

Conservative physiotherapy treatment in 4 patients with brachial plexus avulsion

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ABSTRACT

The avulsion of the brachial plexus is a pathology often resulting from trauma and quite frequent in the clinic of small animals. In addition to drug therapy with prednisone, it is important to start physiotherapy immediately to counteract neurogenic atrophy.

There is no surgical treatment and the alternative to a physiotherapeutic intervention is represented by the amputation of the involved limb, in order to avoid self-trauma. Currently, an integrated physiotherapeutic intervention is applied, consisting in appropriate exercise, laser therapy and diathermy. In this work, the outcome of conservative treatment was evaluated for 4 subjects suffering from avulsion of the brachial plexus, which arrived at the "Livorno Veterinary Physiotherapy" Clinic.

Different parameters were studied and the pre- and post-conservative physiotherapy clinic compared. The 50% had a positive outcome with recovery of the autonomous movement; the remaining patients did not have clinical recovery, resulting in a permanent loss of autonomy.

The present study highlighted that an important variable to treatment success is the time interval from diagnosis to the start of therapy: the best results were obtained for shorter waiting times.

INTRODUCTION

Brachial plexus avulsions are divided into cranial, caudal and total. The cranial one affects the C6 - C7 roots. There is modest atrophy of the supraspinatus and infraspinatus muscles, reduced arm extension and elbow flexion but there is good elbow extension. The caudal avulsion affects the roots C8 - T1 and T2. The symptoms are more important and the animal is unable to support the limb that is held with the shoulder and elbow flexed. Sometimes there is transient damage to the spinal cord with consequent involvement of the ascending and descending fibers relating to the ipsilateral hind limb, therefore in the first phase it is possible to find postural neurological deficits and posterior ipsilateral MNS syndrome. The total avulsions are a sum of the two previous ones, the limb is dragged hemiplegic and the prognosis is poor because the chances of reinnervation are minimal (1, 2). Diagnosis is achieved by clinical examination, electromyography, CT and MRI. The treatment in this case is exclusively conservative, trying to protect the limb from further injuries, self-trauma, muscle contractures and subjecting the patient to rehabilitation. In addition to drug therapy with prednisone, it is important to start physiotherapy immediately to counteract neurogenic atrophy. There is no surgical treatment (3). For this pathology the prognosis is

defined after 6 months from the damage and what determines it most is the presence or absence of deep pain.

MATERIALS AND METHOD

In our study we took into consideration 4 cases, of which 3 dogs and 1 cat, all visited and treated at the Clinic of Veterinary Physiotherapy Livorno (Italy). The course of the clinical condition was observed from the start of physiotherapy until the time of discharge.

The patients were followed from the first visit, collecting the anamnesis, assessing their general and particular condition, performing the complete neurological examination, examining the existing documentation and diagnostic tests.

For all patients, the following were taken into consideration: signaling, diagnosed pathology, symptoms at the beginning and end of the protocol, time elapsed between diagnosis and the actual start of the physiotherapy protocol (in days). Each subject was assigned an outcome group.

This value refers to the recovery of the patient's ability to walk correctly at the end of the rehabilitation process. Depending on the result there is a different placement for each group: if the patient has fully recovered at the end of the treatment the outcome is positive, if the degree of severity of the pathology has remained unchanged the outcome is negative. Below is the protocol applied to each patient, described in the different phases, according to the clinical condition of the subject. The application times and the manual and instrumental methods used are also reported.

MLS® Laser Therapy's efficacy in regenerating nervous tissue and managing neuropathic pain has been demonstrated in previous studies (4, 5). In this study, it has been applied with the aim to promote repair mechanisms and

decrease neuropathic pain symptoms. In the cases described in this clinical study, we applied the IVDD modality along the physiological course of the nerve affected by the pathological

process, depending on the lesion that the patient presented, with the aim of regenerating the injured nervous tissue and improving the restoration of the normal conduction function of the

stimulus. MLS - Laser treatment was performed with a Multiwave Locked System laser (Mphi VET, ASA S.r.l., Vicenza, Italy). MLS laser is a class IV, NIR laser with two synchronized sources (laser diodes).

PROTOCOL APPLIED	
<p>FIRST STAGE If the patient is non-ambulatory, physiotherapy for the first week is daily.</p>	<p>Daily therapy, from one to two weeks, to avoid neurogenic atrophy and fibrosis.</p> <p>Daily EMS on the muscles involved and adequate exercises, in relation to the subject, the use of the involved limb is encouraged</p> <p>MLS® Laser Therapy "intervertebral disc disease" (IVDD) following the course of the nerve</p> <p>Diathermy in athermic mode following the course of the nerve.</p>
<p>SECOND PHASE As soon as the support of the paw is obtained, three sessions a week, in which the instrumental techniques of the first phase are continued and the following are added:</p>	<p>Massages, to relax contractures and stimulate muscle function.</p> <p>Walking exercises with linear obstacles</p> <p>Proprioceptive exercises.</p>
<p>THIRD PHASE As the paw support frequency increases by the subject, the exercises are intensified in terms of difficulty and duration. Therapy three times a week.</p>	<p>In this phase, UWT exercise is added for muscle strengthening and mentally facilitating the subject to use the limb more and more.</p>
<p>FINAL STAGE Upon reaching the autonomous use of the paw, maintenance is continued through two sessions per week, scaling to one, until discharge.</p>	

The two modules have different wavelengths, peak power and emission mode. The first one is a pulsed laser diode, emitting at 905 nm, with 25 W peak optical power; each pulse is composed of a pulse train (100 ns single pulse width, 90 kHz maximum frequency). The frequency of the pulse trains may be varied in the range 1–2000 Hz. The second laser diode (808 nm) may operate in continuous (power 1 W) or frequenced (repetition rate 1–2000 Hz) mode, 500 mW mean optical power output, duty ratio 50% independently of the repetition rate.

The two laser beams work simultaneously, synchronously and the propagation axes are coincident. The treatment parameters were the following: 18Hz, 100% intensity, 4,01J/cm².

RESULTS

As explained in the section "Material and Methods", patients were divided

by outcome group based on the results obtained in the recovery of the use of the limb affected by the disease pro-

cess: if at the end of the physiotherapy course they had completely recovered, the outcome was positive; if there had

Signaling	Diagnosed pathology	Symptoms at the beginning	Symptoms at the end of the protocol	Time elapsed between diagnosis and the actual start of the physiotherapy protocol (days)	Outcome group
Dog, Jagdterrier, whole male, 5 months, 7 Kg	Impact trauma, right side and consequent brachial plexus injury to the left and ligament instability of the medial compartment of the shoulder. Injury of the cranial plexus	Monoparesis left front limb, IV degree lameness, occasionally slight hint of load. Postural reactions of the left anterior limb absent, absent spinal reflexes on the left anterior limb, very slow / absent deep pain in the area of competence of the ulnar nerve	Recovery of autonomous movement of the left front limb	3	Positive
Dog, Mixed breed, whole male, 4 months, 6 Kg	Impact trauma, total avulsion of the left brachial plexus	Limb held with shoulder, elbow and wrist flexed and impossible support, severe state of supraspinatus and infraspinatus atrophy, neither superficial nor deep sensitivity distal to the elbow. Very small extensor ROM for all joints	Surgical resolution through the amputation of the paw	30	Negative
Dog, Mixed Breed, whole female, 5 years, 15 Kg	Impingement trauma, cranial brachial plexus avulsion	Monoparesis right forelimb and presence of muscular atrophy, absent postural reactions right forelimb, absent spinal reflexes right forelimb, absence of deep sensitivity, presence of multiple licking injuries and self-trauma right leg	There is still a fourth degree lameness on the front	60	Negative
Cat, Ragdoll, whole male, 2 months, 800 gr	Cranial injury of the left brachial plexus	Monoparesis left front limb, every now and then slight hint of load. Postural reactions absent left front limb, absent spinal reflexes left front limb, deep pain present	Recovery of autonomous movement and loading of the left limb	7	Positive

been no improvements, negative outcome. As shown in tab. 2, the results obtained were the following:

- 2 patients in the positive outcome group
- 2 patients in the negative outcome group.

In the positive group the subjects were a dog and a cat, in the negative group 2 dogs.

Subsequent evaluations were aimed to define which parameters had the greatest influence on the results obtained. We calculated averages in the two outcome groups by species, sex, age and the days elapsed from diagnosis to the start of the physiotherapy protocol in the different patients using an Excel sheet.

No particular links were highlighted regarding variables such as species, sex, age or weight.

As for the time interval from diagnosis to the start of physiotherapy, the average time in the positive group was 5 days. The average in the one failing was 45 days.

DISCUSSION

The 4 subjects affected by avulsion of the brachial plexus and treated at the Livorno Veterinary Physiotherapy clinic, underwent a specific physiotherapy protocol, based on exercise, laser therapy and diathermy. They were subsequently divided into outcome groups according to the result obtained.

In the event that they had recovered the autonomous movement, they were assigned to the positive outcome group; in the event that this recovery was not obtained, to that of a negative outcome.

The results obtained were 50% successful. Subsequently, further correlations were investigated. Data processing did not show any signif-

icant link between the treatment success and variables such as species, sex, age or weight. On the other hand, the time interval from diagnosis to the start of physiotherapy has proved to be important. In fact, the best results were obtained in those subjects who started the rehabilitation process early.

The average time in the positive group was 5 days, that in the negative outcome was 45 days.

Consequently, from the data obtained, it can be said that a prompt start of a physiotherapy action plan is the basis for a faster recovery of a normal movement in autonomy in the limb which was involved in avulsion of the brachial plexus.

CONCLUSION

The clinical trial aimed to evaluate the success in recovery of autonomous movement in 4 subjects affected by avulsion of the brachial plexus using a specific physiotherapy protocol consisting in exercise, laser therapy and diathermy. The results showed that the therapeutic strategy applied was effective in the 50% of the patients.

Therefore two groups were defined, depending on the result obtained, with or without recovery of the autonomous movement at the end of the rehabilitation protocol.

A further analysis of the data revealed that the treatment strategy applied was highly effective (100% success) when started promptly after the traumatic event and diagnosis of brachial plexus avulsion.

Therefore, the most important variable was the time interval from diagnosis to the start of the physiotherapy protocol. In fact, the Group with a

positive outcome was the one with an average of 5 days elapsed, contrary to the one with a negative outcome, with 45 days delay in starting therapy. Consequently, from the data obtained, it can be said that a prompt start of a physiotherapy action plan, based on the protocol listed above, is the basis for a faster recovery of a normal movement in autonomy in the limb which was involved in avulsion of the brachial plexus.

ABBREVIATIONS

MNS = Upper Motor Neuron
MRI = Magnetic Resonance
CT = Computed Tomography
UWTD = Under Water Treadmill
MLS® = Multiwave Locked System
EMS = Electrical Muscle Stimulation
IVDD = Intervertebral Disc Disease

BIBLIOGRAPHY

1. Bernardini, M. (2002). Neurologia del cane e del gatto. Poletto.
2. Dragone, L. (2015). Fisioterapia riabilitativa del cane e del gatto. Elsevier srl.
3. Bockstahler B., Levine D., Maierl J., Millis D., Wittek K. (2019) Essential facts of physical medicine, rehabilitation and sports medicine in companion animals BE Vet Verlag.
4. Gigo-Benato, D., Geuna, S., de Castro Rodrigues, A., Tos, P., Fornaro, M., Boux, E., ... & Giacobini-Robecchi, M. G. (2004). Low-power laser biostimulation enhances nerve repair after end-to-side neurorrhaphy: a double-blind randomized study in the rat median nerve model. *Lasers in Medical Science*, 19(1), 57-65.
5. Micheli L., Cialdai F., Pacini A., Branca J.V., Morbidelli L., Ciccone V., Lucarini E., Ghelardini C., **Monici M.** & Di Cesare Mannelli L. Effect of NIR laser therapy by MLS-MiS source against neuropathic pain in rats: *in vivo* and *ex vivo* analysis. *Scientific Reports* | (2019) 9:9297 | <https://doi.org/10.1038/s41598-019-45469-5>.