Pulsed Magnetic Field Versus Ultrasonic in Treatment of Patients with Chronic Mechanical low Back Pain

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ABSTRACT

Back ground and purpose of the study: *Non-specific mechanical low back pain (LBP) is a major health problem that frequently restricts patient's daily living activities. The purpose of this study was to compare between the efficacy of two physical therapy modalities; pulsed magnetic field and ultrasonic on back pain, spinal range of motion, and functional activities in treatment of patients with mechanical low back pain.* ***Patients, Materials and Methods:*** *Thirty male patients with chronic mechanical LBP, age ranged from 30:45 years. The patients were assigned randomly into two equal groups: group (A) received ultrasonic therapy and exercise program; group (B) received the same exercise program plus pulsed magnetic field. The physical therapy program was applied every other day for eight weeks.* ***Results:*** *There were a statistical significant reduction in pain, increase spinal range of motion and improvement of functional activities in group B compared to group A.* ***Conclusion:*** *Pulsed magnetic field has superiority in treating patients with LBP in term of pain reduction, improvement in spinal range of motion and functional activities compared to ultrasonic therapy.*
Key words: *Magnetic field – Mechanical low back pain –Ultrasonic therapy.*

INTRODUCTION

Mechanical low back pain (LBP) remains a major diagnostic and therapeutic challenge for medical professions. It continues to represent the most common form of work related musculoskeletal disorders because its management poses significant problem to the health cares services. The size of the problem can be illustrated by the fact that patient with LBP may account for 60% of the referrals to physical therapy department[1].

Many types of physical therapy modalities have been tried with some success during this century for treating patients with LBP including spinal traction, massage, hydrotherapy, ice and heat. These physical agents are used for reducing pain and muscle spasm[2]. The usage of this type of treatment before and in combination with exercise may lead to early mobilization and improvement of functional activities[3].

Magnetic therapy is a newly born option for managing LBP that is used to reduce pain and improve joints function that can be achieved through different pathways including: increase vascularization, promote healing of the damaged cartilage, stimulate collagen and bone formation through the proliferation of fibroblasts, chondroblasts and osteoblasts[4].

It has been shown that electromagnetic field provides a practical exogenous method for cell and tissues modification[5]. So, It could be used for treating delayed fracture union, failed joint fusions and healing in musculoskeletal disorders[6]. Using of pulsed magnetic field in treating patient with LBP is a safety non invasive but relatively cost effective modality compared with other physical therapy modalities[7].

Ultrasonic is one of physical therapy agents commonly used to increase temperature in deep tissue. Its biological effects include changes in blood flow, tissue metabolism, nerve function, and the extensibility of connective tissue. During ultrasound application, percentage of waves is absorbed through the tissues and this leads to the generation of heat within that tissue[8]. The physiologic responses attributed to thermal mechanism including: increased collagen tissue extensibility, pain threshold, enzymatic activity and changes in the contractile activity of skeletal muscles[9]. Thermal effects decrease muscle spindle activity, or relieve pain, resulting in a break down in the pain- spasm - pain cycle[10].

Authors mentioned that the optimal management of LBP is still under debate[11,12]. The purpose of this study was to compare between the efficacy of pulsed magnetic field and ultrasound in treating patients with chronic mechanical low back pain.

PATIENTS, MATERIALS AND METHODS

Thirty male patients with chronic mechanical LBP, based on neurological assessment and MRI on the spine, participated in this study. Duration of illness was not less than three months. The patients did not suffer from motor or sensory disturbance in the lower limbs. Age ranged from 30 to 45 years. The patients were selected from Out-Patient Clinic, Faculty of Physical Therapy, Cairo University.

Patients were excluded if they had leg length discrepancy, history of visceral pathology that could refer pain to back, surgical approach at lumber area, spinal canal stenosis, spinal cord compression, spinal tumor, fracture, infection or inflammatory disease affecting the spine, disc prolapsed, spinal deformity (kyphosis, scoliosis), advanced arthritis in hip, knee or ankle joint and if they had any contraindication to exercises (e.g. uncontrolled hypertension, myocardial infarction). The aim and procedures of the study were explained to all patients before their informed consent was given.

Instrumentations

1- Visual Analogue Scale VAS[13] (0 :10 cm.): Straight line as (0= no pain) and (10= worst pain) was used to assess pain intensity pre and post treatment.
2- Functional activities measurements: The functional activities of each patient were measured by using disability questionnaire[14]. It consists of 12 daily living activities.
3- Back range of motion (BROM) instrument was used to measure back ROM. It is a modified protractor goniometer. It consists of: flexion / extension and rotation / lateral flexion units that use an inclinometer and a compass on a positioning frame and a magnetic booster. The positioning frame consists of two slip-resistant feet, which are approximate 15 centimeters apart and rest against the patient's back. The magnetic booster provides a stable magnetic field for the compass, which in turn provides quick response and accurate readings.
4- Pulsed magnetic field device (ASA magneto therapy, automatic PMT Quattro PRO, 00001543) consists of an appliance, motorized bed and applicable solenoids which can be move in four different positions according to the treatment area.
5- Pagani ultrasound apparatus (pulson 200) consists of multi-frequency (1:3 MHz),

head surface area 4 cm², Continuous and pulsed mode, voltages (100- 240-VAC, 50/60 HZ) with maximum power (85 VA).

Procedures

All assessment and treatment procedures were done at Faculty of Physical Therapy, Cairo University. All patients underwent the same evaluation protocol which included the followings:

- Back pain was assessed by using VAS pre and post treatment sessions.
- Disability questionnaire was used to measure the level of daily activities. Each patient was asked to mark, which of 12 every day activities were conformable. High disability index (DI) indicated low level of function activities while low score indicated high level of activities.
- Back ROM assessment[15]: Patient was instructed to stand upright and assumed comfortable erect posture with body weight evenly distributed on feet, hands were hanged loosely beside the patient. Each patient was given three warm-up repetitious for each movement to provide a pre-condition stretch to the soft tissue of the lumber spine in each plane of motion:

- For flexion ROM measurement; the patent was instructed to bend forward as far as he can trying to reach his finger tips to the floor, As the patient moves, slide the arm along with the upper measurement point (Fig.1a).
- For extension measurement; the patient was instructed to bend backward as far as he can. The reading was the difference between the base line measurement and position of full extension.
- For rotation measurement; the arrow of the compass was adjusted to zero before each rotation measurement. The patient was instructed to twist his trunk to the right side as far as he can without exceeding the comfortable rotation (Fig. 1b).
- For lateral flexion measurement; each patient stood parallel to the wall to avoid substitution pattern of forward trunk flexion. The positioning frame was leveled at the upper measurement point so that the needle of the inclinometer pointed to zero. The patient was instructed to slide his hand down the side of thigh and try to reach his knee while maintaining his weight over the opposite foot.

(a) (b)

Fig. (1): The flexion\ extension unit (a) and rotation\ lateral flexion unit (b) of the back range of motion instrument (BROM).

Treatment procedures

Patients were randomly assigned randomly into two equal groups (A and B); group A received treatment program in the form of pulsed ultrasound therapy and modified spinal flexion exercise program. Group B received the same exercise program in addition to pulsed magnetic field. The patients in both groups received treatment session every other day for eight weeks.

-Modified spinal flexion exercise (MSFE) program[16]:

1- Standing to squatting (45°) exercise by using wall bar for more stabilization.
2- Sitting on a chair and leaning forward.
3- Sit up exercise in the form of curl up and sitting with flexed knee.
4- Gradual knee to chest exercise.
5- Cross sitting and leaning forward.

Each exercise was done in two sets/ session. Each set has five repetitions with one minute's rest between each repetition and five counts hold before the patient returned to starting position.

-Ultrasonic Therapy: Group A received pulsed US for 15 minutes (3 MHz, 1W/cm^2) on paraspinal area of the lumbar region from prone lying position. Transmission gel was applied on the head of US device before the application.

-Pulsed Magnetic Field[17]: Group B received pulsed magnetic field from prone lying position. The patient was exposed to low intensity 20 G PMF with low frequency 20Hz for 20 minutes /session.

Statistical Analysis

Descriptive statistics (mean and standard deviation) were done for all variables. The t-tests were used to compare values of measuring outcomes within and between two groups. The P-value < 0.05 was taken as significant.

RESULTS

Demographic characteristics of both groups presented in (Table 1). There were no significant differences between the two groups regarding age, weight, height and symptoms duration (P>0.05).

Table (1): Demographic data of the patients in both groups (A and B).

Characteristics	Group A mean ±SD	Group B mean ±SD	P-Value
Age (year)	35.07±2.25	36.42±3.29	NS
Weight (kg.)	85.26±17.23	82.47±8.45	NS
Height(m.)	172.4±5.2	170.6±6.7	NS
Duration of symptoms(month)	7.31±1.93	8.65±1.3	NS

NS= non significance. SD= standard deviation.

The results revealed that the mean values of back pain decreased post treatment from 7.22±2.32 to 3.30±3.5 for group A and from 8.20±2.15 to 2.97±1.15 for group B. This reduction in pain was statistically significant in both groups (P<0.001). The same trend was observed in the values of disability index (DI) with significant reduction post treatment in both groups (P<0.001) as shown in table 2.

Table (2): Comparisons between mean values of pain (VAS) and disability index (DI) Pre and Post treatment within both groups (A and B).

Variable	Group	Pre		Post		P-Value
		Mean	SD	Mean	SD	
Pain intensity (VAS)	A	7.62	2.32	3.30	3.5	0.001*
	B	8.20	2.15	2.07	1.15	0.001*
Disability index (DI)	A	0.64	0.27	0.22	0.13	0.001*
	B	0.67	0.15	0.09	0.01	0.001*

* Significance at P<0.05. SD= standard deviation.

Comparisons between both groups related to pain intensity and DI showed that there were no significant differences between both groups pre treatment while statistical significant differences between both groups with P values (0.002 & 0.001) showed post treatment. The results revealed that pain reduced in G2 than in G1 as well as the disability index (table 3 and fig. 2).

Table (3): Comparisons between mean values of pain (VAS) and disability index (DI) between both groups (A and B) post treatment.

Variable	Group A		Group B		P- value
	Mean	SD	Mean	SD	
Pain intensity (VAS)	3.30	3.5	2.07	1.15	0.002*
Disability index (DI)	0.22	0.13	0. 10	0.01	0.001*

* Significance at P<0.05 SD= standard deviation

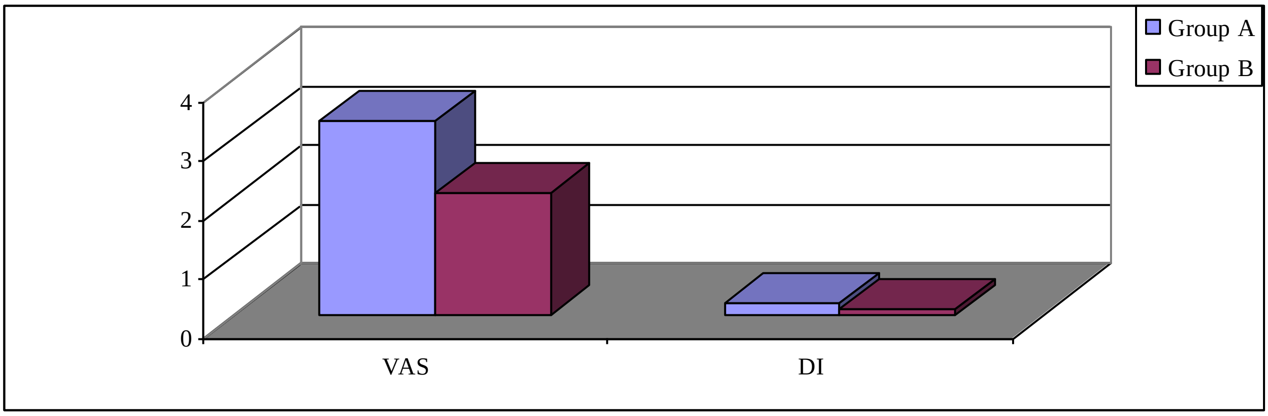

Fig. (2): Mean values of back pain (VAS) and disability index (DI) post treatment in both groups (G1 and G2).

The results of back ROM measurements showed that there were significant differences for all back movements between group A and group B post treatment in favor to group B (P<0.05). Observation of the data revealed that maximum increase in ROM was obtained in flexion followed by lateral flexion, side rotation, and extension movements.

Table (4): Comparisons between mean values of back ROM between both groups (A and B) post treatment.

Back ROM	Groups				P-Value
	Group A		Group B		
	Mean	SD	Mean	SD	
Flexion	24.9	5.32	32.1	6.25	0.003*
Extension	6.63	3.15	9.21	2.29	0.004*
Left side rotation	12.1	3.53	18.7	3.75	0.002*
Right side rotation	13.0	4.17	18.5	4.19	0.001*
Left lateral flexion	17.9	6.20	25.3	5.34	0.001*
Right lateral flexion	20.10	6.53	26.12	7.85	0.001*

* Significance at $P<0.05$ SD= standard deviation

DISCUSSION

This study was conducted to compare the efficacy of pulsed magnetic field and ultrasonic on pain intensity, back ROM, and functional activities in treatment of patients with mechanical LBP. The results showed significant gains in pain reduction (as determined by decrease VAS scores), increase in the back mobility (ROM) and improvement of function activities (reduced DI) after treatment in the patients who were treated with pulsed magnetic field compared to the patients who received ultrasonic therapy.

The findings of the present study agreed with the previous studies which examined the use of magnetic field in treating patients with LBP and explained that the analgesic effect of low intensity magnetic field could be attributed to one of the following physiological mechanisms; First, the reversible blockage of action potential firing including blocking of sodium dependant action potential firing of sensory neurons and calcium dependant response to the irritant[18]. Second, the molecular mechanism of the magnetic field involves conformational changes in the ion channels and/or neural membrane as well as its ability to modulate the action of hormones, antibodies and chemical neurotransmitters at some receptor sites of certain cell types which could enhance pain reduction[19].

In contrast to other physical therapy modalities which may evoke hyperthermia, proteolysis enzyme activity, increases the cartilage destruction and potentially induces swilling, pulsed magnetic field application may be a thermally less. Besides its ability to closely mimic the effects of mechanical stimuli, pulsed magnetic field could be especially useful for those patients who can not exercise readily without pain. Moreover, the magnetic field considered as pain refining intervention due to its pre-synaptic inhibitory effect which in turn reduce pain fiber excitability[19,20].

The findings of the present study come in contact with the study of Brown et al.,[21] who stated that magnetic field therapy result in significant improvement in disability and reduce pain when active magnets are worn continuously for four weeks in patients with chronic pelvic pain.

Magnetic therapy has been used as a safety and less side effect new trend for pain management. The use of magnetic field has proven to be much more effective even when the conventional druges have failed for pain management[22]. The improvement of the functional activity in the present study may be attributed to the positive analgesic effect of magnetic field which lead to decrease back pain and increase ROM which were reflected on the functional level.

These results are greatly supported by the work of Fischer et al.,[23], who reported that pulsed magnetic therapy has a beneficial effect on the joint blood flow leading to reduction of the inflammation, enhancing bone and cartilage healing and providing greater joint mobility if it is applied over a longer period from eight to twelve weeks.

Conclusion

Pulsed magnetic field has a superior effect in reducing back pain, increasing back mobility and functional activities than ultrasonic therapy in patients with mechanical chronic low back pain.

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الملخص العربي

المجال المغناطيسي المتردد مقابل الموجات الصوتية في علاج مرضى ألم أسفل الظهر الميكانيكي المزمن

يعد ألم أسفل الظهر من أهم المشكلات التي يمكنها أن تعوق المريض عن ممارسة نشاطه اليومى. تهدف هذه الدراسة إلي مقارنة تأثير المجال المغناطيسي المتردد مقابل الموجات الصوتية على شدة الألم ومدى الحركة للظهر و القدرة على أداء النشاطات الوظيفية في المرضى الذين يعانون من ألم أسفل الظهر الميكانيكي المزمن . أشتملت العينة على 30 مريض من الذكور تراوحت اعمارهم بين 30 - 45 سنة، تم تقسيمهم عشوائيا إلي مجموعتين: مجموعة (أ) عولجت ببونامج من التمارين العلاجية بالاضافه الى الموجات الصوتيه،و مجموعة (ب) عولجت بنفس برنامج التمرينات العلاجيه مع إضافة المجال المغناطيسى وذلك لمدة شهرين متتاليين بمعدل جلسة يوم بعد يوم . تم قياس مدى الحركة للعمود الفقري و شدة الألم و القدرة على أداء النشاطات اليومية وذلك قبل وبعد تطبيق البرنامج العلاجي فى كلا المجموعتين وقد أسفرت النتائج عن تحسن درجة الألم و زيادة المدى الحركى للعمود الفقري والقدرة على أداء النشاطات اليومية فى كل من المجموعتين بعد العلاج الا أن معدل التحسن أعلى و ذو دلالة إحصائية في مجموعة (ب) بالمقارنة بمجموعة (أ) . ويستنتج من هذه الدراسة إن المجال المغناطبسى المتردد أفضل من الموجات الصوتيه في التأثير على شدة الألم و مدى الحركة للعمود الفقري والقدرة على أداء النش اطات اليومية في مرضى ألم أسفل الظهر الميكانيكي .