Cryostimulation as a supporting factor in rehabilitation of patients with multiple sclerosis suffering from fatigue syndrome

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Introduction: Fatigue syndrome is listed by patients suffering from multiple sclerosis as one of the main and dominating symptoms, which occurs at 75-95% of the patients. This aspect of multiple sclerosis seems to be the most upsetting for most patients as it severely decreases their life quality. One of the distinguishing features for patients with MS is deterioration due to heat. There is little research on fatigue in multiple sclerosis. The most common evaluation for fatigue in MS is the Fatigue Severity Scale (FSS). Whole-body cryotherapy is used for treating depressive syndrome.

Research aim: Comparing the influence of whole-body cryotherapy as a supporting factor for kinesiotherapy in improving strength for selected muscle groups of lower limbs and disability of patients suffering from multiple sclerosis with chronic fatigue syndrome and without the syndrome.

Material and methods: The research included 60 randomly chosen patients with diagnosed multiple sclerosis (ICD10-G35). The results were evaluated according to the following scales: EDSS, FSS and the extended Lovett scale (marking with accuracy to 0.5 point).

The interpretation of results in FSS was done according to Krupp, et al. The fatigue syndrome was present at marks 6.5 and above. Evaluation of muscle strength concerned selected muscle groups of lower limbs: quadriceps femoris muscle, iliopsoas, biceps femoris muscle. In cases of asymmetry of muscle strength between left and right lower limb, the lower marks on the Lovett scale were taken into account.

The patients were divided into two groups depending on presence or absence of the fatigue syndrome. The study group (n=24) consisted of patients with the fatigue syndrome (marking acc. to FSS above 6.5). The control group (n=36) had marking below 6.5 acc. to FSS.

All patients underwent cryostimulation and an individual workout program adjusted to their level of disability.

Results: Using cryostimulation and kinesiotherapy for patients suffering from MS with fatigue syndrome showed statistically relevant (p=0.05) decrease in the level of disability on the EDSS, and improvement in the strength of quadriceps femoris and iliopsoas muscle in comparison with patients suffering from MS without the fatigue syndrome.

Conclusions: Cryostimulation is a factor improving kinesiotherapy for patients suffering from multiple sclerosis with fatigue syndrome.
INTRODUCTION

Fatigue syndrome is enlisted by 75-90% of patients suffering from multiple sclerosis as one of the three dominating symptoms, and 20-40% even mentions it as the main symptom. Fatigue may be general, lasting all day with slight improvements after a longer period of rest or sleep, or it may be local appearing after effort and passing after short-time rest, usually limiting itself to certain parts of body. Fatigue, apart from multiple sclerosis, may be also a symptom in other nervous system diseases or diseases concerning other systems, but it may also occur for healthy people [1].

There are both similarities and discrepancies between fatigue for multiple sclerosis patients and fatigue occurring among healthy people. In both situations the fatigue increases under stress, depression (ca. 20% of MS patients with fatigue has depression) or continued mobility. It is usually more intense in the afternoon. It often is combined with a lessened motivation to act, lack of patience, and need to rest. Improvement usually comes after relaxation and sleep [2].

Multiple sclerosis seems to be the most upsetting for most patients as it strongly influences their everyday life activities. Fatigue hinders severely (more than in case of healthy people) working professionally, family duties, and any participation in social life [3]. One of the distinguishing features for patients with MS is deterioration due to heat.

MS patients suffer from Usthoff’s phenomenon, i.e. loss or troubles with eyesight due to heat (e.g. hot bath or shower) or sometimes exertion [4]. The reason behind deterioration of symptoms in case of heat is its influence on nerve conduction in partly demyelinated nerve fibers. This results in a blockage of nerve conduction in myelin sheath gaps. The conducted research showed that heat increases fatigue for 69-92% asked patients [2]. Intensification of fatigue indicates a correlation with the level of motor disability formulated in the marking of EDSS. There were no correlations determined between fatigue and age or gender of MS patients.

Multiple sclerosis may be accompanied both by primary or secondary fatigue. Primary fatigue is directly connected to the demyelination process [3]. Secondary fatigue relates to the influence of taking medications, sleep disorders, depression, pain, and stress.

Medications which may cause fatigue include interferons alpha and beta, analgesics, anticonvulsants, anti-inflammatory drugs, muscle relaxants, sedatives, as well as antihypertensive drugs. Drug treating fatigue includes Amantadine, Modafinil, and Pemoline [2]. A widely used quantifying scale for a MS patient’s disability is the Expanded Disability Status Scale (EDSS) [5] which evaluates mobility of the patient on a 10-step scale. There is unusually little research on fatigue in multiple sclerosis. Usually fatigue in MS is evaluated by means of Fatigue Severity Scale [6], which is short and easy to use. The scale assigns marking from 1 to 7 points to each of 9 questions about different aspects of fatigue, such as physical activity, motivation to act, influence of exercises on fatigue, etc. All answers for each question are averaged.

Whole-body cryotherapy is a treatment used more and more often for patients with neurological disorders, where a chronic disease influences both the motor system, as well as the mental condition (depressive syndrome).

**Research aim:** Influence of whole-body cryotherapy on strength of selected muscle groups of lower limbs, and level of disability of patients suffering from multiple sclerosis with fatigue syndrome.
MATERIAL AND METHODS

The research included 60 randomly chosen patients with diagnosed multiple sclerosis in ages between 34 and 58. The results were evaluated according to the following scales: EDSS, FSS, and the extended Lovett scale (0-5; marking with accuracy to 0.5 point).

The interpretation of results in FSS was done according to Krupp, et al. [6]. If an average score in FSS is 2.8 that means a person is healthy. Depressive syndromes are characterized by 4.5 in score. MS patients usually are evaluated at 5.1. Fatigue syndrome was reserved for 6.5 and higher marks. Evaluation of muscle strength included selected muscle groups of lower limbs: quadriceps femoris muscles, iliopsoas, biceps femoris muscles. In case of cases of asymmetry of muscle strength between left and right lower limb, the lower marks on the Lovett scale were taken into account.

The patients were divided into two groups depending on presence or absence of the fatigue syndrome. Six patients during treatment went on with their half-year Amantadine therapy. The group with fatigue syndrome included 24 people (6 men and 18 women). The second group without the fatigue syndrome consisted of 36 people (10 men and 26 women). Both groups underwent physical examination qualifying patients for the therapy including 10 whole-body cryotherapy and individual kinesiotherapy treatments. MS must have been diagnosed at least 5 years ago. All patients were under constant control from the Multiple Sclerosis Clinic or the Neurological Clinic, which sent the patients to the Ward or Rehabilitation Clinic of the Jonscher Hospital in Łódź. Whole-body cryotherapy treatments were done in the ATOS Clinic.

The patients were instructed on the cryotherapy procedure and necessary safety precautions. Cryotherapy treatments lasted 2 minutes at start at temp. of -110°C (-166°F), but the end series were extended up to 3 minutes at temp. of -130°C (-202°F). The cryogenic chamber used by patients had two rooms: the adaptive chamber with temperature of -60°C (-76°F), and the main chamber with a range of temperature between -110°C and -160°C (-166°F to -256°F). The agent used for cooling temperature was liquid nitrogen. Kinesiotherapy included active and passive exercises, neurophysiological methods: PNF and Bobath.

STATISTICAL ANALYSIS

Due to non-parametric distribution of data Tischer test was used. The research concentrated on the level of disability and strength of selected muscle groups of lower limbs: the quadriceps femoris muscle, the iliopsoas, the biceps femoris muscle. Evaluation included results before and after treatment for both groups.

RESULTS

WBCT gave statistically relevant (λ=0.02) decrease in EDSS values, higher in the group with the fatigue syndrome in comparison to the control group. In case of muscle strength statistically relevant differences were discovered for the study group in case of the quadriceps femoris muscle at relevance level (λ=0.003), and the iliopsoas at relevance level (λ=0.0005). However, there was no statistical improvement in case of the biceps femoris muscle.
DISCUSSION

The carried out research of using cryogenic temperatures for treating multiple sclerosis resulted in a good result in decreasing the disability in terms of EDSS, and improving the muscle strength of lower limbs, influencing patients' ability to walk.

A remarkably beneficial effect of whole-body cryotherapy was observed in its influence on the mental state of patients with fatigue syndrome. This happened probably due to hormonal change in the system, increased endorphin secretion, antidepressant action, mobilization of the body due to cold, and increased physical activity [7-10]. Considerable improvement of patients with fatigue syndrome after cryotherapy may be connected to the probable antidepressant action of cold confirmed in a research done by Rymaszewska, et al. based on an antidepressant scale survey [11].

After ca. 4 minutes from the cryostimulation treatment vessels expand, and remain that way for several hours after the treatment. Tissue congestion is favorable not only to metabolism and elimination of accumulated metabolism products, but also increases oxygenation of tissues [7, 11-13].

Antioxidant effect of cryotherapy is also a clinically valid result. Free radicals take part in injuries, inflammations, and hypoxia. Reactive oxygen parts are engaged in the process of ageing and neurodegeneration diseases. Recent studies underline the antioxidant and neuroprotective factors of cold [14].

Rehabilitation based on neurophysiological and aerobic methods aided by physical therapy are key factors for activating neuroprotection, neuroregeneration, and neuroplasticity, decreasing the level of disability. MS is a disease predisposing patients to the co-occurrence of spondylosis, depressive syndromes, and fatigue syndrome, as well as other diseases that is why it seems necessary and natural to use rehabilitation for MS, and even to design a special interdisciplinary treatment program for this ailment [15].

The risk for any undesirable symptoms and contraindications is extremely low, thus using this relatively new treatment method deserves to be recognized due to safety of the procedure while taking the necessary precautions. The results of studies are encouraging, and should be a springboard for further research evaluating separately influence of cryotherapy on motor fatigue (drop in mobility during uninterrupted muscle activity) and cognitive fatigue (drop in cognitive functions during uninterrupted cognitive activity).

CONCLUSIONS

Using cryostimulation and kinesiotherapy for patients suffering from MS with fatigue syndrome showed statistically relevant (p=0.05) decrease in the level of disability on the EDSS, and improvement in the strength of quadriceps femoris muscle and iliopsoas in comparison with patients suffering from MS without the fatigue syndrome.

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