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MAGNOTHERAPY AS ADJUVANT MODALITY IN PAIN MANAGEMENT IN FUNCTIONAL REHABILITATION

Veterinary Science

Daniel Nunes Faculdade Medicina Veterinária, ULHT, Portugal

Inês Viegas Faculdade Medicina Veterinária, ULHT, Portugal

Sónia Campos Faculdade Medicina Veterinária, ULHT, Portugal

António Ferreira Faculdade Medicina Veterinária, Universidade Lisboa, Portugal

Ângela Martins Faculdade Medicina Veterinária, ULHT, Hospital Veterinário da Arrábida/Centro Reabilitação Animal da Arrábida, Portugal

ABSTRACT

A multimodal approach to functional rehabilitation is crucial for the patient's positive recovery process. This article focuses on the use of Magnotherapy as an adjunctive modality in pain management in patients with neuropathic and inflammatory pain. The objectives of this study consist in verifying if the use of low frequency pulsed electromagnetic fields (PEMF-LF) has any effect in pain management and consequent benefit to the patient's rehabilitation during a functional rehabilitation protocol. This study included a sample of 40 dogs, evenly parted into 4 groups. Groups A and C contained only patients with pain of neuropathic origin and groups B and D contained only patients with pain of inflammatory origin. The four groups followed the same functional rehabilitation protocol with the only variable being the application of Magnotherapy in groups A and B, with C and D serving as control groups. The results have shown significant and quantitative differences in group B when compared to group D, supporting the theory that patients with pain of an inflammatory origin benefit from the use of magnotherapy. However, groups A and C had a very similar development over the observation period. The use of magnotherapy has also shown the added benefit of allowing patients to obtain a greater muscular relaxation, when compared to patients from the control groups.

KEYWORDS:

Magnotherapy; Functional Rehabilitation; Neuropathic pain; Inflammatory pain; Pain Management.

Introduction

Magnotherapy is a modality that theoretically helps in relieving pain, increasing well-being and reducing stress. With that said, some scientists defend that it can be useful in raising the chances of a successful functional rehabilitation protocol and decreasing patient's hospitalization time.

However, there's controversy between experts, being that some stand to the opinion that the clinical studies that are available still don´t demonstrate solid results that allow the acceptance of this modality as a therapeutic choice.

This study aims to contribute to this scientific discussion, and it does so by verifying the benefits of magnotherapy in dogs' rehabilitation functional protocol with neuropathic or inflammatory pain, for a better understanding of this study we advise to read the "Review Article- The importance of Magnotherapy in Functional Rehabilitation, in a sub-analysis for pain".

Material and Methods

The observation period ran between December 2015 and July 2016, in Arrábida Animal Rehabilitation Centre (CRAA), Portugal.

This clinical study involved the comparison and analysis of four distinct groups.

1. Group A- Dogs with neuropathic pain put through a rehabilitation protocol with magnotherapy as a supplementary modality;
2. Group B- Dogs with inflammatory pain put through a rehabilitation protocol with magnotherapy as a supplementary modality;
3. Group C - Dogs with neuropathic pain put through a rehabilitation protocol without the use of magnotherapy;
4. Group D- Dogs with inflammatory pain put through a rehabilitation protocol without the use of magnotherapy;

The total sample had 48 specimens, but 8 incurred in one of the exclusion criteria, therefore the final sample was 40 specimens.

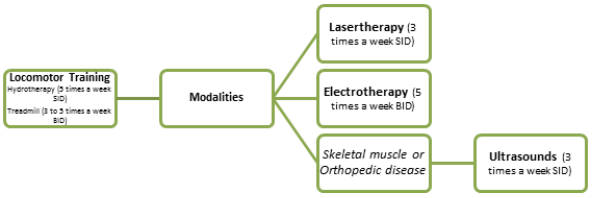
All the case studies had a follow up of one month in permanent hospitalization. With all the inclusion criteria fulfilled, the dogs were randomly allocated to the four groups, therefore, this study can be classified as a Randomized controlled trial.

The inclusion criteria were dogs without any specific criteria relative to genre, race or age; dogs with orthopedic or skeletal-muscle disease and inflammatory origin pain; dogs with neurological disease with upper neuron motor lesion and neuropathic origin pain, dogs with polyradiculopathy that originated spastic muscles; All the included dogs had a minimal presence of one trigger point in one of the limbs, regardless of the muscle group or limb.

The Non- inclusion criteria were any patient that wasn't a dog; dogs with neurological disease with lower neuron motor lesion, without muscular spasticity; dogs with orthopaedic disease with metal plates or any material that wasn't compatible with magnotherapy; dogs diagnosed with any disease that could compromised the results viability, like endocrine diseases; dogs treat with corticotherapy or NSAIDs (Nonsteroidal Anti-Inflammatory Drugs) with less than 7 days of washout; dogs without deep sensitivity.

The exclusion criteria were dogs that didn't end the established protocol or that needed deep alterations to their therapeutic protocol; dogs that died or had been euthanized during the observation time; dogs that started their treatment with relieve pain drugs, with the exception of the use of Gabapentin 5 mg/bid and Tramal 2 mg/bid in dogs that exceeded grade 2 in the Colorado Pain scale, due the necessity of a multimodal approach and the patient´s well being; dogs with any disease that forced the end of rehabilitation protocol; dogs that lost deep sensitivity.

Functional Rehabilitation Protocol



Groups A and B were also submitted to magnotherapy (PEMF-LF) 3 times a week in the first and second hospitalization week and 2 times a week in their third and fourth hospitalization week.

The Magnotherapy sessions were performed with the use of an BTL-4920 equipment and with an BTL 239-3 arc, in which, the established protocol followed the parameters from the relieve pain protocol of human medicine.

The intensity of electromagnetic fields were 42 mT/10, with a frequency of 18,86 Hz and rectangular pulses with 42 ms breaks between them.

Each session had duration of 30 minutes and they were performed in an isolated room. Every specimen was put through these sessions. However, while dogs from group A and B (test groups) were effectively undergoing magnotherapy, dogs from groups C and D were just resting without receiving said therapy.

Evaluated Parameters

Every dog that took part in this case study was evaluated according to 4 distinct parameters: trigger points evaluation scale, vital parameters before and after undergoing magnotherapy, the Colorado canine chronic pain scale and an Owner questionnaire based on HCPI-E2

Trigger Points Evaluation Scale

Trigger Points Evaluation Scale (TPES) was created with the purpose of verifying the presence of local pain sites in muscle groups of the anterior and posterior limbs.

TPES evaluates trigger points in the distal and centre region of the muscle mechanoreceptors, giving each affected limb a total maximum of 6 Points, 3 points in extensor muscles and 3 points in flexors muscles.

None of the individuals of this case study had more than two affected limbs, therefore, hypothetically, the maximum possible trigger points for those dogs would be twelve points, and by taking this into account, the TPES results were divided into three groups; 0-3: Excellent prognosis, 3-8: Moderate prognosis and 8-12 points : Severe prognosis.

Theoretically, patients with the worst prognosis would have a slower evolution, because pain limits the patient's performance in functional rehabilitation training.

The first evaluation was made in the first consultation, the second after a week of hospitalization, the third evaluation in the third hospitalization week and the last evaluation after a month of hospitalization.

Vital parameters pre and post magnotherapy

Before and after each magnotherapy session, the dogs cardiac output and respiratory frequency were evaluated, with a 5 minute interval before incurring on the measurement of these vital parameters, in order for the dog to have a acclimatization period to the room.

Colorado canine chronic pain scale

The Colorado canine chronic pain scale (CCCPS) consists in three important scores, Psychological & Behavioural (That was defined as Pain score 1 (Ps1)); Postural (That was defined as Pain score 2 (PS2)); Response to Palpation (That was defined as Pain score 3 (PS3)), resulting the arithmetic mean of the three Pain scores in a Global Pain Score (GPS).

The CCCPS evaluation and respective pain score was performed in day 0, 7, 14, 21 and 28 of hospitalization in each case study.

The individual observation and evaluation of each case study was done during a minimal period time of 10 minutes, being the observation period divided in three parts, the first one was the observation of the dog while it was resting, the second observation was performed while the dog was walking and the third one was it's response to palpation.

Owner questionnaire

The Owner questionnaire was adapted from HCPI-E2. In spite of it being used mainly as an orthopaedic disease questionnaire, it was found to be the best one within the available questionnaires, since it could be used with good results in both orthopaedic and neurological disorders.

The Owners answered the questionnaire in two different occasions, before the beginning of functional rehabilitation protocol and after one month of hospitalization.

In order to achieve the best interpretation of the given results, a number was assigned to each answer, being the highest score possible of 55 points, which corresponded to negative answer to every question and a minimum of 11 points, that was indicate that all the answers had a positive response.

Statistical Analysis

Statistical analysis of the collected data during the observation period was organized using Microsoft Office Excel 2010 and analysed with IBM SPSS Statistics 22.0. software.

Taking into account the sample number dimension (more than 30 individuals), It was considered the normality of data (Ghasemi & Zahediasl, 2012), whereby the choice of the appropriate parametric tests was made.

Descriptive Statistical Analysis

The first analysis's step consisted in a descriptive analysis of quantitative variables.

In categorical parameters like genre, race, diagnose and owner questionnaire answers it was performed a frequency analysis.

Inferential statistical analysis

The inferential statistical analysis was made using ANOVA test and T-Test with a statistical significance level equal or less than 0,05.

The aim of those tests was to find statistical significance differences in the means of the several evaluated parameters, in groups evolution over the hospitalization time period.

ANOVA test was applied for means comparison in the variables weight, age, pain score and trigger points. Additionally the Post-Hoc Tukey HSD Test was used to evaluate the data obtained for those variables.

T-Test was applied for means comparison of the variables weight, age, pain score and trigger points between the groups that underwent magnotherapy (Group A and B) and the groups that didn't undergo magnotherapy (group C and D).

The variables: cardiac output and global pain score; were analysed under the Pearson product-moment correlation coefficient.

Results

The total sample had 40 specimens (n=40) which were distributed evenly into 4 different groups. Groups A and C only had dogs with

neuropathic origin pain and groups B and D only had dogs with inflammatory origin pain.

The variables genre and age were very similar between the groups without any significant statistical difference, however, in the variable class weight, group A had demonstrated significant statistical differences in comparison with groups B and D, as you can see in table 1.

Table 1- Post-hoc Tukey HSD for class weight mean comparison between groups

Variable			Mean difference	Significance
Class weight	A	B	-5,6700	0,037
		C	-5,3800	0,053
		D	-10,3400	0.000
	B	A	5,6700	0,037
		C	0,2900	0,999
		D	-4,6700	0,119
	C	A	5,3800	0,053
		B	- 0,2900	0,999
		D	- 4,9600	0,087
	D	A	10,3400	0,000
		B	4,6700	0,119
		C	4,9600	0,087

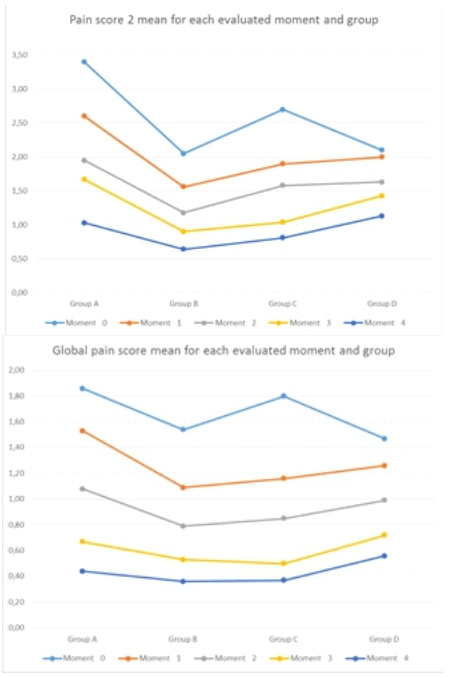
Pain score

The first approach to the pain score scale was to find significant differences in individual Pain scores evolution and global pain score between the groups that had the same pain origin.

In dogs with pain of neuropathic origin (Groups A and C) it's possible to observe very similar evolution regarding the Global Pain Score (GPS), graphic 1, along all 5 observation periods.

When it comes to dogs with pain of inflammatory origin (Groups B and D), in spite of having a similar GPS mean in the first observation momentum (Group B (1,54); Group D (1,47)), the downward trend in group B appears to be bigger than in group D, which is frankly noticeable in the last observation period (Group B (0,36); Group D (0,56)). When focusing on individual Pain score analysis, the differences are even clearer, especially in Pain score 2, which evaluates the evolution of postural response and gait.

Graphic1- Global pain score mean for each evaluated moment and group

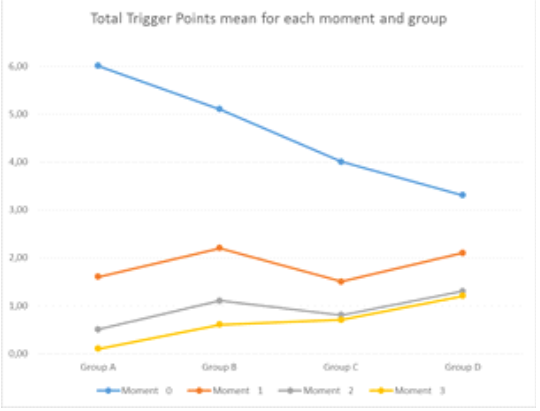


Even though quantitative differences appear to exist in groups A and C, regarding Pain score 2, graphic 2, the statistical analysis did not demonstrate any difference between these groups. However the quantitative differences between group B and D were supported by statistical analysis, as it is possible to assess in table 2.

Table 2- Anova test for Pain score 2 in group B and D

PS 2				Mean difference	Significance				Mean difference	Significance
	Group B	0	1	,490	,406	Group D	0	1	,100	,999
			2	,870	,024			2	,470	,745
			3	1,150	,001			3	,670	,429
			4	1,410	,000			4	,970	,109
		1	...	...	...		1	...	...	...
			4	,920	,015			4	,870	,183

Graphic 2- Pain score 2 mean for each evaluated moment and group



While in group B we can see significant statistical differences in the means between observation periods 0 to 2, 3 and 4, as well as in 1 to 4, in group D there wasn't any significance statistical differences between any observation periods, regarding to Pain score 2.

Trigger Points

At the first observation period, observable in graphic 3, it is clear that group A shows the highest trigger point mean (6 points), followed by groups B (about 5 points), C (4 points) and D (3,5 points).

After the first week of hospitalization, all groups had a big downward trend; however, when evaluating the third and last hospitalization week, it's possible to assess that the groups that went under magnotherapy (A and B) appear to continue its' descendant tendency while groups that did not undergo magnotherapy appear to stagnate.

It is also curious to see that the obtained line in the first momentum completely reverses its form in the last evaluation momentum. Graphic 3- Total trigger Points mean for each moment and group

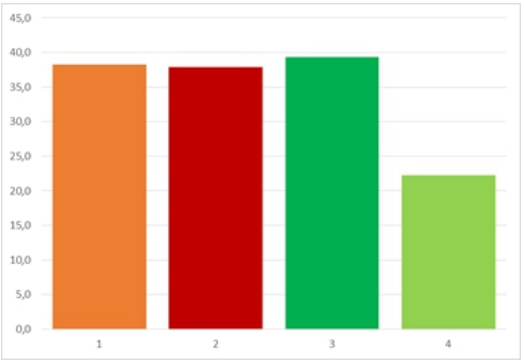
Vital parameters

The obtained results regarding cardiac output and respiratory frequency were inconclusive, as the Pearson product-moment correlation coefficient, possibly due intrinsic and extrinsic factors during data collection.

Owner questionnaire

Generally speaking, owners in all the groups found the functional rehabilitation protocol to be beneficial; however, when you look at graphic 4, which compares the percentage difference between the two evaluated periods, it is obvious than even the owners considered that group D had the worst evolution when compared to the group with the same pain origin (group B).

Graphic 4- Owner questionnaire- Percentage difference between the two evaluated periods



Discussion

The sample showed a rather uniform distribution, the exception being the variable "class weight" in group A, which had statistically significant differences in comparison with groups B and D.

The variable "Pain score" was very similar between groups with the same pain origin in the first observation period, providing good consistency to the interpretation of this variable during the following evaluation periods.

The application of a magnotherapy protocol, more precisely Low frequency pulsed electromagnetic fields (PEMF-LF), seemed to favour a faster and more positive evolution in dogs with pain of inflammatory origin (Group B), when compared with the Control group (Group D).

The results were similar to the conclusions of Rogachefsky et al. (2004), Pinna et al. (2013) and Sullivan et al. (2013), which stated that magnotherapy could be useful for a better recovery in dogs with 1orthopaedic or skeletal muscle diseases, as well as some human medicine clinical studies like Boopalan et al. (2009) and Zhang et al. (2014) that pointed to the advantages of the use of this physical modality in those pathologies.

Concerning dogs with pain of neuropathic origin, the test group (group A) and the control group (Group C) had a similar evolution during the various observation periods, despite the conclusions from Omar et al (2013) and Szajkowski et al (2014) that have been defending the use of magnotherapy in some neurological diseases.

Physical modalities, according to Sharp (2010), contribute to reduce pain and increase muscle mass, improving the patient's functionality.

The global Pain score didn't exhibit any statistically significant differences between groups with the same pain origin; however, there were evident quantitative differences in the groups with pain of inflammatory origin.

Looking at the individual Pain scores we found that Pain score 2 had quantitative and statistically significant differences when comparing groups B and D. Taking the first observation period into account, where the mean of pain score 2 is similar in groups B and D, it is logical to conclude that group B had a better evolution regarding functionality.

The hypothesis that arose from those results, like Millis & Levine (2014) stated, was that by reducing pain, there's an increase in physical performance, which contributes to a faster and more efficient functional recovery.

"Trigger point" was defined by Gerwin (2010) as a local pain site in skeletal muscle system, associated to a hypersensitivity and tension in the muscle band.

Trigger point scale was useful to ascertain if magnotherapy could have any effect as a modality to reduce muscle tension.

Although all the groups had a significant descendant tendency when comparing trigger point mean in the first and last observation periods, possibly due to the multimodal approach done by Functional Rehabilitation, in the end It was obvious that the groups that underwent magnotherapy had a higher downward trend than control groups.

Markov (2007) described that PEMF-LF normalizes the transmembrane's potential in injured cells, Chapman et al. (2008) and Cooley (2015) stated that peripheral sensitization could have an influence in changing ion flux in cells.

From a practical point of view our results indicated that the groups that experienced magnotherapy had a better quantitative improvement, regarding trigger point means, than control groups, which are similar results to those from a clinical study done by Krukowska et al. (2012) in humans with muscle pain. Therefore, we can suppose, based on the results and bibliographic references, that the stabilization of the transmembrane's potential of muscle and nerve cells, influenced by PEMF-LF, reduces muscle tension and pain.

The owners' questionnaire was useful to solidify all the previous conclusions, as Reid et al. (2015) and Lindley (2016) said, "Owner's opinion is crucial to interpret dog's pain".

It's important to highlight the idea that, as in any other clinical study, mainly when undergoing in an uncontrolled environment, intrinsic and extrinsic factors can easily affect the results, and this study was not immune to those factors.

Conclusion

This study allowed to obtain rather important hypothesis and conclusions which can be useful as a basis to future researches about magnotherapy as physical modality.

All the dogs appeared to improve their functionality, pointing out to the importance of functional rehabilitation.

The statistical and quantitative differences between groups B and D supported the theory of magnotherapy as an important adjuvant physical modality in pain management in patients with orthopaedic or skeletal muscle diseases.

The results offer support, in a practical point of view, towards the use of PEMF-LF in order to reduce muscle tension, although the explanation for this remains open.

It´s important to standardize PEMF-LF's protocols and learn more about the biophysical aspects of this physical modality, in order to better understand its interaction with injured cells and its biological effects.

Soon, PEMF-LF may have its place in functional rehabilitation's multimodal approach to pain, given the efforts that are being made to credibilize this modality, regardless of commercial propaganda with economic interests, which, unfortunately is done so many times.

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