parametric Wilcoxon signed-rank test (for the measurable variables) and the Chi-squared test for independence and the McNemar-Bowker test (for the qualitative variables).

To evaluate the interdependence between the variables, the Spearman rank order correlation coefficient has been applied.

The results have been considered statistically significant with the $p < 0.05$.

Results

Table 1 presents the data for patients, regarding the pain intensity according to the Laitinen scale, before and after the therapy.

Table 1. Data for patients, regarding the pain intensity according to the Laitinen scale, before and after the therapy

Variable		Results [N(%)]		p value
		before rehabilitation i	after rehabilitation	
Intensity of pain	no pain	0 (0%)	2 (4%)	<0.0001
	mild	2 (4%)	29 (58%)	
	strong	16 (32%)	16 (32%)	
	v. strong	26 (52%)	3 (6%)	
	unbearable	6 (12%)	0 (0%)	
Prevalence of pain	not present	0 (0%)	3 (6%)	<0.0001
	periodically	0 (0%)	17 (34%)	
	often	10 (20%)	22 (44%)	
	v. often	15 (30%)	3 (6%)	
	continuous pain	25 (50%)	5 (10%)	
Administration of medicines	none	0 (0%)	5 (10%)	<0.0001
	ad hoc	9 (18%)	13 (26%)	
	continuous small doses	19 (38%)	28 (56%)	
	continuous large doses	17 (34%)	4 (8%)	
	continuous v. large doses	5 (10%)	0 (0%)	
Physical activity limitation	none	0 (0%)	2 (4%)	<0.0001
	partial	18 (36%)	27 (54%)	
	precludes work	17 (34%)	12 (24%)	
	partial help required	15 (30%)	9 (18%)	

During the assessment of the intensity of pain before the therapy had been applied, in the majority of patients (64%) the pain was very strong and unbearable. After the therapy, there had been observed the statistically significant improvement of the intensity of pain (p<0.0001) – 4% of the patients declared there was no pain, and 58% only the mild pain.

Before the treatment, 80% of the patients felt the pain very often or continuously. After completion of the treatment, in 6% of the patients the pain was not present, in 34% it occurred only periodically, and in 44% often (p<0.0001).

The applied therapy had allowed to reduce the amount of the administered painkiller medications (p<0.0001). Before the treatment, 44% of the patients were taking the pain medications continuously, in large or in very large doses. After the therapy, this ratio had decreased to 8% and most patients (56%) had declared the continuous intake of the low doses of medications.

Before the therapy, all the patients declared the varying degrees of limitation of their physical activity, for 34% of the patients the pain made it impossible to work, and 30% needed some support in this area. After the series of treatments, there had been the statistically significant improvement noted (p <0.0001) – no limitation declared 4% of the patients and more than half (54%), only a partial reduction of their activity. The percentage ratio of those in need of the some support had decreased to 18%.

While evaluating the pain intensity with the 10-points VAS scale and the Laitinen scale, in both cases there had been the statistically significant reduction in the intensity of pain (Table 2).

Table 2. Pain intensity evaluation with the Laitinen and the VAS scale, before and after the therapy

Variable		Results		p value
		before rehabilitation	after rehabilitation	
Laitinen scale	median(IQR)	10 (8-12)	6 (4-8)	< 0.0001
	minimum-maximum	6-14	1-13	
VAS scale	median(IQR)	8 (7-8)	4 (3-5)	< 0.0001
	minimum-maximum	4-9	0-8	

In the Laitinen scale evaluation after the treatment, there was noted reduction in the intensity of pain by 40% (median (IQR), respectively: 10 (8-12) before the therapy vs 6 (4-8) after the therapy, p<0.0001). In the case of the VAS scale, the intensity of pain had decreased by half (median (IQR), respectively: 8 (7-8) before the therapy vs 4 (3-5) after the therapy, p<0.0001).

After the therapy, there was also noted the statistically significant (p <0.0001) reduction of the duration of the morning stiffness, respectively 108±27 minutes before the treatment vs 67±34 minutes after the treatment (Table 3).

Table 3. Evaluation of the morning stiffness, before and after the therapy

Variable		Results		p value
		before rehabilitation	after rehabilitation	
Morning stiffness	mean ± SD	108±27	67±34	< 0.0001
	median(IQR)	105 (90-120)	60 (45-90)	
	minimum-maximum	60-180	15-180	

In the subjective assessment of the result of the treatment, made by the patients, 62% of them have assessed the efficacy of the therapy as good and very good. 28% of the patients have evaluated the effects of the therapy as satisfactory and 10% have judged it completely ineffective.

In addition, it had been found, that there was a statistically significant, moderately strong negative correlation between the reduction in the intensity of pain according to the Laitinen scale and the age of the patient (R=-0.2961; p=0.0368), and the BMI value (R=0.3696; p=0.0083). This means, that the worse treatment results are related to the patient being older and with the higher BMI value.

The overall lasting period of the disease did have the statistically significant impact the effect of the therapy. There was the statistically significant, moderately strong, negative correlation between the reduction in the pain intensity, according to the Laitinen and the VAS scale, and the disease lasting period (respectively: R=-0.5140; p=0.0001 and R=-0.4413; p=0.0013). Therefore, the significantly worse results of the treatment had been associated with the disease being in more advanced stage.

Discussion

RA is a chronic systemic disease of the connective tissue, which reduces the physical, psychosocial and professional abilities of the patient.

Rehabilitation is an important element of the therapy, which the patients receive. The procedures applied depend on the stage of the disease and the degree of the degenerative changes. Physical treatments produce the positive results in the form of alleviating the pain, the inflammation, the swelling of joints and the reduction of morning stiffness time.

According to the scientific studies, particularly effective treatments in the case of the RA are: cryotherapy, laser biostimulation, TENS and ultrasounds (7, 9, 13). One of the commonly applied physical treatments is also the magnetic field procedure (9, 11, 14).

So far, in the magnetotherapy there have been used the alternating magnetic field with the frequencies of 0.5 to 50 Hz, and the magnetic induction from 0.1 to 20 mT; and in the magnetostimulation – the slow-alternating magnetic field with the strength of 1 pT to 100 µT, and the frequencies from a few hundred to several thousand Hz (14). In the research work of Krawczyk-Wasilewska (8) and Sieroń (14), the beneficial effects of the magnetic field of low induction have been demonstrated. Kądzioła et al. point out the raise of the pain threshold as the result of the treatment (9). Leśniewicz et al. have demonstrated the statistically

significant decrease of the intensity of pain, according to the VAS and the Laitinen scales (except for the limitation of physical activity), after a four-weeks therapy. The authors, however, indicate the better efficacy of the magnetic field treatment when it is combined with the iontophoresis (11).

Presently, there is ever growing interest in the therapy with the magnetic field, with the induction value of up to 2,5T. The research is under way, with the aim to confirm the efficacy of this therapy method for the various disease entities.

On the basis of our experiment of using the deep electromagnetic stimulation in the treatment of patients with the RA, it may be concluded that this method proves to be effective.

The assessment of the pain intensity, according to both the Laitinen and the VAS scales, carried out before and after the therapy – shows the reduction of the pain sensation. The statistically significant correlation has been found between the age, the BMI and the degree of the lesions, and the level of the pain reduction according to the Laitinen scale. The applied therapy has made it possible to limit the amount of the administered painkiller medications, and has helped to improve the day to day functioning of the patients.

Similar beneficial results of the reduction of the intensity of the pain, after the deep electromagnetic stimulation in patients with the osteoarthritis, have shown in their studies Poděbradský (12), Przedborska (15, 16), Wasilewski (17).

According to the literature, one of the symptoms that greatly limits the functioning of the RA patients, is their morning stiffness (4). This is an important element to be taken into account in the research on the efficacy of treatment in patients with the rheumatoid arthritis. Physical treatments significantly reduce the therapy duration (13).

In the report by Krawczyk-Wasielewska et al., the average time of the morning stiffness before the therapy was 1 hour and 35 minutes, and after the application of the physical treatments it was 42 minutes (8).

In our research we have also established the reduction (of about 38%) of the morning stiffness time. Before the therapy it lasted, in the examined group, on average 108 ± 27 minutes, and after therapy the average was 67 ± 34 minutes.

From the point of view of the RA patient, the decrease of the pain intensity and the reduction of the morning stiffness are the main criteria of his or her clinical improvement.

The presented clinical material is not overly extensive, and the assessment of the efficacy of the pain relieve in the rheumatoid arthritis with the deep electromagnetic stimulation does call for the further in-depth studies. However, due to the satisfactory therapeutic results achieved in our experiment, the method can provide a valuable complementary treatment in the management of pain caused by the RA.

Conclusions

1. The deep electromagnetic stimulation has a significant impact on the reduction of the pain intensity and of the painkiller medications administered due to the rheumatoid arthritis.

2. The applied therapy has significantly shortened the duration of the morning stiffness.
3. Statistically significant impact on the result of the treatment have: age, BMI and the severity stage of the disorder.

Adres do korespondencji / Corresponding author

dr Agnieszka Przedborska

Oddział Kliniczny Rehabilitacji Pourazowej
ul. Żeromskiego 113, 90-549 Łódź
e-mail: agnieszka.przedborska@umed.lodz.pl
Tel.: 42 6793144 w. 220

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