Physical medicine in the prevention of osteoporosis in the 21st century

Medycyna fizykalna w profilaktyce osteoporozy

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SUMMARY

Introduction: Physiotherapy is one of the oldest among medical specialities. Its methods are usedfor remedial and prophylactic aim. Osteoporosis is one of the most common diseases of present civilisation. Analysis of freguency of osteoporotic fracture occurrence in different countries indicates negative influence of civilisation's development on it. In Poland 25% of women and 15% of men after 50 years of age have osteoporosis. Osteoporosis treatment is long-term and multidirectional. The most important are prophylactic methods: healthy education, motor activity and physical methods.

Aim of the study: Estimation of usefulness and efficiency low-freguency alternate magnetic field (LFAMF) in the prophylaxis of bone mass loss in patient with chronic obstructive pulmonary disease (COPD).

Material and methods: subjects group 50 men with chronic spinal pain (mean age 65,2 years) treated with steroids because of COPD and which received series procedures with LFAMF. Bone density (densimeter) and pain intensification (Laitinen's scale) were estimated. Study schedule : exposure time 12 minutes to thoracic spine and 10 minutes to lumbosacral spine. 40 procedures- once a day (20 days) and next twice a week for 3 months. Procedures were repeated after 3 months.

Results: After 1 year increase (1.75%) of bone density was observed in study group which received series procedure with LFAMF.

Conclusions: Good therapeutic effects in all patients treated with LFAMF indicate purposefulness of this method in osteoporosis prophylaxis. This method should be applied in practice in wider range because of its effectiveness, easiness and no side-effects.

Key words: physiotherapy, health prophylaxis

STRESZCZENIE

Wstęp: Medycyna fizykalna jest najstarszą dziedziną wsród specjalności lekarskich, a stosowane metody wykorzystywane są zarówno w celach leczniczych , jak i profilaktycznych. Jedną z głównych chorób współczesnej cywilizacji jest osteoporoza. Analiza częstości występowania złamań osteoporotycznych w różnych krajach wskazuje na negatywny wpływ rozwoju cywilizacji na występowanie tej choroby. W Polsce osteoporozę stwierdza się u 25% kobiet i 15% mężczyzn po 50 roku życia. Leczenie osteoporozy, schorzenia mającego charakter przewlekły i postępujący jest długotrwałe i wielokierunkowe. Najistotniejsze jest więc wdrożenie metod mających charakter profilaktyczny, edukacja zdrowotna, właściwa aktywność ruchowa i stosowanie metod fizykalnych.

Cel pracy: Ocena przydatności i skuteczności zmiennego pola magnetycznego niskiej częstotliwości (zpmncz) w profilaktyce utraty masy kostnej u chorych leczonych przewlekle sterydami z powodu obturacyjnej choroby płuc (POCHP).

Materiał i metody: Badaną grupę stanowiło 50 mężczyzn (średnia wieku 65,2 lat) z przewlekłym zespołem bólowym kręgosłupa leczonych sterydami z powodu POCHP. Oceniano gęstość kości badaniem densytometrycznym i nasilenie bólu w skali Laitinena. Metodyka wykonywania zabiegów – czas ekspozycji 12 minut na odcinek piersiowy, 10 minut na odcinek L-S, seria 20 zabiegów codziennie i 20 zabiegów dwa razy w tygodniu przez 3 miesiące – zabiegi powtórzono po 3 miesiącach – dwie serie w ciągu roku.

Wyniki: W grupie badanej po rocznej obserwacji stwierdzono zwiększenie gęstości tkanki kostnej o 1,75%.

Wnioski: 1. Korzystne efekty terapeutyczne uzyskane u wszystkich leczonych zpmncz potwierdzają celowość stosowania tej metody w profilaktyce osteoporozy. 2. Wykazane działanie, łatwość wykonania zabiegów, brak objawów ubocznych przemawiają za szerszym wdrożeniem tej metody w profilaktyce.

Słowa kluczowe: medycyna fizykalna , profilaktyka zdrowia

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INTRODUCTION

Osteoporosis is one of the main diseases of our modern civilization. More than 25% of women and 10% of men over the age of 60 are diagnosed with osteoporosis. An analysis of the prevalence of osteoporotic fractures in various countries indicates that the development of civilization has a negative effect on the problem (1, 2, 6, 7, 8).

Our lives are dominated by:
- low physical activity,
- inappropriate diet,
- too much animal fats,
- too much carbohydrates and salt
- too little calcium,
- too little fresh fruit.

We have too much:
- alcohol, tobacco, coffee,
- stress,
- too little exposure to sunlight.

In Poland, osteoporosis is found in 25% of women and 15% of men over the age of 50. In the fifth decade of life the spine starts undergoing involutional changes. At first, cortical bone loss does not exceed 0.3-0.5% per year. Annual lamellar bone loss reaches 0.6-2.4% in women and 1-2% in men (3, 4, 5, 9).

Aging processes are always accompanied by the limitation of mobility and physical activity to a necessary minimum while the bones lose their natural stimulator of osteoporosis. Women develop age-related osteoporosis 2 times more often than men (1, 2, 9).

However, not everyone is affected by osteoporosis, which is connected with significant differences within populations in response to the risk factors. These include demographic, genetic, endocrine, dietary, and environmental factors as well as the use of medication, mostly glucocorticoids (1, 3, 4).

The excess of endogenous and exogenous glucocorticoids induces osteoporosis, affecting mostly, but not exclusively, the lamellar bone. They influence osteogenesis (suppression of osteoblastic activity) and indirectly increase bone resorption activity.

The use of new methods of measuring bone density (SPA, DEXA, QCT) and biochemical markers of bone turnover allows for early diagnosis and determining the degree of metabolic disturbances of the bone tissue and its density.

The treatment of osteoporosis, which is a chronic and progressive disorder, is long and multidimensional. Apart from pharmacological treatment, it is vital to introduce preventive measures:
- health education and elimination of risk factors,
- appropriate diet,
- appropriate physical activity,
- use of physical methods,
- health resort treatment.

Health education is extremely important, especially in patients with risk factors for osteoporosis. It is often necessary to change one's lifestyle as well as dietary habits and introduce appropriate physical activity. Moreover, in the case of advanced osteoporosis the patient's environment has to be altered in order to reduce the risk of fractures.

The measures aimed at preventing osteoporosis should be introduced at an early age, that is in the period of the bone mass increase, so as to achieve a high peak value of bone mass at the age of 30-35 years. The higher the bone mass at the age of 30, the lower the risk of fractures due to physiological ageing in old age.

The education is best conducted during a stay at a health resort. Everyday contact with the doctor and the staff help educate the patients who can also attend talks given by doctors, rehabilitation specialists, and dietitians. In addition, this place allows the patients to exchange experience.

Appropriate diet is a basic element of osteoporosis prevention. It is crucial to convince the patient that it is necessary to follow the instructions concerning the diet, which should be rich in calcium and vitamins while containing limited amounts of protein, salt, and alcohol.

Apart from the diet, physical exercise is the other basic part of osteoporosis prevention and treatment.

During skeletal growth, proper loading of the skeleton influences the development of a large bone mass and strong high-quality bone while proper spinal loading may slow down the osteoporotic processes during the involutional period.

We recommend exercise improving the range of motion in the joints, coordination, and general physical function and gradually introduce resistance exercises. The most important part of the treatment is proper selection of exercises and loads, depending on the severity of osteoporosis, and adapting them to the patient's general physical performance.

The treatment and prevention of osteoporosis involve light therapy and phototherapy using UV light which stimulates the production of vitamin D_3 in the skin. We recommend ultraviolet-B wavelengths ranging from 280 to 315 nm.

Sunlight is the best stimulator of vitamin D synthesis, but in our climate zone there is too little sunlight during the 5-7 colder months of the year. Consequently, in the autumn and winter it is advised to use even a simple quartz lamp as a preventive measure. Irradiation at a dose of 1 MED, which is then gradually increased by 1 MED every two days, is applied from a distance of 1 m.

A physical therapy method directly stimulating the improvement of bone density is the use of variable low frequency magnetic fields (VLVMF). Studies have confirmed that it accelerates bone union and facilitates the treatment of nonunion. Some publications report improved bone mineralization in osteoporotic patients.

In osteoporosis it is recommended to use triangular VLVMF (15 mT, 10 Hz) at the site of bone defects for 12 minutes 3 times a day during more than ten weeks.

Low- and medium-frequency electrical currents may play a supportive role in reducing the pain and inflam-

mation caused by osteoporosis. This allows the patient to follow the rehabilitation programme and take physical exercise. Iontophoresis with calcium chloride is routinely recommended in local osteoporosis. The procedure involves the use of 1-2% calcium chloride ($CaCl_2$) from the positive electrode.

Systemic cryotherapy is also recommended in osteoporotic patients. It has an analgesic and anti-inflammatory effect and relaxes the muscles. Together with a kinesiotherapy programme, it indirectly improves the range of mobility and increases muscle mass.

Recommended balneological procedures include therapeutic mud compresses on the spine and peripheral joints. Therapeutic mud components have a positive effect on the musculoskeletal system.

Kinesiotherapy procedures in brine pools allow for taking exercises with no loading, thanks to which the patients are sooner able to ambulate freely after musculoskeletal injuries or surgeries and can perform resistance exercises which strengthen the skeletal system and accelerate the metabolism of bone formation.

Therapy with natural potable mineral calcium, fluoride, and magnesium waters may be helpful in the treatment of osteoporosis as it is an additional source of calcium. These waters include fluoride waters in Cieplice and Lądek Zdrój as well as hydrogen carbonate and magnesium waters in Krynica, Polanica, Szczawno, and Duszniki. Brine from Ciechocinek contains calcium and magnesium ions.

The aim of the study was to assess therapeutic usefulness and efficacy of variable low frequency magnetic field (VLFMF) in bone loss prevention in patients undergoing long-term steroid treatment due to chronic obstructive pulmonary disease.

A morphological feature of steroid-induced osteoporosis, which differentiates it from post-menopausal osteoporosis, is a different type of the decrease in the number and thickness of lamellae. In steroid-induced osteoporosis, the number of lamellae decreases by only 10%, but their thickness drops by 30%.

Biophysical mechanisms and biological effects of VLFMF
- influence on uncompensated magnetic spins of paramagnetic elements and free radicals as well as diamagnetic molecules,
- influence on liquid crystals, especially cell membrane elements with liquid crystal properties,
- displacement of moving electrical charges,
- inducing potentials in spaces filled with electrolyte,
- influence on depolarization of cells with their own automatism,
- influence on structures with piezoelectric and magnetostrictive properties,
- intensifying the process of oxygen utilization and tissue respiration,
- vasodilatatory and angiogenic properties,
- increase in soft tissue regeneration processes,
- accelerated bone union,
- anti-inflammatory and anti-oedema effect,
- analgesic effect.

Benefits of magnetic therapy
- low level of stimuli – may be used in acute cases,
- magnetic field penetrates all body parts evenly,
- procedures may be conducted through: clothes, cast, bandages,
- metal implants and foreign bodies are not contraindications to VLFMF treatment (apart from electronic implants supporting organ function, such as cardiac pacemaker),
- effectively influences the connective (bone) tissue,
- no side effects with long-term application.

MATERIAL AND METHODS

The study group consisted of 50 men (mean age was 62.5) with chronic obstructive pulmonary disease, treated with steroids (tab. 1).

Parameters of the magnetic field used and the methods of conducting the procedure:
- sinusoidal magnetic field (bipolar),
- frequency 50 Hz,
- field strength 2.5 mT,
- exposure time: 12 min. on the thoracic section + 10 min. on the L-S section,
- series of 20 procedures daily and 20 procedures 2 times a week (3 months),
- procedures were repeated after 3 months (2 series per year).

Table 1. Steroid therapy.

Mean steroid treatment time (years) (X±SD)	Mean cumulative dose of steroids orally (Prednisone) g (X±SD)	Mean cumulative dose of steroids parenterally (X±SD) g	Mean annual dose orally (X±sd) g	Cumulative dose during vlfmf treatment (1 year) (X±sd) g		
				orally	parenterally	inhalationally
8.3 ± 4.3	3.4 ± 2.4	0.65 ± 0.43	0.44 ± 0.27	0.96 ± 0.58	0.05 ± 0.02	0.31 ± 0.19

RESULTS

Table 2. Vlfmf treatment results.

	L2-L4 densitometry				Symptom severity according to Laitinen questionnaire (X ± SD)		Number of exacerbations during 1 year (X ± SD)	
	BMD g/cm² (X ± SD)		T-score (X ± SD)					
	before treatment	after treatment	before treatment	after treatment	before treatment	after treatment	before treatment	during treatment
Mean X ± SD	1.069 ± 0.061	1.191 ± 0.068	-1.32 ± 0.27	-0.71 ± 0.23	5.9 ± 2.5	3.3 ± 1.7	2.6 ± 1.5	1.2 ± 0.8

CONCLUSIONS

1. Beneficial therapeutic effects achieved in all the patients treated with VLFMF confirm the efficacy of the method in the prevention of osteoporosis.
2. The analgesic effect of VLFMF, its ability to inhibit the process of bone tissue destruction, easily conducted procedures, and no side effects suggest that this method should be widely used in osteoporosis prevention.

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