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MUSCULAR SPASTICITY CLASSIFICATION - IMPLEMENTATION OF THE MODIFIED ASHWORTH SCALE IN VETERINARY FUNCTIONAL REHABILITATION

Veterinary Science

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ABSTRACT

Muscular spasticity is a clinical sign common on Veterinary Medicine´s patients with upper motor neuron syndrome (UMNS) syndrome and can be explain by neuroanatomy, thus extremely important when adressed from an Animal Rehabilitation point of view, being that these kind of animals are potential future patients of functional neuro-rehabilitation (FNR). Considering its limitation to the functionality and quality of life of patients, Human Medicine invests a lot of work in the full understanting of spasticity. On the other hand this clinical sign is undervalued in Veterinary Medicine. Thus, the presente article aims to classify muscular spasticity in dogs, introducing a qualitative clinical scale of evaluation, already been proved by neuroscience in Human Medicine. Therefore, the main goal of this study was the implementation of the Modified Ashworth Scale (MAS) to Veterinary Medicine. With this method, it becomes possible for all veterinarians in the rehabilitation field to speak the same clinical language and, through the initial MAS classification during the FNR examination, to obtain an indication of prognosis regarding morbidity and functionality.

KEYWORDS:

Muscular spasticity; Upper motor neuron syndrome; Functional neuro-rehabilitation; Modified Ashworth scale.

INTRODUCTION

Definition

In 1980, Lance published the definition of spasticity as "a disorder of the sensorimotor system characterized by a velocity-dependent increase in tonic stretch reflexes (muscle tone) with exaggerated tendon jerks, resulting from hyperexcitability of the stretch reflex, as one componente of the UNMS" (Lance, 1980). Although this definition is widely accepted, it has been challenged and evolved over time (Gómez-Soriano et al. 2012; Edwards, 2004).

All existing definitions emphasize the fact that spasticity and associated phenomena are the consequence of abnormal exacerbated reflexes, resulting in increased resistance during passive stretching and involuntary sustained muscle contractions).

Unlike spasticity, which is velocity-dependent and becomes evident when the spastic muscle is stretched, there are other types of muscle hypertonia that can lead to abnormal postures, resulting in increased tonic muscle contraction that remain in the absence of movement (Edwards, 2004; Queiroz, 2012). Muscle contracture, muscular stiffness, fibrosis and muscle spasm are some examples (Biering-Sørensen et al., 2006; Lorenz, 2011; Dewey & Talarico, 2016).

Etiology

Spasticity is a complex clinical sign, resulting in an involuntary movement disorder caused, in a general basis, by an imbalance in UMN facilitation and inhibition mechanisms (Edwards, 2004; Lorenz et al., 2011).

The pathophysiology of spasticity remains unclear, but there is a notion of a multifactorial contribuition (Boulenguez et al., 2010, Edgerton & Roy, 2010, Martins, 2016a, Martins, 2016b). Therefore, the suggested explanation is based on the interconnection between the supraspinal and the spinal mechanisms, that is abnormal descending pathways and/or abnormal intraspinal processing of spinal stretch reflex arc, as well as muscular peripheral contribuitions and the role of neuroplasticity (Roy & Edgerton, 2012, Li & Francisco, 2015 ;

Martins, 2016a, Martins, 2016b).

Central nervous system lesions are a major cause of disability in the human biped, resulting from a countless number of neurological disorders , such as traumatic injuries, stroke, cerebral palsy, multiple sclerosis and hereditary spastic paraplegias (Edwards, 2004, Elbasiouny et al., 2010, Queiroz, 2012, Abreu & Mendes, 2014).

Veterinary Medicine extrapolation suggests that the motor skills restriction and its implications to independence appears in both human biped and quadrupedal animal, being in most cases a result of pyramidal and extrapyramidal pathways lesions (Martins, 2016a, Martins, 2016b). Thus, in dogs it can appear as a UMNS componente, predominantly in thoraco-lumbar spinal cord injuries, but also in cerebral lesions and polyneuroradiculitis, such as those secondary to Toxoplasma gondii and Neospora caninum (; Dewey, 2006; Elbasiouny et al., 2010; Ródenas, 2012).

Spasticity assassment

From a clinical perspective, spasticity is generally easy to recognize but difficult to assess and quantify (Biering-Sørensen et al., 2006; Alter et al., 2016). However its evaluation remains extremely important, allowing the gathering of information regarding the initial patient assessment and its evolution when faced with a multidisciplinary approach of a FNR protocol.

These assessment methods can either be quantitative (biomechanical, electrophysiological) or qualitative (clinical) (Pajaro-Blázquez et al., 2014). The quantitative tools provide objective information on muscle hypertonicity with high reproducibility and an accurate examination when compared to traditional clinical scales, while requiring specific instrumentation outside the context of clinical practice (Gómez-Soriano et al., 2012; Pajaro-Blázquez et al., 2014).

On the other hand, clinical scales are a rapid and easy method with no need for specific instruments, the most frequently used being the

Ashworth Scale (AS) and the modified Ashworth Scale (MAS), providing an accessible and subjective way of assassment (Barnes, 2001a, Barnes, 2001b; Ansari et al., 2006; Pajaro-Blázquez et al., 2014; Li & Francisco, 2015; Alter et al., 2016)

Modified Ashworth Scale

The original Asworth scale emerged in 1964, being its prime objective the study of an antispastic drug effects on multiple sclerosis (Asworth, 1964). However, its modified version is currently used to assess spasticity, both in a daily medical practice as in advanced research environments (Ansari et al., 2006; Gómez-Soriano et al., 2012).

The AS and MAS method assigns a degree of resistance produced by muscular stretching, as a measure of severity in a range from 0 to 4, adding an extra category in the MAS (Bohannon & Smith, 1987; Biering-Sørensen et al., 2006; Pajaro-Blázquez et al., 2014).

Despite some criticisms associated with validity and realiability of the MAS, it is suggested that, by providing specific guidelines and a training program for the examiners, can improve agreement among different technicians and undermine the associated subjectivity . Therefore, the main goals of this study were: the implementation of the MAS of Human Medicine to Veterinary Medicine (Table 1); the gathering of information regarding initial patient assessment and its monitoring during treatment; to obtain a possible correlation between the initial spasticity degree and the time needed for treatment, as well as treatment viability, providing a functional performance indicator.

Table 1 - The Ashworth and Modified Ashworth scales (Bohannon & Smith, 1987 adapted)

Grau	Original	Modificada
0	No increase in tone	No increase in muscle tone
1	Slight increase in tone giving a "catch" when the limb was moved in flexion or extension	Slight increase in muscle tone, manifested by a catch and release or by minimal resistance at the end range of motion when the affected part(s) is moved in flexion or extension
1+ (2)	-	Slight increase in muscle tone, manifested by a catch, followed by minimal resistance throughout the remainder (less than half) of the range of motion (ROM)
2 (3)	More marked increase in tone but limb easily flexed	More marked increase in muscle tone through most of the ROM, but the affected part(s) is easily moved
3 (4)	Considerable increase in tone – passive movement difficult	Considerable increase in muscle tone, passive movement is difficult
4 (5)	Limb rigid in flexion or extension	Affected part(s) rigid in flexion or extension

MATERIAL AND METHODS

In this study a sample of 19 dogs with muscular spasticity was subject to a therapeutic protocol, in an internment regime in the animal rehabilitation center "Centro de Reabilitação Animal da Arrábida" (CRAA). All the patients enrolled in the study were referred after a veterinary neurologist diagnosis that allowed them to be differentiated in terms of etiology.

The subjects were then submitted to an FNR examination performed by the center Clinical Director and an initial classification according to the MAS was made, as well as biweekly monitoring.

Selection Criteria

All the selected animals showed the clinical sign of spasticity, regardless of their central or peripheral origin. The inclusion of these subjects was performed independently, being a non-probabilistic convenience sample, and then characterized according to their race, age, weight, gender, etiology and affected muscle area.

On the other hand, dogs with no clinical signs of spasticity, despite other signs compatible with UMNS, animals with contractures, muscle fibrosis and / or stiffness not secondary to spasticity were excluded from this study, as well as those that did not complete the prescribed FNR protocol.

Modified Ashworth Scale Implementation

As mentioned above, all animals included underwent an initial evaluation according to this scale, as well as biweekly reassessments of their evolution and the potential effects of the implemented FRN protocol, having been assigned a degree from 0 to 5. These evaluations were taken place in CRAA and they were made by the Clinical Director.

Functional Neuro-Rehabilitation Protocol

All subjects were submitted to the same FNR therapeutic protocol developed by CRAA. This one was based on a multimodal approach, including pharmacological and non-pharmacological management, with the prime objective of improving function, reducing secondary complications and managing pain of these animals. Therefore, oral administration of anti-spastic drugs, kinesiotherapy exercises and rehabilitation modalities were performed through the algorithm described in Figure 1.

The implementation of this protocol was taken place in an internment regime during a variable period of time, accordingly with patient evolution.

Pharmacological management of spasticity was based on combined oral administration of systemic drugs. Thus, Diazepam (0.5 mg / kg Bid) was perscribed to reduce muscle spasms and Gabapentin (5 mg / kg Tid) primarily for the treatment of neuropathic pain

Statistical analysis

Statistical analysis was performed using the Microsoft Office Excel 2013 program and the IBM SPSS Statistics 22.0 software.

A descriptive statistical analysis of categorical variables was performed (e.g. "race", "gender", "weigth", "age", "etiology", "affected área"), allowing the characterization of the sample.
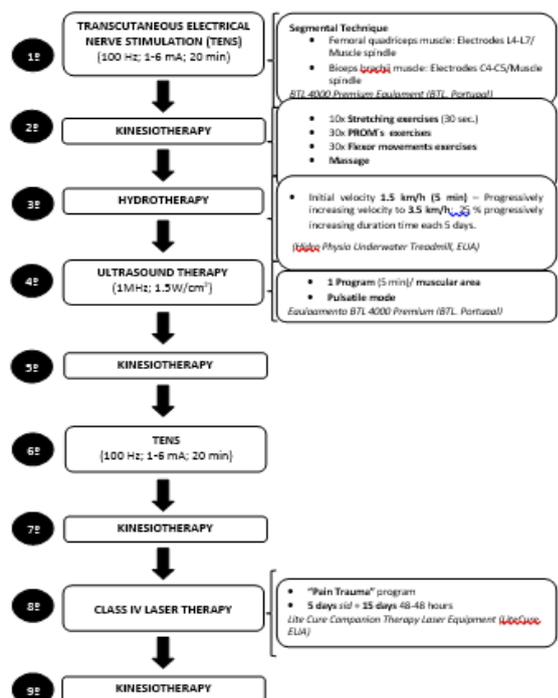
Figure 1 – Muscle Spasticity protocol algorithm of Functional Neurorehabilitation in CRAAA (PROM's = Passive range of motion)

Regarding the inferential analysis, it was noted that the data were not a normal distribuition, according to the Shapiro-Wilt and Kolmogorov-Smirnov tests (probably due to sample size), and non-parametric tests were performed.

On the other hand, and taking into account a different approach to statistical data, it was used the Chi-squared test to cross categorical variables and ANOVA tests to detect significant differences in the mean MAS classification score during patient treatment evolution.

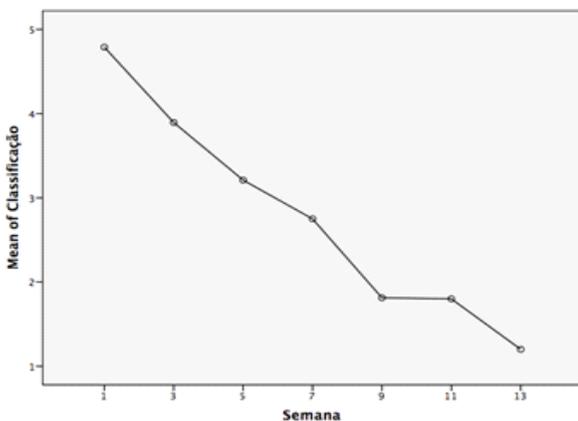## RESULTS
Sample characterization
Regarding our sample (n=19), the results do not show any type of racial predisposition, neither associated to gender, age or weight. There is, however, a clear prominence of the spinal origin in terms of etiology and being the most affected muscle the quadríceps femoris (94.7% of cases).

Complications secondary to spasticity, namely muscle atrofies (26.3%) and muscle contractures (52.6%), were observed, but with no statistically significant relationship between their presence and the MAS degree of spasticity.

The CRAA hospitalization time ranged from 30 to 90 days, with an average time of 2 months until patients´ rehabilitation.

Relationship between MAS classification at entry and exit of CRAA

Wilcoxon's Tukey HSD and post-hoc ANOVA non-parametric tests revealed significant differences between the initial classification of MAS and those of subsequent weeks, including the final classification (weeks 5, 9 or 13).


Graphic 1 – Graphic representation of the MAS classification mean diference throughout hospitalization weeks (MAS = Modified Ashworth Scale)

Therefore, the results revealed a rapid decrease, statistacallhy significant (p<0,001), on the entry and exit (of the CRAA) classification scale marks, like show on graphic 1.

Relationship between MAS initial classification and CRAA hospitalization time
Regarding the hospitalization time, it was observed statistical significance (chi-squared (2, N=19) =13,530, p<0,001), in the relation between this variable and the initial classification scale, which suggests that more serious levels at entry are associated with longer recovering periods.

It is shown on graphic 2 that dogs with initial MAS grade 4 remain fewers days
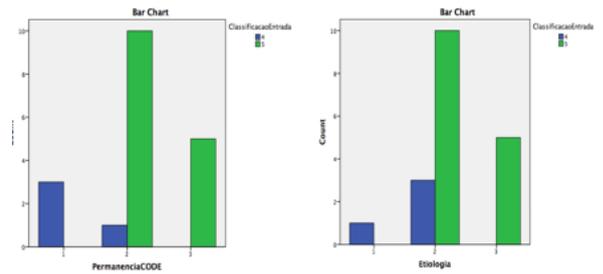
Graphic 2 – Statistical relationship between time for treatment at the center (1 = 30 days; 2 = 60 days; 3 = 90 days) and MAS classification degree at entrance (4 = 4

Graphic 3 -Statistical relationship between etiological origin (1 = Intracranial; 2 = Medullary, 3 = Peripheral) and MAS classification degree at entrance (4 = Grade 4 of the scale, 5 = Grade 5 of the scale))

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