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Zindywidualizowna terapia polem magnetycznym niskich częstotliwości na przykładzie zespołu de Quervaina

Individualised low frequency magnetic field therapy, using the example of the de Quervain syndrome

Marcin Machnia[1(A,B,C,D,E,F)], Natalia Cichoń[2(E,F)], Elżbieta Miller[3(D,E,F)]
[1]Zakład Rehabilitacji, Instytut Centrum Zdrowia Matki Polki, Łódź, Polska/Polish Mother's Memorial Hospital – Research Institute, Lodz, Poland
[2]Katedra Biochemii Ogólnej, Wydział Biologii I Ochrony Środowiska, Uniwersytet Łódzki, Łodź, Polska/Department of General Biochemisty University of Lodz, Poland
[3]Zakład Medycyny Fizykalnej Katedra Rehabilitacji, Uniwersytet Medyczny w Łodzi, Polska/Department of Physical Medicine, Medical University of Lodz, Poland

Streszczenie:
W pracy przedstawiono przypadek leczenia zespołu de Quervaina polem elektromagnetycznym niskich częstotliwości (PEMF) według odmiennej procedury od dotychczas stosowanych. Pacjentka z rozpoznanym zespołem de Querwaina lewej dłoni była leczona przez kilka miesięcy w typowy sposób (unieruchomienie, farmakoterpia, fizykoterpia, kinezyterpia) bez znaczącej poprawy.
Z powodu braku oczekiwanego efektu terapeutycznego w zakresie sprawności manualnej jak i zmniejszenia dolegliwości bólowych chora została poddana terapii PEMF z wykorzystaniem biofeedbacku do określenia parametrów terapii. Procedura terapii polegała na użyciu aparatu ONDAMED generującego impuls imitujący potencjał czynnościowy komórek nerwowych z płynną regulacją parametrów (indukcja, częstotliwość, czas) umożliwiających zastosowanie biofeedbacku tętna mierzonego na tętnicy promieniowej. Zastosowana procedura diagnostyczno-terapeutyczna przyniosła po 4 tygodniach poprawę funkcji dłoni oraz ustąpienie dolegliwości bólowych. Wynik leczenia i sposób terapii opisany w pracy skłania do dalszych badań oddziaływania impulsów magnetycznych zbliżonych kształtem do potencjału czynnościowego komórek nerwowych oraz wykorzystania biofeedbacku w celowanej magnetoterapii.
Badania końcowe wykazały znaczną poprawę ruchomości pasywnej, aktywnej oraz szybkości ruchów badanej ręki. W badaniach wykazano także zmniejszenie poziomu subiektywnych odczuć bólowych chorego oraz powrót funkcji nerwu łokciowego.

Słowa kluczowe:
zespól de Quervaina, pole elektromagnetyczne niskich częstotliwości, biofeedback, magnetoterapia, ONDAMED

Abstract
Background. The paper presents a case of treatment of the de Quervain syndrome with low frequency electromagnetic field (PEMF), following a procedure different from those applied to date. A patient with de Quervain syndrome diagnosed in her left hand, had been treated in the typical fashion for several months (immobilisation, pharmacotherapy, physiotherapy, kinesitherapy) without any significant improvement.
Due to the absence of the expected therapeutic effect in terms of manual skills, or abatement of pain, the patient was subjected to PEMF therapy with the use of biofeedback, in order to determine the parameters of the therapy. The therapeutic procedure involved using the ONDAMED device, generating an impulse imitating the functional potential of neural cells with a smooth adjustment of parameters (induction, frequency, time), allowing the use of biofeedback of pulse measured on the radial artery. The diagnostic and therapeutic procedure resulted, after 4 weeks, in an improvement of hand function and cessation of pain. The result of treatment and manner of treatment described in the paper encourage further study into the effect of magnetic impulses of waveforms similar to the functional potential of neural cells and the use of biofeedback in targeted magnetotherapy.

Key words:
PEMF, biofeedback, ONDAMED, magnetotherapy, tendovaginitis

Introduction

The de Quervain syndrome (first described by the Swiss surgeon Fritz de Quervain in 1895) is a condition including tendovaginitis of the extensor pollicis brevis and abductor pollicis longus. The cause of the syndrome has not been fully identified. It is among syndromes encountered more and more frequently among persons of different age groups and occupations. The root causes of the de Quervain syndrome include, among other things, hormonal factors, as well as coinciding injuries and stress of the aforementioned tendons, caused by occupational activities, sports, and increasingly in the recent years, young people using mobile telephones for games and texting. The condition is more prevalent among women than in men. The syndrome is frequent during and after pregnancy. Frequent change of the directions of action of thumb and hand muscles leads to a conflict of synovial sheaths of thumb and hand tendons leads to a conflict of tendon sheaths and tendons with the adjacent tissues. Bone changes of the distal end of the radial bone can also deteriorate the slippage of tendons within the synovial sheath. The sheath, subject to protracted stress, reacts in an inflammatory process – congestion, oedema, exudate, followed by fibration, which leads to thickening of the walls and permanent narrowing of the light of the sheath. The first symptoms include pain in the area of the styloid process of the radius, appearing upon movement of the thumb, and then the hand, with radiation to the thumb and forearm, making it increasingly difficult to perform daily life activities.

Diagnostics of the de Quervain syndrome is facilitated by: the Finkelstein test, USG and RTG, in order to exclude bone changes of the styloid process. Treatment in the early phase of the disease uses non-steroidal anti-inflammatory and pain relief drugs (NSAIDS), and immobilisation of the wrist and hand. In case of no improvement, the tendon sheath is injected with corticosteroids, physiotherapy is administered, and eventually the synovial sheath is incised [1, 2, 3, 4].

Pulsed electromagnetic field (PEMF) has been in use in medicine for many years. Many in vitro and in vivo tests have been performed of the effect of PEMF with different parameters (impulse waveform, frequency, field intensity) upon living organisms. On the basis of statistical calculations, particular PEMF parameters have been assigned to individual diseases, which are, in many cases, stored in the memory of therapeutical devices [5, 6, 7, 8, 9, 10, 11].

Biofeedback is used in medicine and psychology as a diagnostic and therapeutic tool. Its origins go back to the nineteen fifties. Several types of widely used biofeedback were classified, based on EEG, EMG, EKG, among others [12, 13, 14, 15]. One of those methods was developed by dr Paul Nogier in the nineteen sixties, as he described the

change of the nature of pulse tested on the radial artery, caused by touching certain points on the ear lobe. The phenomenon was described as the Vascular Autonomic Signal – (VAS) or the Peripheral Arterial Tonometry (PAT) [16, 17].

Objective of the paper

The objective of the paper is to illustrate, based on the de Quervain syndrome treatment, the method of individualized magnetotherapy by adjusting magnetic field parameters with the use of biofeedback.

Case description

Patient AK, age 51, called orthopaedics outpatient clinic due to an increasing pain of the styloid process of the left radial bone, lasting for about 4 weeks, occurring upon movement of the thumb, adduction and handgrip. After a period of more or less 3 weeks, the pain began to irradiate to thumb and elbow. The ailment systematically prevented the patient from performing everyday chores as well as professional work (computer work 8-10 hours a day). RTG of patient's left wrist did not reveal any pathological changes. Oral NSAID treatment was recommended in conjunction with orthotics immobilization for 3 weeks, which subsequently was extended for 8 weeks, with the recommendation to take the orthotics off during the day for a maximum period of 4-5 hours. Due to lack of regression of symptoms and emergence of oedema on the radial side of the wrist, a USG was performed at the next call, in which tendovaginitis of the extensor pollicis brevis and abductor pollicis longus was found. Antibiotics treatment was administered: clarithromycin for 14 days, followed by amoxicillin for 7 days, without the effect of improvement of pain. There being no reaction to treatment, the patient was proposed rehabilitation and local corticosteroid injections, to which the patient did not agree. As part of rehabilitation, four 10-day cycles were held, consisting of: hydrocortisone ionophoresis, laser treatment, local cryotherapy, magnetic therapy and phonophoresis with diclofenac – treatments combined in accordance with principles, in different configurations. The patient performed the recommended exercises at home, but in situations of increased pain she significantly decreased their intensity and frequency, or discontinued exercises altogether. Pain was partly abated during treatment and for several days afterwards, but failed to provide full comfort. As the symptoms were not improved, the patient was proposed a surgery, which she did not agree to.

The patient called the Rehabilitation Outpatient Clinic a year and a half after the first ailments occurred. She was proposed pulsed magnetic field treatment with the use of the ONDAMED device (ONDAMED® system was approved in the EU as a Class IIA device in accordance with Directive no.

93/42/EEC, and as a Class IIA neurobiofeedback device by the United States FDA). The difference includes the waveform of the impulse generated and the treatment procedure. The device induces a magnetic impulse with a waveform similar to that of the activity potential of nerve cells, but shurter. The therapy involved 3 diagnostic-therapeutic modules. Diagnostics involved determining the treatment parameters using the pulse biofeedback VAS method: frequency in Hz (in the range of 0.1 to 32 000 Hz), intensity of magnetic field in mT (0.5 to 50 mT range) and duration.

Each therapeutic module was preceded by a VAS (PAT) pulse test. The patient was treated with the following PEMF parameters, and with the following applicator layout:
First module:
- frequencies of 6.34Hz and 861.07 Hz administered interchangeably,
- field intensity 2.5 (on a linear scale 1-10 represents a range of 0.5 mT to 50 mT)
- treatment duration 12 min.
- placement of applicators: flat on hand and forearm, clamp on patient's neck.
Second module – programs automatically interchanged:
- interchangeably frequencies of 8.00 and 10.00 Hz, field intensity 4.0 duration 1:30
- interchangeably frequencies of 9.00 and 13.33 Hz, field intensity 5.0 duration 1:30
- interchangeably frequencies of 3.75 and 6.00 Hz, field intensity 4.0 duration 1:30
- interchangeably frequencies of 2.81 and 7.20 Hz, field intensity 5.0 duration 1:30
- interchangeably frequencies of 4.00 and 5.00 Hz, field intensity 4.0 duration 1:30
- interchangeably frequencies of 4.50 and 6.66 Hz, field intensity 5.0 duration 1:30
- interchangeably frequencies of 7.50 and 12.00 Hz, field intensity 4.0 duration 1:30
- interchangeably frequencies of 5.62 and 14.40 Hz, field intensity 5.0 duration 1:30
Total treatment duration 12 min.
Third module
- frequency of 108, 3 Hz, field intensity 6, 0 duration 5:00

After 7 days, the patient underwent treatment consisting of the second and third module of the previous treatment and, after pulse test was performed using the VAS (PAT) method:
- interchangeably frequencies of 152.21 and 2.51 Hz, field intensity 6.0, duration 6:00
- interchangeably frequencies of 0.77 and 20.47 Hz, field intensity 8.8, duration 11:00

The third and fourth treatment were also carried out at 7 days' intervals, and were repetitions of the second treatment.
During the therapy, the patient did not use pharmacotherapy or other physiotherapeutic treatment.

Results

Four weeks after commencement of magnetotherapy (7 days after the last treatment), medical checkup was performed. The patient reported no ailments of pain. She said that she could perform all occupational and daily life activities freely, without hindrance. No oedema or tenderness was found in the physical test, there was a full range of mobility in all joints of the left hand. Finkelstein symptom proved negative. Control check after another 4 weeks did not demonstrate deviations from norm in examinations, the patient reported no ailments, and treatment ended.

Discussion

Over the period of more than a decade to date, many scientific reports have been published, confirming the favourable effect of using the therapeutic pulsed electromagnetic field. It has been demonstrated, that the effectiveness of operation of PEMF and its efficacy depends on the parameters applied, i.e.: frequency, induction, pulseform, duration of treatment and period of therapy. Depending on the applicator used, widely used magnetotherapy devices feature frequency ranges of up to 160 Hz and field intensities of up to 125 mT, with bipolar or unipolar, sine, square or sawtooth pulses [5, 8, 10, 11].
In the case of the patient, a method of magnetotherapy was used which differed from those used previously. The difference involved, among other things, the waveform of the pulses generated by the ONDAMED – a pulse similar in shape to the activity pulse of nerve cells, and the "matching" of the therapy parameters using biofeedback (frequencies, inductions, duration). In a single treatment, the patient was subjected to electromagnetic fields of different parameters: a minimum frequency of 0.77 Hz, maximum of 861.07 Hz, field intensity min. 2.5, max 8.8 in a linear scale representing a range of 1-0.5 mT, 10-50 mT. Max. treatment duration was 29 minutes. Existing literature describes studies into use of PEMF in individual diseases, comparing the operation of magnetotherapy with 2-5 different parameters, but not when used in combination on one organism, as was the case with the patient described [6, 8, 10, 11]. Literature available lacks trials connecting PEMF and biofeedback. Determining particular PEMF parameters with the use of biofeedback allowed a targeted, multi-parameter (frequencies, inductions, duration) therapy to be applied.

The de Quervain syndrome involves pain, oedema, inflammatory reaction of soft tissues [1]. Under the influence of the applied magnetic field, electric and magnetic fields are induced in tissues of a system, in accordance with the Maxwell's law, and the movement of electrostatic charges in the applied magnetic field is dependent upon Lorentz forces. Many authors emphasise that a magnetic field affects the spin states of paramagnetic particles in living organisms, including free radicals, and thus it stimulates antioxidant, anti-inflammatory and anti-oedemic effects [5, 6, 8, 10]. The effect of PEMF influences the body through the existence of the so-called Adey's biological windows, which are a range of increased biological sensitivity to the effect of an exogenous electromagnetic field, specific for a particular system. The use of the ONDAMED device with the assistance of biofeedback allowed the "Adey's windows" to be found, and therapy to be applied with individually chosen electromagnetic field parameters, bringing a favourable, quick and expected result [16, 17, 18]. The therapy used allowed the patient to revert to full mobility in a non-invasive, painless manner, without the need to apply pharmacotherapy or burdensome procedural treatment.

Conclusions

1. The therapy with pulsed electromagnetic field of complex, interchangeably applied parameters, used consecutively within a single treatment, demonstrated good effectiveness in treating the de Quervain syndrome.
2. The use of biofeedback is an effective method for determining individually matched PEMF therapy parameters.

3. A magnetic pulse similar in form to the activity potential of nerve cells, as generated by the ONDAMED, shortens the therapy and improves its effectiveness, while remaining safe
4. The effectiveness of the therapeutic method used requires further observations and studies.

Adres do korespondencji / Corresponding author

Marcin Machnia

tel.: +48 508071006,
e-mail: m.machnia@iczmp.edu.pl

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