PROSTAGLANDIN E2 LEVELS IN THE EVALUATION OF MANAGEMENT OF OSTEOARTHRITIS USING PULSED ELECTROMAGNETIC FIELD – AN INTERVENTIONAL STUDY

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Abstract: Knee pain is one of the most frequent musculoskeletal problems among the middle-aged and elderly people and 'Osteoarthritis' is the widespread clinical pathology of the knee. **Objective:** The present study was conducted to evaluate whether low frequency Pulsed Electro Magnetic Field (PEMF) therapy is effective in patients with osteoarthritis knee using surface Electromyography (sEMG) of vastus medialis. **Methods:** The participants were subjected to Pulsed Electromagnetic Field Therapy using the PULSATRON instrument designed by Madras Institute of Magnetobiology, Anna nagar. They were given PEMF therapy of 10 Hz for 60 minutes/ day for 21 days with a break after every 6 days. Serum PGE2 levels are measured by invitro ELISA method. Serum Prostaglandin E2 levels are estimated before and after PEMF therapy. **Results:** The study shows that Low frequency PEMF (10 Hz) can be used as a treatment modality for Osteoarthritis. PEMF therapy, when given for a sufficient time (21 days) has shown to reduce the inflammation by decreasing the levels of the inflammatory marker Prostaglandin E2. Serum PGE2 levels were found to be significantly decreased ($p < 0.001$) in the study group following the Pulsed Electro Magnetic Field (PEMF) therapy.

Keywords: Low frequency PEMF, Serum PGE2

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INTRODUCTION

Osteoarthritis causes degradation of joints, articular cartilage and subchondral bone[1]. About 40% of the elderly Indian Population suffer from osteoarthritis, 2% among them experience crucial pain and disability.[2] Females are affected more severely with osteoarthritis with more number of joints involved particularly the knee and hand.[3] Osteoarthritis is broadly classified into two main categories – Primary osteoarthritis and Secondary osteoarthritis.[4] The Primary form of osteoarthritis occurs due to an idiopathic etiology. The secondary forms of osteoarthritis occur as a consequence of some underlying pathology. The common etiologies include: Congenital, Post surgery, injury, Endocrine, Metabolic, Rheumatologic and Neurological.

Patients of osteoarthritis knee present with knee pain, stiffness, swelling of the joint, cracking with joint movement and decreased function of the joint. A longstanding osteoarthritis knee left untreated leads to severe functional disability. The limitations are due to the cartilage defect, erosion and fusion of the joint and muscle stiffness. Most of the treatments at present are aimed at pain reduction, improving the joint stiffness and maintenance of joint function.

Inflammation is the defense mechanism of the body in response to the injury involved in Osteoarthritis. It is an advantageous event which results in elimination of pathogenic factors and restoration of normal function of the tissues. The failure of the acute phase of inflammation to terminate the deterioration will progress to chronic inflammation and tissue damage.[5] The inflammatory mediator PGE_2 is responsible for all three established signs of inflammation – redness, swelling and pain. Redness and edema are due to the fact of increased blood supply to the inflamed tissue produced by the local arteriolar dilatation. Pain results from the action of

PGE_2 on the sensory neurons at the peripheral and central sites .[6]

Pulsed Electromagnetic Field (PEMF) is a modern therapeutic device used in treating many clinical conditions. Though the clinical application of PEMF is still under controversy, it is being widely used as a treatment modality over the past two decades and has shown to decrease pain, inflammation and stiffness in patients with osteoarthritis.[7] The mechanism behind this is the increase in blood supply to peri-articular compartment due to synthesis of nitric oxide.[8]

This study focuses on evaluating whether the low frequency and low-intensity Pulsed Electromagnetic Field (PEMF) therapy is effective in osteoarthritis by assessment of inflammation by estimating the level of Prostaglandin PGE_2 before and after administration of Pulsed Electro Magnetic Field Therapy.

BASELINE PARAMETERS		
S. No	Variable	Mean ± SD
1.	Age (in years)	62.08±4.36
2.	Duration of osteoarthritis (in years)	3.46±1.53
3.	BMI	27.57±2.59

MATERIALS AND METHODS

An interventional study was conducted in the Institute of Physiology and Experimental Medicine, Madras Medical College in collaboration with the Institute of Geriatrics, Rajiv Gandhi Government General Hospital, Chennai from April 2015 to March 2016. Fifty patients between 50 to 70 years of age with osteoarthritis knee having symptoms for atleast one year duration were included in the study after obtaining Ethical approval from Institutional Ethics Committee (IEC), Madras Medical College, Chennai. Patients with chronic disorders were excluded from the study.

Methodology:

The participants were subjected to Pulsed Electromagnetic Field Therapy using the PULSATRON instrument designed by Madras Institute of Magnetobiology, Anna nagar. They were given PEMF therapy of 10 Hz for 60 minutes/ day for 21 days with a break after every 6 days (protocol designed by Madras Institute of Magnetobiology). Blood samples are collected under strict aseptic precautions by venepuncture of antecubital vein and serum is separated by centrifugation. Serum PGE2 levels are measured by invitro ELISA method. Serum Prostaglandin E2 levels were estimated before and after PEMF therapy.

Statistical Analysis: After collection, data were checked for consistency and completeness. Then the data was entered in database Statistical Package for the Social Sciences (SPSS) software version 21. The Paired Student's t test was carried out to compare the mean of variables before and after administration of Pulsed Electro Magnetic Field therapy.

RESULTS

The present study was done to evaluate whether low frequency Pulsed Electro Magnetic Field (PEMF) therapy is effective in patients with osteoarthritis knee by estimating the level of Prostaglandin PGE_2 before and after administration of Pulsed Electro Magnetic Field Therapy.

The mean age of the individuals included in the present study was 62.08 ± 4.36 years with the 50 to 70 years. The mean duration of symptoms of osteoarthritis in study subjects was 3.46± 1.53 years. The average BMI was found to be 27.57 ± 2.59.

Blood samples are collected under strict aseptic precautions by means of venepuncture of antecubital vein and serum is separated by centrifugation. Serum PGE2 levels are measured by invitro ELISA method. Serum Prostaglandin E2 levels were estimated before and after PEMF therapy.

Table 2**:** Comparison of mean values of the of PGE2 levels before and after PEMF therapy

Variable	Group	N	Mean	SD	P –Value

Prostaglandin E2 levels	Before PEMF	50	471.16	104.94	<0.001***
	After PEMF	50	290.65	74.14	
*** P – Value < 0.001 Very Highly Significant					

Table 2 shows that the Serum PGE2 levels were found to be significantly decreased (p <0.001) in the study group following the Pulsed Electro Magnetic Field (PEMF) therapy.

DISCUSSION

The present study revealed that Low frequency PEMF (10 Hz) can be used as a treatment modality for Osteoarthritis, when given for a sufficient time (21 days). Similar results are shown by various studies found in the literature. Fini et al stated that PEMF being applied at 75 Hz, 1.6 mT, 6 hrs per day for three months proved to prevent the development of osteoarthritis in aged guinea pigs.[9] Aaron and Ciombor et al examined the effects of PEMF in a decalcified bone matrix. The observations were noted with the increase in matrix synthesis which is stimulated by the proliferation of mesenchymal cells.[10] Ciombor et al had proved the enhanced synthesis of cartilage under the effect of themagnetic field applied at a burst of 4.5ms duration and further repeated at 15 bursts. [11] De Mattei et al observed the anabolic effects of PEMF in the cartilage at different ranges of exposure length (1,4,9 and 24 h), different frequencies (2, 37,75 and 110 Hz) and magnitudes (0.5, 1, 1.5, 2mT).[12]

Although the osteoarthritis is a non- inflammatory disease, various cytokines, prostaglandins and reactive oxygen species are believed to play important roles in pathogenesis.[13] The degenerative actions of PGE2 on the chondrocytes are exerted through the EP4 receptor which activates the enzyme adenylcyclase through G proteins resulting in the accumulation of intracellular cyclic adenosine monophosphate.[14] Lawand et al stated that Pain in osteoarthritis is contributed mainly by factors like increase in inflammation occurring at early stages of arthritis and destruction of articular cartilage.[15] The genetic studies conducted by Sato et al proved that there was an elevation in the expression of the terminal synthase microsomal prostaglandin synthase (mPGEs) which was essential for the COX-2 derived PGE2 production in the diseased cartilage.[16] PGE2 induced *pain reduction was seen* during magnetic field exposure by modulating the exogenous and endogenous opioid systems in a study conducted by M.Kavaliers et al.[17] Senthil Kumar V et al observed a decrease in lysosomal activities in arthritis rats on exposure to PEMF. [18.] Studies done by Chang et al noticed a reduction in levels of TNF-α and IL-6 in ovariectomised rats which were exposed to PEMF for 7 days with different intensities of electric field. [19]

CONCLUSION

The study shows that Low frequency PEMF (10 Hz) can be used as a treatment modality for Osteoarthritis. PEMF therapy, when given for a sufficient time (21 days) has shown to reduce the inflammation by decreasing the levels of the inflammatory marker, Prostaglandin E2. Hence, PEMF, a novel approach, can be used in treating chronic osteoarthritis knee adjunctive to the pharmacotherapies that are currently in use.

Limitation of the study: Further studies including a large number of diabetic and hypertensive participants and assessment of the efficacy of PEMF therapy by other markers of the disease should be done.

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