Original work

Pulsed electromagnetic fields and ozone in the treatment of knee osteoarthritis in the elderly

Pulsed electromagnetic fields and ozone in the treatment of the knee Arthrosis in elderly Patients

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• Short title of the article: PEMF and ozone in the treatment of osteoarthritis of the knee.

SUMMARY

Objective: To evaluate the effect of pulsed electromagnetic fields for the treatment of osteoarthritis of the knee and the combination of these with intra-articular injections of ozone in the elderly.
Method: A prospective, longitudinal was performed in 90 patients over 60 years of age with clinical and radiological diagnosis of knee osteoarthritis grade II and III refractory to medical treatment, who attended the consultation ozonoterapia polyclinic Ramp the period from January to March 2014. the sample was divided into three groups: 1) Control, they were applied NSAIDs 2) was applied 15 therapy sessions with pulsed electromagnetic frequency (PEMF). 3) They were given 10 sessions of intra-articular infiltrations with ozone. They were evaluated before and after completion of treatment with a six month follow up study extending to December 2014, the variables studied were: the degree of clinical improvement, the minimum amount of applications that improvement is achieved, the incidence of adverse events.
Results: The protocol used with PEMF therapy for osteoarthritis of the knee was much higher than the application of NSAIDs with a statistically significant difference ($p < 0.5$) and the results were even better when combined with intra-articular injections with ozone. In the groups treated with ozone and pulsed electromagnetic frequencies with no adverse events were reported, with the application of aines gastrointestinal adverse events and high blood pressure were presented.
Conclusions: Treatment with pulsed electromagnetic fields and intra-articular injections with ozone to knee osteoarthritis grade II and III are safe and effective methods when applied as monotherapy and when combined potentiate each other.

Keywords: pulsed electromagnetic fields, knee osteoarthritis, ozonoterapia

SUMMARY

Objective: Evaluate the effect of pulsed electromagnetic fields as treatment for arthrosis of the knee and combination of These With intra-joint infiltration of ozone in elderly Patients.

Method: A longitudinal and prospective study was Performed in 90 Patients older than 60 years of age, with clinical and radiological diagnosis of grade II and III knee arthrosis resistant to medical treatment, WHO Attended ozone therapy consultation at the Policlinic Ramp Between January and March of 2014. The population was divided in three groups: 1) Control, Non Steroid Anti-Inflammatory was administered. 2) 15 sessions of pulsed electromagnetic fields (PEMF) Were administered. 3) 10 sessions of ozone therapy intra-joint infiltration Were administered. These groups Were EVALUATED Before and After the treatment, with the following variables being Studied: the degree of clinical improvement, the

minimal amount of therapy applications to Achieve improvement and the incidence of side effects.

Results: The protocol used formally PEMF therapy for arthrosis of the knee was very superior to the application of NSAID's with a statistically Important difference ($p < 0.5$) and the results even better Were When They Were combined With intra-joint infiltrations of ozone . In the groups Treated With ozone and pulsed electromagnetic fields Were not there side effects reported almost as in the groups for Treated With NSAID's gastrointestinal There Were high blood pressure and elevated Manifested side effects.

Conclusion: Treatments With pulsed electromagnetic fields and ozone infiltrations intra-joint arthrosis of the knee for grade II and III are safe and effective methods When applied as monotherapies and potentiate When combined Between them.

Key Words: Pulsed electromagnetic fields, arthrosis of the knee, ozone therapy

INTRODUCTION

Osteoarthritis of the knee or also called osteoarthritis localized in the knee is a very common disease whose prevalence increases with age1, and significantly affects the quality of life of patients with the disease, is a disease with great social and economic costs associated with the current knowledge indicates that this condition is multifactorial, abandoning the concept of pure degenerative disease and recognizing the importance of the component in fl amatorio.2 are indicated in symptomatic osteoarthritis moderate or severe nonsteroidal antiinflammatory drugs (NSAIDs), when there has been good response to paracetamol in inflamatorios3 outbreaks since its analgesic effect it is superior to paracetamol in knee osteoarthritis (grade a, level of evidence Ia), although its use is limited by its effects adversos4. They are effective in relieving symptoms and improve functional capacity but do not modify the course of the disease.5

The use of anti-inflammatory requires monitoring of liver and kidney function and blood counts at the start of administration and thereafter at regular intervals during treatment to prevent indeseables.6 effects in the elderly in order to avoid accumulation NSAIDS of choice are the short plasma half-life, such as diclofenac and ibuprofen, which are better documentados.7 There is evidence that both therapy with pulsed electromagnetic fields (PEMF) 8.9 and infiltrations ozono10 have a beneficial effect and do not cause adverse events that occur NSAIDs

In studies results in favor of PEMF were found to decrease pain, stiffness and improve the quality of life in patients with knee osteoarthritis, however, a significant inverse correlation between patients over 65 years of age11 found

It has been reported that ozone is a biological response modulator, which is manifested by the tendency to normalization of blood glucose and other metabolites in patients undergoing this treatment. 12, 13

It has been postulated that the possible mechanism of action is related to ozone generation of byproducts. It has been suggested that the compounds formed as organic peroxides and Ozonides are in adequate and controlled amounts exert different biological actions that provide ozone a set of therapeutic properties such as improved tissue oxygenation, immune modulation and release of autacoids, besides having broad spectrum germicidal effect and function as regulatory metabólico.14

One of the most important properties possessed ozone for use in medicine, the antioxidant effect is exerted through the stimulation of enzymes belonging to the antioxidant system. 15, 16

In order to determine the effects of therapy with electromagnetic frequencies pulsed combination with intra-articular injections with ozone in the symptomatic progression of osteoarthritis patients located at knee level II and III as classified by the American College of Rheumatology 17, is conducted a prospective longitudinal randomized study in the department of Ozonoterapia the Policlinico Rampa, in the period from January to December 2014. randomly selected a sample of 90 patients over 60 years old with more than five years of having diagnosis of osteoarthritis of the knee, which had received different treatments for this condition getting any or light or medium improve its clinical symptoms.

MATERIAL AND METHODS

The sample was divided into three groups of 30 patients each:

1) Control, was applied therapeutic nonsteroidal anti-inflammatory drugs (ibuprofen 400 mg every eight hours for 15 days.

2) Ozone intraarticular, intra-articular injections were administered with ozone dose of 20 ml of ozone at a concentration of 20µg / ml three times a week, to complete 10 sessions.

the anteromedial approach was used for intra-articular injection. The technique employed was as follows:

Patient sitting with bent leg around 90; the injection is 1.5 to 2 cm depending on the adipose tissue, into the tip of the patella using 27 G needles by one-half inches, meeting the aseptic measures established for this proceeding; puncture was performed in slightly obliquely backward and inward to feel a sense of emptiness that allows easy penetration of the Ozone-oxygen mixture without resistance; previously he aspirated to realize that was not within a blood vessel.

3) Therapy with pulsed electromagnetic fields: They were given 10 sessions of magnetic therapy on the affected at a rate of three times a week knee follows: the patient sitting with bent leg around 90; he was placed in the form rope-oriented handle most painful area, and was stimulated for three minutes, he rested for five minutes and was repeated three minutes to 30 kHz and 60 Gauss (check this please).

All groups were assessed before and after treatment, at three and six months after completion of the same, the variables studied were: the degree of clinical improvement (pain and joint mobility) and the minimum amount of applications that is achieved improvement.

Inclusion criteria

1. Patients over 60 years and both sexes.
2. Patients who consented to be included in the study.
3. Diagnosis of knee osteoarthritis localized chronic phase of the disease grade II and III. Knee joint pain most of the days in the last month, more femorotibial radiographic osteophytes, morning stiffness less than or equal to 30 minutes Crepitus with the active mobilization of the knee

Exclusion criteria

1. below 60 years of age
2. No consent to be included in the study.
3. patient's mental or neurological deficit.
4. Presence of recent trauma to the joint.
5. Suspicion of another associated joint injury.
6. Affections of the hip joint or Tibiotalar that impact on joint mechanics.
7. acute phase of the disease.

8. History of prior ulcer disease
9. Liver Disease
10. active chronic alcohol abuse
11. Treatment with anticoagulants and / or corticosteroids
12. debilitating disease associated
13. Patients with electronic implants

Exit Criteria
1. Voluntary departure of the study.
2. No more than 2 consecutive sessions of treatment.
3. Present irregularity in treatment.
In the interrogation and physical examination data of interest as age, sex, predisposing factors, duration, previous treatment, joint mobility and adverse reactions were obtained, among others.
He was informed correctly the patient about his illness, he was advised to avoid overloading joints (use sticks if necessary), Rest of the joint when there is pain and exacerbation of symptoms and strengthening exercises of the quadriceps femoris

Measuring instruments
the perceived pain by visual analog pain scale (VAS) and function was evaluated by administering the questionnaire WOMAC (The Western Ontario and McMaster Universities Osteoarthritis Index) .11 This scale includes three basic aspects among which are titrated five items pain, stiffness and physical two items 17 items, classified as a quantitative function discrete variable (points scored)
Pain intensity: 5 items maximum possible score 20
Joint stiffness: 2 items maximum possible score 8
Functional capacity: 17 items maximum possible score 68
Your score ranges between 0-96 points, meaning that the fewer points is obtained, the patient presents more functionality.
To measure the intensity of pain visual analogue scale (VAS) and subjective pain measurement method was used. It consists of a line of values from 0 through 10. The leading 0 means no pain and 10 on the far right, maximum tolerable pain between the two extremes there are intermediate values from 1 to 9 in an increasing order. The patient once the procedure has scored in each session, the intensity of pain on the scale explained.
0 1 2 3 4 5 6 7 8 9 10
An evaluation was also performed considering the following categories
• 0: no pain
• 1-2: Very mild
• 3-4: Leve
• 5-6: Moderate
• 7-8: Intense
• 9-10: Very Intense

The evaluation criteria were as follows:
Very good: pain down three levels in relation to the first evaluation.
Good: pain down two levels in relation to the first evaluation.

Regular: pain low level relative to the first evaluation.
Bad: the pain remains the same in relation to the first evaluation.
Very bad: pain intensity worsens in relation to the first evaluation.
the beginning of improvement is considered from the meeting at which there is a minimal change two figures on the scale of EVA
In addition an assessment of the mean value for pain measured by WOMAC questionnaire per treatment group considered for assessing the response was performed:
0 = None 1 = A little 2 = Somewhat 3 = Much 4 = Very Much

As for joint mobility Mobility:
ν Extent of movements:
- Deflection: 0º-130º active, passive 0º-145º.
- Extension: 0º active, passive -10º.
- Rotations: 10th.
the incidence of adverse events in the three groups was also evaluated during the study
statistical processing.
A statistical analysis was performed on a scale of response of three values by ordinal logistic regression method, using Confidence Interval 95% for a proportion considering the improved and unimproved (binomial) in the three groups.

RESULTS
Characterization of the sample by age and sex
Tables 1 predominance of aged from 66 to 70 years with 31 patients (34.5%) and 60 to 65 with 28 patients (31.1%), followed by the group of 71-75 years is shown 15 (16.7%). As for sex 59 patients (65.5%) were female sex and 31 (34.5%) males, the average age for women and 69.05 years for men and 69.7 years 69.2 for both sexes.
Tables 2 and 3 general sample information is specified in terms of sex and age per treatment group behaving evenly across the three groups no disagreement with the hypothesis of risk ratios ($p > 0.05$) was detected at it was considered appropriate any conclusion drawn from the fit of the regression Cox
Table 1: Characterization of the sample by age group and sex
sex Total
Age group Male Female
No no no %
60-65 12 38.7 16 27.1 28 31.1
66-70 12 38.7 19 32.3 31 34.5
71-75 5 16.1 10 16.9 15 16.7
76-80 2 6.5 12 20.3 14 15.5
Over 80 0 0 2 3.4 2 2.2
Total 31 100.00 59 100.00 90 100.0
Source medical history N = 90

TABLE 2: Treatment groups by sex
Tto groups. Sex
Female Male

No Patients% Patients% Not
Group 1 NSAIDS
Group 2 ozone-PEMF
Group 3 PEMF
Total 18 60.0% 12 40.0%
20 66.7% 10 33.3%
20 66.7% 10 33.3%
58 64.4% 32 35.6%
Source medical history N = 90 30 (per group)

Table 3: Average ages for treatment groups
Tto groups. Age
Mean Standard deviation Minimum Maximum No Patient
Group 1 NSAIDS 68.97 5.744 60 80 30
Group 2 ozone-PEMF 69.23 5.992 60 82 30
PEMF Group 3 69.67 6.222 60 81 30
Source medical history N = 90 30 (per group)

the number of sessions required for each patient to obtain an improvement using survival analysis techniques modeled. In this case the time variable is the number of sessions, the event in question is whether or not improvement and predictor is the group (taking group 1 as control) was considered that the improvement began when there was minimal change 2 units on the scale of EVA.

Table 4: Number of sessions that improvement begins
Group 1 Group 2 Group 3
Sessions Amelioration Amelioration Amelioration
1 0 December 14
2 0 14 December
3 0 4 3
4 0 0 1
5 4 0 0
More than 5 26 0 0
Total 30 30 30
Source: History of a primary N = 90 30 (per group)

The median number of sessions required for patients to achieve an improvement was 7 ([5, 9] 95% CI) for Group 1, Group 2 was 2 ([1, 3] 95% CI) and 3 ([1, 4] 95%) in group 3. noting that groups 2 and 3 are the same but both are better than group 1.
pain intensity was assessed, joint stiffness and functional capacity by administering the questionnaire WOMAC, pain was also evaluated by visual analogue scale VAS pain
In the analysis of pain evaluated by questionnaire WOMAC treatment no difference between the groups before treatment behaving evenly across the three groups it observed that there is a statistically significant difference in pain reduction between them, the best group which he was followed Ozone-PEMF group where only Penfield was used was applied, both better than the group that was applied

NSAIDS (tables 5 and 6) the results were maintained at three and six months after treatment.

TABLE 5: Behaviour of pain before and after treatment (ANOVA)
Sum of squares df Mean Square F Sig.
Pain Before 2 2,411 4,822 Between groups, 505, 605
Groups within 4.778 415.667 87
Total 420.489 89
Pain After 2 234.100 468.200 Between groups 100,131, 000
203.400 87 groups within 2,338
Total 671.600 89
Table 6: Percentage reduction in pain after treatment in the three groups
Pain treatment groups -Pain Before After% reduced pain
Group 1 NSAIDS 4.4 31.3613685
Group 2 ozone-PEMF 9.47 69.63235294
Group 3 PEMF 7.47 55.33333333
Total 7,11 51.85995624

Table 7: Descriptive Statistics for WOMAC pain assessment
N Mean Standard Deviation 95% confidence interval for the mean Minimum Maximum
Lower Limit Upper Limit
Pain Before NSAIDS Group 1 30 14.03 2.297 13.18 14.89 10 18
Group 2 ozone-PEMF 30 13.60 2.010 12.85 14.35 10 17
Group 3 PEMF 30 13.50 2.240 12.66 14.34 8 18
Total 90 13.71 2.174 13.26 14.17 8 18
Pain After NSAIDS Group 1 30 9.63 1.629 9.03 10.24 7 13
Group 2 ozone-PEMF 30 4.13 1.196 3.69 4.58 2 7
Group 3 PEMF 30 6.03 1.712 5.39 6.67 2 10
Total 90 6.60 2.747 6.02 7.18 2 13

As for the stiffness significant difference between before and des was obtained for each group and between each group ($p < 0.05$) to give a much higher response in the group treated with PEMF in connection with the group treated with NSAIDs group group, comparing the group treated with the combination of PEMF and intraarticular ozone infiltrations latter group had better results (tables 8.9, 10 and 11)

Table 8: Descriptive Statistics for stiffness
N Mean Standard Deviation 95% confidence interval for the mean Minimum Maximum
Lower Limit Upper Limit
Before stiffness NSAIDS Group 1 30 5.93 1.258 5.46 6.40 3 8
Group 2 ozone-PEMF 30 5.43 1.104 5.02 5.85 3 7
Group 3 PEMF 30 5.57 1.073 5.17 5.97 3 7
Total 90 5.64 1.154 5.40 5.89 3 8

After stiffness NSAIDS Group 1 30 4.37 1.129 3.95 4.79 2 7
Group 2 ozone-PEMF 30, 77, 898, 43 1.10 0 3
Group 3 PEMF 30 2.43 1.040 2.04 2.82 0 4
Total 90 2.52 1.794 2.15 2.90 0 7

Table 9: Percentage reduction in joint stiffness after treatment in the three groups
Stiffness treatment groups Before After%-stiffness pain stiffness
Group 1 NSAIDS 26.306914 1.56
Group 2 ozone-PEMF 4,66 85.81952118
Group 3 PEMF 3,14 56.37342908
Total 3,12 55.31914894

TABLE 10: joint stiffness behavior before and after treatment (ANOVA)

Sum of squares df Mean Square F Sig.
Among groups stiffness Before 2,011 1,527 4,022 2, 223
Within groups 87 114,600 1,317
Total 118.622 89
Among stiffness After 194.756 2 97.378 92.387 groups, 000
Within groups 87 1,054 91,700
Total 286.456 89

Table 11: Multiple comparisons of stiffness
Bonferroni
Dependent variable (I) Tto groups. (J) Groups Tto. Mean difference (I-J) Standard Error Sig. 95% confidence interval
Lower Limit Upper Limit
After stiffness NSAIDS Group 1 Group 2 ozone-PEMF 3,600 *, 265, 000 2,95 4,25
Group 3 PEMF 1,933 *, 265, 000 1,29 2,58
Group 2 Group 1 NSAIDS ozone-PEMF -3.600 *, 265, 000 -4.25 -2.95
Group 3 PEMF -1.667 *, 265, 000 -2.31 -1.02
Group 1 Group 3 PEMF NSAIDS -1.933 *, 265, 000 -2.58 -1.29
Group 2 ozone-PEMF 1,667 *, 265, 000 1,02 2,31
*. The mean difference is significant at the 0.05 level.

During the study, no adverse events occurred in the groups treated with PEMF and treated with ozone-PEMF, not the case in the group treated with NSAIDs where three adverse events of causality likely were presented according to the criteria of Uppsala Monitoring Center 16, of light intensity according to the criteria of Claudio Naranjo 17 with treatment interruption, which quickly recovered

Table 12: Incidence of adverse events per treatment group.

Adverse events Group 1
NSAIDS Group 2
PEMF ozone-Group 3
PEMF
Raises blood pressure 2 0 0
Nausea 1 0 0

DISCUSSION

Knee osteoarthritis is a condition which is eminently clinical diagnosis based on patient signs and symptoms, risk factors and alterations in the physical examination. The classic presentation of this condition is in patients over 50 years of age with chronic pain of mechanical characteristics, which is higher than initiating movement, can I decrease subsequently associated with stiffness greater than 30 min and deformity of joints with loss of joint ranges, crepitus and spill, now it recognized as a multifactorial disease which is damaging articular cartilage with subsequent response of the synovium and subchondral bone 18, in this way, when the extracellular matrix agrees chondral a decrease is generated the water holding capacity and tissue wasting resistance against compression elasticity 19.20, increasing damage surrounding tissue.

Due to the low rate of cell turnover and poor reparative capacity cartilage fails to compensate the damage suffered, being generated osteoarthrosis regardless of the original cause of the damage, the fibroblasts of the synovium respond by secreting various cytokines and factors in fl amatory (IL-1, TNF, TGF, IL-8, Gro, etc.). 21,22, 23

The insu response sufficient subchondral bone replaces the hyaline cartilage by fi brocartílago consists mainly of type I collagen, which confers him a lower mechanical capacity 24,25

Every cell in the body functions as a transmitter and a receiver of electromagnetic information and are precisely those frequencies which correspond to precede or biochemical functions. Normal cells oscillate with different frequencies to diseased cells, therefore, the biological activity is the product of interaction energy. The cellular response to electromagnetic radiation is known as inductive coupling.

Electromagnetic forces act intracellularly producing biochemical responses characterized by mobilization of electrolyte through the cell membrane, excretion of toxic products, protein synthesis, stimulation of cellular metabolism, link generation high energía.26

The magnetic fields produced biochemical, cellular, tissue and systemic effects. Initially it produces deflection of charged particles in motion, producing induced intra- and extracellular which generates a piezoelectric effect on bone and collagen currents also the solubility of various substances in water, thus a general stimulation of metabolism is generated cell, with normalization of potential altered membrane favors a direct stimulation of cell tropism, manifested by stimulation in the synthesis of the energy required by the body for its function at the cellular level thereby increasing cell division, synthesis protein and prostaglandin production which gives it an anti-inflammatory effect. 27

If we consider that magnet therapy has different biological effects at the biochemical level, subcellular, cellular and tissue, as well as evaluating the therapeutic effects derived from these biological effects, then you can get an idea of all processes in the which can be influenced by the fields magnéticos.28 29

The National Institutes of Health (NIH) of the USA accept treatment with electromagnetic fields at least for the following indications: bone repair and chronic tendon injuries, nerve stimulation, wound healing

and varicose ulcers, osteoarthritis, electropuntura, tissue regeneration, stimulating the immune system and neuroendocrine modulations. 30 Other authors have expanded this list by adding: control pain, trauma and injury, reduction of inflammation and improvement in blood circulation, fibromyalgia, infectious processes (antimicrobial effects), specific treatment of malaria, stress reduction, correction of neurological disorders, increased physical energy and athletic performance, etc., 31.32
Electromagnetic fields most commonly used for medical diagnosis and treatment are called pulsed electromagnetic fields (PEMF for its acronym in English). Your application starts in 40 in Japan, but until 1979 when the Food and Drug Administration (FDA) supports its use in the United States to stimulate bone repair in non-union fractures. A decade later, the FDA approved its use for the treatment of pain and edema in soft tissues superficiales.33
The good results obtained in this work with the application of PEMF therapy may be due to pulsed electromagnetic fields influence cell behavior by inducing changes in cell membrane potential and increased tissue oxygenation, activating cell regeneration, also because increases calcium transport and stimulating the repair cartilage growth and simultaneously decreases dolor34
In addition laboratory studies have revealed that electromagnetic fields can stimulate new bone formation, indicating a potential of electromagnetic stimulation in the treatment of fractures that failed to function consolidar.35
The results obtained in this study correspond to that reported in the literature where it is stated that the pulsed electromagnetic field therapy (PEMF) produces a rapid and substantial reduction of pain in patients with knee osteoarthritis temprana.36
Moreover it arises that ozone has antiinflammatory effect explained by its ability to compounds oxidize containing double bonds, including arachidonic acid and prostaglandins, biologically active substances synthesized from said acid and participating in high concentrations in development and maintenance inflamatorio37 process, has been referred to the intraarticular ozone infiltrations have a beneficial effect in the treatment of knee osteoarthritis. 38
The mechanisms of action of PEMF and medical ozone producing an antiinflammatory effect can be enhanced as it was found in the results of this study.
Regarding the incidence of adverse events only it occurred in the group that was applied Ibuprofen. (Table 12)

CONCLUSIONS

After all the above it can be concluded that the protocol applied in this study, treatment with PEMF applied independently and combined with infiltration intraarticular ozone is effective and safe for the symptomatic treatment of osteoarthritis of the knee over 5 years of evolution in patients older than 60 years.

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