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Mälaren Equine Clinic, Sigtuna, Sweden

Clinical Effects of Betamethasone and Hyaluronan, and of Defocalized Carbon Dioxide Laser Treatment on Traumatic Arthritis in the Fetlock Joints of Horses

A. C. Lindholm[1], U. Swensson[1], N. de Mitri[1] and E. Collinder[2,3]

Addresses of authors: [1]Mälaren Equine Clinic, Hälgesta 1, S-193 91 Sigtuna; [2]Division of Medical Microbial Ecology, Department of Cell and Molecular Biology, Karolinska Institutet, von Eulers väg 5, S-171 77 Stockholm, Sweden; [3]Corresponding author: Tel.: +46 18 536531; fax: +46 18 591804; e-mail: eje.collinder@telia.com

With 1 figure and 3 tables

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Summary

The clinical effects of intra-articular betamethasone together with hyaluronan (βM/HA) and treatment with a defocalized carbon dioxide laser on acute traumatic arthritis of the fetlock joint were assessed. The horses in these studies were selected using a thorough lameness examination, including intra-articular anaesthesia abolishing the lameness. This investigation comprised an observer-blind study, including 10 sport horses (10 joints), and a prospective study, including 180 sport horses (333 joints). In both studies, the material was divided into two groups treated with either βM/HA or a carbon dioxide laser. The treatment doses were 12 mg of βM, 20 mg of HA or 60 J/cm^2 of treated area. Convalescence before training was 21 days for both groups in the observer-blind study. In the prospective study, convalescence in the βM/HA group was 21 days but was only 7 days for the laser-treated group. In the observer-blind study, three of five treated joints recovered in both cohorts. In the prospective study, the groups had significantly different recovery rates – 68% of the βM/HA-treated joints and 80% of the carbon dioxide laser-treated joints. These results indicate that the defocalized carbon dioxide laser should be an applicable mode of treatment of acute traumatic synovitis in horses. However, the biochemical functions related to carbon dioxide laser treatment require further elucidation.

Introduction

Traumatic arthritis, which usually originates from continual trauma to one or several joints, is a frequent clinical problem in active sport horses, manifested as synovitis and capsulitis. Arthritis may include desmitis of the intra- or peri-articular ligaments and damage to articular cartilage (McIlwraith, 1996). Inadequate conditioning, conformational defects and inadequate shoeing are central aetiological factors. Lameness, the main clinical symptom, increases after flexion of the affected joint, and joint effusion is often noticed. The lameness may be observed at a walk, but is more obvious at a trot. Quite often the lameness is only identified at high speed or when the horse is lunged at a trot. For confirmation of the diagnosis and for treatment guidance, a positive intra-articular anaesthesia must be performed (Trotter and McIlwraith, 1996).

During the past few decades, arthritis in the distal joints has often been treated successfully, with either cortisone (Auer and Fackelman, 1981) or hyaluronan (HA) alone (Åsheim and Lindblad, 1976; Howard and McIlwraith, 1996) or with a combination of the two drugs (Ronéus et al., 1993). Much is known about various corticosteroids and how they treat arthritis (Foland et al., 1994; Frisbie et al., 1997, 1998), but the correct doses have not been fully clarified (McIlwraith, 1992). Adverse reactions to intra-articular treatment with drugs may occur and joint infection may occasionally interfere with the results. Therefore, horse owners have become more interested in alternative treatments for acute traumatic arthritis. To meet these wishes, carbon dioxide laser therapy for arthritis has been applied as an alternative treatment at Mälaren Equine Clinic.

Previous research on defocalized carbon dioxide laser therapy (DLT) in humans has indicated a positive clinical effect on osteoarticular diseases and peri-arthritis in the shoulder and other localities, as well as on tennis elbow, lumbago sciatica and tendonitis (Longo et al., 1988; Hatit and Lammens, 1992). These promising results have inspired us to investigate whether this therapy could be of value in the treatment of traumatic arthritis in the horse.

The purpose of this study was to evaluate the clinical effects of non-surgical DLT on acute synovitis and capsulitis in one or several fetlock joints in horses compared with conventional intra-articular treatment consisting of betamethasone (βM) combined with HA. The study was conducted in two parts, with an observer-blind study and an open, prospective study.

Materials and Methods

Study design

Observer-blind study

Horses with acute traumatic arthritis in one fetlock joint and no lameness of other origin were selected and divided into two groups. One group was treated intra-articularly with βM combined with HA and the other group was treated with DLT. The clinical effects of these treatments were evaluated 3–5 weeks after treatment (i.e. at the end of the convalescence period) and, for the evaluation of the influence of training, 2–3 months thereafter (i.e. during the training period).

At both lameness re-examinations, horses with no lameness were classified as recovered. Horses judged as improved or recovered at the first lameness re-examination and without lameness at the second re-examination were classified as recovered. Thus, the horses were, after each re-examination, classified into the two categories recovered or not recovered.

Prospective study

Horses with acute traumatic arthritis in one to four fetlock joints, and showing no lameness of other origin, were selected and divided into two groups. Group A was treated intra-articularly with βM/HA and the clinical effects were evaluated 3–4 weeks after treatment. To evaluate whether the time between treatment and re-examination of lameness influences the clinical outcome, the group treated externally with DLT was subdivided into two groups, re-examined 3–4 (group B) or 8–9 (group C) weeks after treatment.

The Ethical Committee for Animal Experiments, located in Uppsala, Sweden, approved the experimental design.

Horses

Observer-blind study

During a 6 month period, sport horses diagnosed with acute traumatic arthritis in a single front fetlock joint were studied at the clinic. The horses, 3–10 years of age, included six geldings and four mares and consisted of four Swedish Warmbloods (i.e. show jumpers and dressage horses), three Thoroughbreds (i.e. race horses) and three Standardbreds (i.e. race horses).

Prospective study

A total of 169 sport horses were brought to the clinic during an 18 month period, all suffering from lameness and diagnosed with acute arthritis in the fetlock joints. The group was comprised of 69 Swedish Warmbloods (i.e. show jumpers and dressage horses), 76 Standardbreds (i.e. race horses), 10 Thoroughbreds (i.e. race horses and show jumpers) and 14 ponies. In total, 62 mares and 107 geldings and stallions were included in the study. Eleven horses were 2–4 years old, 87 were 5–8 years old and 71 were more than 8 years old.

Joints

Observer-blind study

All horses had a history of lameness for a period of 2 weeks or more prior to the examination. The clinical examination revealed lameness in one fore fetlock joint before and after a flexion test. Two different veterinary surgeons performed the clinical evaluation of the horses and a third carried out the treatments.

Five of the joints were treated intra-articularly with βM/HA and five were treated with DLT, as described below.

Prospective study

All horses had a history of lameness for a period of 2–4 weeks prior to the examination. The clinical examination revealed lameness before and after a flexion test in one or several fetlock joints. Of all the horses, 55 showed lameness in one joint, 81 in two joints, 16 in three joints and 17 in four fetlock joints. In total, 333 fetlock joints were treated, 171 intra-articularly with βM/HA and 162 externally with DLT.

Diagnostic methods used in both studies

The joints selected with lameness were, as far as possible, assigned to relatively homogeneous groups in terms of acute traumatic arthritis in the fetlock joints, as diagnosed by the clinical observations of initial lameness, the flexion test and intra-articular anaesthesia, supplemented with radiographic and ultrasonographic examinations.

Initial lameness

The degree of lameness and reaction to the flexion test were assessed on a scale of 0–5, where 0 represents no lameness and 5 represents a non-weight-bearing limb (Åsheim and Lindblad, 1976). All horses showed an initial lameness when trotting on a flat surface at the clinic, on a treadmill or being lunged.

Flexion test

The flexion test (Nilsson et al., 1973; Åsheim and Lindblad, 1976; Stashak, 1987) is applied routinely at this clinic in all lameness cases to determine which limbs and joints are the origin of the actual lameness. Basically, the flexion test involves flexing the joint maximally, exerting a smooth and not too strong flexion force. The flexion remains at a constant force for a period of 60 s. Afterwards, the horse is immediately trotted off for 30 m and back. In this movement, the horse usually experiences increased pain in the inflamed joints, manifesting a provoked lameness. In contrast, the movement patterns of horses with intact healthy joints do not show lameness after this manipulation. The joints selected for this study showed an increase in lameness up to 2° or more after a 1 min flexion test.

Intra-articular anaesthesia

For confirmation of whether the lameness originated from the joint cavity, an intra-articular anaesthetic injection was applied to all joints that reacted to the flexion test. After anaesthesia of each joint, the horse had a 20 min box rest. The horse was then given an additional flexion test. Horses that were still lame after this anaesthesia were excluded from the studies.

Radiographic examination

Radiographic examinations were performed to exclude all horses with intra-articular lesions, such as palmar/plantar or dorsal fragments, from the study.

Ultrasonographic examination

In chronic traumatic arthritis, the total joint capsule thickens (Nilsson, 1973; Reef, 1998; Macrae and Scott, 1999) and intra-articular treatment is often unsuccessful (Ronéus et al., 1997). Fetlock joints suspected of chronic arthritis were examined using sagittal ultrasonographic scans of the dorsal aspect of the fetlock joint (next to the long digital extensor tendon), and joints with an obviously thickened capsule were excluded from the studies. Clinical findings have hitherto shown that healthy horses and those with acute arthritis have a total fetlock joint capsule thickness of up to 10 mm.

Treatments used in both studies

Intra-articular treatment

The single intra-articular treatment consisted of withdrawal of the existing synovia, followed by a limited lavage, i.e. an injection and withdrawal of 20 ml of saline through the same needle, and a subsequent injection of 12 mg of βM (Celeston® bifas®; Schering-Plough, Stockholm, Sweden) combined with 20 mg of HA (Hylartil® vet.; Pharmacia and Upjohn Animal Health, Uppsala, Sweden).

Laser treatment

Before treatment, the horses were placed in a stock under sedation with 5 mg of detomidine (Domosedan®; Orion Pharma AB, Sollentuna, Sweden). A defocalized carbon dioxide laser, 25 W (KSV 25 S, Laser class 4; El.En. S.p.A., Florence, Italy) was used, consisting of a carbon dioxide emitter with a wavelength of 10 600 nm and a scanning device. The power of the radiation emitted by the laser gun was tested regularly with the laser power probe P100C (Macken Instruments, Inc., Santa Rosa, CA, USA). A visible helium–neon laser (wavelength 632.8 nm), superimposed on the carbon dioxide emitter, made the area covered by the carbon dioxide laser beam visible. Using the scanning device, the helium–neon and carbon dioxide lasers can, by setting time, focusing, etc., deliver adequate and equal amounts of radiation to each cm^2 of tissue. A timer on the scanner stops the treatment after the appropriate time has been reached. In this controlled manner, the scanning device automatically directs an equal amount of radiation over the actual tissue to avoid the risk of side-effects such as burning or over/underexposure.

In these studies, the surface tissues were exposed to 60 J/cm^2, adjusted from 25–50 J/cm^2 for the treatment of humans (Longo and Clementi, 1992). The duration of each treatment was 6 min for the lateral and 6 min for the medial side of the joint. In the case of long-haired horses, the hair around the joints was clipped. The joints were treated three times, on days 1, 3 and 5, by the same technician (Fig. 1).

Convalescence period

Observer-blind study

After treatment, all horses in both groups had box rest for 3 days with two daily walks of 10 min each. Afterwards, they were kept in a paddock for 2 weeks. The horses were then walked with a rider or with a jog cart for 30–40 min/day for 4 days, and 3 weeks after treatment they resumed complete training.

Prospective study

High amounts of βM may remain in joints for some weeks after treatment (Ronéus et al., 1993). For this reason, the intra-articularly treated horses had the same 3 week convalescence program as described above for the observer-blind study.

The laser-treated horses had a convalescence period of 1 week in a paddock. They were then returned to complete training to ascertain if a shorter rest period than that following βM/HA treatment could be appropriate with laser treatment.

Statistical analysis

The methods of treatment studied were analysed using a GLM factorial ANOVA (STATISTICA, 2000), with modes of treatment and limbs as categorical factors and the recovery result as a dependent variable.

Results

Observer-blind study

In this study, three out of five joints recovered in 3–5 weeks after treatment with βM/HA and after laser treatment. At the

Fig. 1. Laser treatment of a horse, as performed in this study.

second re-examination, 11–15 weeks after treatment, four of the five fetlocks treated intra-articularly and four of the five joints treated with the laser had recovered (Table 1) and in the training period thus far, no lameness reappeared.

Prospective study

Of the 171 fetlock joints treated intra-articularly with βM/HA, 116 (67.8%) had recovered 3–4 weeks after treatment (Table 2).

Of the 114 fetlock joints treated with DLT and re-examined 3–4 weeks after treatment, 92 (80.7%) had recovered (Table 2).

Of the 48 fetlock joints treated with DLT and re-examined 8–9 weeks after treatment, 38 (79.2%) had recovered (Table 2).

The recovery results of the groups treated with intra-articular injection and of those treated with the carbon dioxide laser were found to be significantly different ($P < 0.05$), namely revealing a better clinical outcome in the carbon dioxide laser group (Table 3). There was no difference in clinical outcome between the limbs on which the diseased fetlocks were located, regardless of the mode of treatment (Table 3).

Discussion

The authors recognize that there was no control group in this study. However, all of the sport horses in the prospective study had been rested because of lameness for at least 2–4 weeks without any clinical improvement prior to visiting the clinic. All of the horses entering the study were lame, and the lameness could be temporarily abolished in the affected fetlock joints by the investigators. The authors feel that this justifies the lack of a pure control group, given that ethically it is almost impossible to recruit control horses for a study designed with a sham-treated group.

Table 1. Results from an observer-blind study of two modes of treating acute traumatic arthritis in a single fetlock joint in horses with no lameness of other origin

					Re-evaluation of lameness			
					2nd flexion		3rd flexion	
Horse	Treatment	Joint	Initial lameness (°)	Diagnostic 1st flexion (°)	Time (weeks)	°	Time (weeks)	°
Group 1								
1	βM/HA	Right fore	1	2	3	1	15	0
2	βM/HA	Right fore	1	3	4	0.5		–
3	βM/HA	Right fore	0.5	2	4	0	15	0
4	βM/HA	Left fore	1	2	3	0	14	0
5	βM/HA	Left fore	1	2	5	0	15	0
Group II								
6	Laser	Right fore	1	3	3	0	11	0
7	Laser	Right fore	1	3	4	0	12	0
8	Laser	Left fore	0.5	2.5	3	0	15	0
9	Laser	Left fore	1	2	4	1		–
10	Laser	Left fore	1	2	4	0.5	15	0

Time, weeks between treatment and re-evaluation of lameness; °, degree of lameness in flexion test; βM/HA, betamethasone + hyaluronan.

Table 2. Results from a prospective study of two modes of treating acute traumatic arthritis in fetlock joints in horses with no lameness of other origin

				Recovered	
Treatment	Joint	*n*	Time (weeks)	*n*	%
Group A					
βM/HA	Left fore	63	3–4	41	65.1
βM/HA	Right fore	53	3–4	36	71.7
βM/HA	Left hind	29	3–4	20	69.0
βM/HA	Right hind	26	3–4	17	65.4
Group B					
Laser	Left fore	36	3–4	30	83.3
Laser	Right fore	30	3–4	24	80.0
Laser	Left hind	25	3–4	19	76.0
Laser	Right hind	23	3–4	19	82.6
Group C					
Laser	Left fore	18	8–9	15	83.3
Laser	Right fore	12	8–9	11	91.7
Laser	Left hind	11	8–9	7	63.6
Laser	Right hind	7	8–9	5	71.4
Group A (βM/HA)		171	3–4	116	67.8
Group B (laser)		114	3–4	92	80.7
Group C (laser)		48	8–9	38	79.2
All joints treated		333		246	73.9

Time, weeks between treatment and re-evaluation of lameness; βM/HA betamethasone + hyaluronan.

Table 3. Factorial ANOVA on the results from treating acute traumatic arthritis in 333 fetlock joints, with two modes of treatment and four limbs as categorical factors and the recovery result as a dependent variable

Source of variation	Sum of squares	d.f.	Variance	F	P
Between factors					
Modes of treatment	1.08	1	1.08	5.62	0.018 ($P < 0.05$)
Limbs	0.20	3	0.07	0.35	0.79
Treatments × limbs	0.24	3	0.08	0.42	0.74
Within factors	62.52	325	0.19		

The lavage used prior to the intra-articular medication was performed to reduce the number of inflammatory mediators and cytokines before treatment. Lavage alone probably has a positive effect and can be useful in the treatment of synovitis (McIlwraith and Bramlage, 1996). To avoid its possible influence on the clinical outcome of the carbon dioxide laser treatment, no lavage was performed on the laser-treated joints.

The positive results of the intra-articular treatment in this study support previous suggestions for treatment with βM (Ronéus et al., 1993; Foland et al., 1994; Howard and McIlwraith, 1996; Frisbie et al., 1997).

In the observer-blind study, the laser treatment revealed a clinical outcome comparable with intra-articular medication. In this study, both groups had 21 days of convalescence between treatment and complete training. In the prospective study, convalescence for the laser-treated horses was only 7 days, but 21 days for the intra-articularly medicated group. In addition to a 14 day difference in convalescence time, the laser-treated group showed significantly better improvements (see Table 2). This positive outcome may result from an effect of the laser on the total joint capsule compared with a local effect of βM/HA treatment. However, this finding should be elucidated in further studies.

The results of DLT treatment in the prospective study were comparatively similar to the promising results recorded for humans. Carbon dioxide laser treatment on humans afflicted with joint lameness, rheumatism, lumbago, and similar diseases, has been reported to yield positive effects, including analgesia (Longo et al., 1988, 1997; Hatit and Lammens, 1992; Longo and Clementi, 1992). Pain is mainly related to disease, and pain relief has been found to correlate with carbon dioxide laser treatments, using the Ritchie scale for pain (Longo et al., 1988; Longo and Clementi, 1992).

The activation of articular nerves not only provides the sensory perception of pain but also results in the release of transmitters that have detrimental effects on synovial and cartilage cell metabolism (McIlwraith, 1996). The exposure of monocytes to substance P and other neuropeptides causes the release of cytokines (Caron, 1996). Elevated synovial concentrations of substance P and other peptides have been observed in humans with joint disease (Marshall et al., 1990) and elevated substance P levels are also suggested in horses with arthropathies (Caron et al., 1992). These damaging effects, from nerves to joints, may gradually correlate with the intensity of local pain (Caron, 1996). The released neuropeptides may also support and maintain the degenerative processes of joint inflammation. The laser beam used may have suppressed the sensation of pain in the joints and correspondingly decreased the levels of neuropeptides to such an extent that the inflammatory processes in the joints disappeared within only a few days. Thus, it is assumed that the nervous system may contribute basically to the pathogenesis of traumatic arthritis, namely as an origin rather than as a result of arthritis.

In this study only three laser treatments were carried out compared with an average of 7.6 in the human joint treatment study of Hatit and Lammens (1992). Theoretically, one could speculate that with more than three laser treatments, even more joints could have recovered.

The treatment of horses with a carbon dioxide laser, at 10 600 nm wavelength and 60 J/cm^2 has, in the authors' experience, evoked no side-effects. Moreover, laser therapy was found to be more effective than intra-articular treatment with βM/HA in facilitating recovery from acute traumatic arthritis. However, it is most important to have a correct diagnosis before treatment.

As carbon dioxide laser treatment is easy to perform, it should be applicable in equine clinics in the future. While this therapy has the disadvantages of requiring expensive equipment and 5 days in the clinic, its short convalescence is an advantage.

The biochemical functions related to the carbon dioxide laser treatment of joints are still mostly unknown. Based on the promising results seen in this study, the authors plan to investigate the biochemical responses after laser treatment more specifically.

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