Chapter 30

Postural evaluation in horses submitted to perineural anesthetic blocks in the thoracic limbs

Crossref doi https://doi.org/10.56238/devopinterscie-030

Jackellyne Laís Ferreira Lins
Veterinary doctor of the Program Research and Extension Group on Equidos and Integrative Health of the Federal University of Alagoas (GRUPEQUI- UFAL)
E-mail: jackellyne_lins@hotmail.com

Juliana de Oliveira Bernardo
Postdoctoral researcher GRUPEQUI-UFAL.
E-mail: rofessorajulianabernardo@gmail.com

Tobyas Maia de Albuquerque Mariz
Associate Professor and Researcher at GRUPEQUI-UFAL
E-mail: tobyas.mariz@arapiraca.ufal.br

Pierre Barnabé Escodro
Associate Professor and Researcher at GRUPEQUI-UFAL
E-mail: pierre.escodro@vicosa.ufal.br

ABSTRACT
Lameness is the condition that most distances horses from training days and sports competitions, with the thoracic limbs being the most affected. Despite the great advances in equine sports medicine, diagnostic analgesia probably remains one of the most valuable tools in identifying lameness, with clear and immediate results. Many cases end up evolving into chronic degenerative diseases, which become unresponsive to traditional therapeutic clinical - surgical procedures, indicating the use of drugs or surgical procedures that promote "irreversible" palliative or prolonged reversible analgesia, through interruption of nerve conduction to the region (neurolysis). The palmar/plantar digital nerve is the most submitted to the technique, as the rates of proprioceptive loss are minimal, but there is information that the more proximal the perineural analgesic block, the greater the motor deficit caused. Given the scarcity of information about these risks, this study aimed to perform the postural assessment of horses submitted to anesthetic blocks with bupivacaine of the palmar, palmar metacarpal, ulnar, median and cutaneous muscle nerves, in isolation and at different times, seeking to identify possible dysfunctions associated with the nerve undergoing blockade. Seven healthy adult horses, without locomotor and trotting problems, were evaluated in triplicate, in relation to the following postural reaction tests for the left forelimb: Limb Dorsiflexion Test (PDF); Member Crossing Test (PCM); Sliding Test (PD) and Obstacle Test after perineural anesthetic block with 0.5% bupivacaine. It was concluded that horses submitted to anesthetic blocks from the palmar metacarpal nerve present proprioceptive deficits that can endanger the life of the horse/rider as a whole, and the use of neurolytic agents should be avoided in active athletic horses.

Keywords: Analgesia, Horse, Proprioception, Risks, Accidents.

1 INTRODUCTION

Cladications are the disorders that further remove horses from training days and sports competitions, indicating structural or functional disturbance of one or more limbs, which can be observed when the horse is stopped or moving, being visually more evident to trot or gallop (Ribeiro, 2013). They are mainly caused by trauma, congenital or acquired anomalies, infections, metabolic disorders, circulatory and nervous changes (STASHAK, 2006).

Cladications in the thoracic limbs are more frequent than in the pelvic limbs and occur as the center of gravity of the horse is located closer to the thoracic limbs, and in these, about 95% of the changes are observed in the carpal region or distal to it. Often these outbreaks end up evolving into chronic degenerative syndromes, not responsive to conservative treatments (LOPES, 2011; DRIESSEN et al., 2008; SCHUMACHER et al., 2008; KEG et al., 1992; DYSON, 1986; GILBSON et al. , 1986).

Despite the great advance in equine sports medicine, diagnostic analgesia probably remains one of the most valuable tools in identifying lameness, with clear and immediate result (Ross et al., 2003). Lidocaine is the most commonly used local anesthetic in equine diagnostic perineural analgesia, promoting analgesic effect of up to 60 minutes. In the need for longer analgesia time, the main option is 0.5 %Bupivacaine Hydrochloride, whose effect can reach up to 240 minutes (SECODRO et al., 2015; LAMOUNT, 2008; MOYER et al., 2007; BALLER ET AL., 2002; LUNA, 1998; GAYNOR et al., 1991).

In the case of chronic degenerative diseases not responsive to therapeutic clinical and surgical conduct, such as those that affect the distal portion of the limb, neoplasms and some disorders of the spine, some authors suggest the use of drugs or surgical procedures that promote “irreversible palliative analgesia ”Or reversible prolonged, through nerve injury (neurolysis) chemical or physical, which promotes interruption of nerve conduction to the region. Palmar/plantar digital nerve is the most subjected to technique, as proprioceptive loss rates are minimal (SCODRO et al., 2015; RICHARDS, 2008; ALVES et al., 2007; GUTIERREZ, 2005; Quan et al., 1999 ; LITON, 1993; GUNDU et al., 1992).

For over 20 years, KEG et al. (1996) In a study on effects of regional nerve blockages on chestnuton in the locomotion and march of healthy horses, they showed that there was no significant difference before and after the low digital palmar block, abaxial and high palmar lock.

Nervous fibers are covered by a sheath called neurilema or Schwann sheath, consisting of a beam of fascicles kept and united by the epineur (outer layer of the peripheral nerve) containing vessels and connective tissue. Each beam of fascicles is surrounded by the perineur and within each fascicle there are myelinized and amielinized axons, connective tissue, capillaries and extracellular fluid that are surrounded and protected by the endoneuro (SCODRO, 2004, Quan & Bird, 1999, 1967).

Equine peripheral nerve fibers are similar to other species, being the palmar digital nerve, which is more infiltrated in the clinical routine of horses, structurally composed of greater amount of type C amielinized fibers, which have approximately 0.4 diameter diameter at 1.2 μm and a myelinized aod fibers, which have a diameter between 2 to 6 μm (Schumacher et al., 2007). Already the proximal nerves have more myelinized nerve fibers of the larger type Aβ type, with approximate diameter of 10 μm. These denser and more myelinized fibers quickly convey sensations to the spinal cord (6-30 m/s), which is fundamental for the integration of sensory information with locomotion reflexes. In contrast, lower thick myelinized fibers transmit more slowly sensory response (2m/s) (SCODRO et al., 2015; SCHUMACHER et al., 2007).

Amielinized nerve fibers transmit varieties of sensations to the spinal cord, from stimuli captured by nociceptors and mechanoreceptors, generating the characteristic sensitivity of claudication. While the most thick myelinized nerve fibers are responsible for the transmission of proprioceptive sensations, which influence the horse's mobility pattern during movement (Schumacher et al., 2007). From this, there are few studies regarding the proprioceptive risk of the animal from the nerve to be subjected to analgesia.

The main neurolytic drugs used in horses are ammonium salts, phenols and alcohols (isopropyl alcohol, benzilic alcohol and ethanol), but few studies indicate the most effective, taking into account the ideal concentration for obtaining nervous interruption for the intended time ; inflammatory and painful reactions at the infiltration site and action time. Also, it is known that the result obtained after anesthetic infiltration is expected as the analgesic therapy of neurolytic compositions (ESCODRO et al., 2011).

Even more rare are the studies about possible motor dysfunctions and proprioception deficit attributed to the use of neurolytic compositions of proximal perineural use to the palm digital nerves, correlating the location and infiltrated nerve into the chest thoracic limbs. What exists is the information that the more proximal the perineural analgesic block, the greater the caused motor deficit (SCODRO et al., 2011; BALLER et al., 2002; SCODRO, 2001; LUNA, 1998).

Given the lack of more information about the risk of proprioceptive deficit after perineal blockages, further research on the subject is necessary to identify the thoracic nerves that can present possible motor dysfunction after perineural analgesia and accident risks with accident the horse-horse-knight ensemble.

This work aimed to perform the postural assessment of horses submitted to anesthetic blocks with palm nerve bupivacaine, palm, ulnar, median and skin muscle, in isolation and in different times, seeking to identify possible motor dysfunctions associated with the sulved nerve.

2 MATERIAL AND METHODS

The experiment was conducted at the Innovation Laboratory in Surgery, Hemotherapy, Integrative Therapies and Veterinary Cell Phones of the Federal University of Alagoas (Labinoovet-Ufal), located at Fazenda São Luiz, in the municipality of Viçosa, Alagoas. The work was submitted and approved by the Animal Use Ethics Committee (CEUA-UFAL) under number 061/2014 (Annex 1).

- Selection and preparation of horses

7 adult adult horses from the Research and Extension Group (Grupequi-Ufal), without problems and trinators, of both sexes and without defined breed. The animals were subjected to prior cascament, aiming to provide better podal biomechanical equilibrium conditions for experimental execution. The evaluations were performed between 7 and 14 days after cascament, making it impossible to discomfort associated with it, as already described by Nicoletti et al. (2007).

During the experiment the animals were kept in stalls during the day and loose in paddocks at night. Food consisted of tifton 85 hay, Duancho® 12 mA commercial feed (3kg/day/animal), mineralized salt (Centaurus® - 50 g/animal/day) and ad -libitum water.

- **Perineural analgesia techniques**

Perineural analgesia techniques that will be described followed the recommendations and suggestions of Schumacher et al. (2008), Moyer et al. (2007) and Luna (1998), as well as followed by the anatomical references cited by Kainer (1990), Getty (1986) and Berg (1978). The local anesthetic used was 0.5 % Bupivacaine Hydrochloride without vasoconstrictor (Neocaína® - Cristalia Chemicals Pharmaceuticals Ltda - Itapira, Brazil), with variable volumes according to nervous group indications and techniques, to be described later.

Aiming at greater reliability in the location of the nerves at times of infiltration, from the nervous anatomical location indicated by Schumacher et al. (2008) and Moyer et al. (2007), a 25g -caliber hypodermic needle was inserted with 10 cm in length connected to the peripheral or neurolocalizing nerve stimulator (DL250 neurolocalizing - Deltalife - São Paulo, Brazil), as shown in Figure 1.

The initial intensity of the electrical stimulus used in the experiment was 5 mA and gradually reduced to 0.5 mA, with a pulse amplitude of 100 µA. The infiltrations were only performed when the electrical stimulus was equal to or less to 0.5 mA and yet promoted motor response, indicating proximity less than 0.3 centimeter of the needle to the nerve, as described by Credie et al. (2011), Scodro (2011) and Riverón et al. (2009).

Figure 1 - Use of neurolocalizing for nerve location

Source: Personal Archive

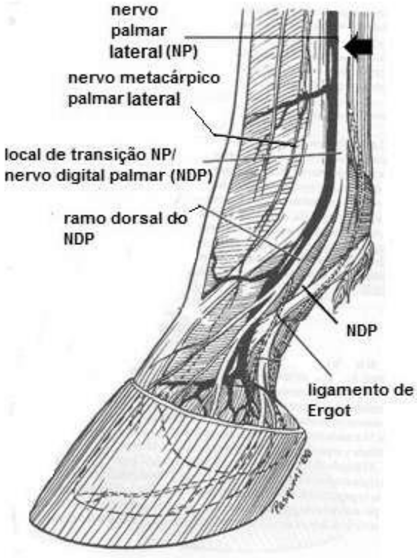
Following the perineal blockages, approximately thirty minutes were waited for the beginning of the evaluations, respecting the latency time of the Bupivacaine, as described to Palmares nerves by Scodro et al. (2015). Discrimination of the techniques used by nerve follow below:

a) **Palmares nerves**

The medial and lateral palm nerves are located between the digital flexor tendons and the billet's suspensory ligament, as shown in Figure 2.

For perineural infiltration, the animal limb was flexed and through bilateral palpation between the suspension ligament of the ticket (LSB) and the deep digital flexor tendon (TFDP) the nerves were identified, then 6 ml bucivacaine inserted, inserted 6 ml of 0.5% in each nerve (Moyer et al. 2007).

Figure 2 - Lateral view of the distal innervation of the left thoracic limb of the equine, being the place of infiltration of the 0.5% bubivacaine in the lateral palmar nerve indicated by the arrow.



Source: Kainer (1990). (Adaptada)

b) **Palmares metacarpic nerves**

Palmares medial and lateral metacarpic nerves are located between the LSB and the accessory metacarpics.

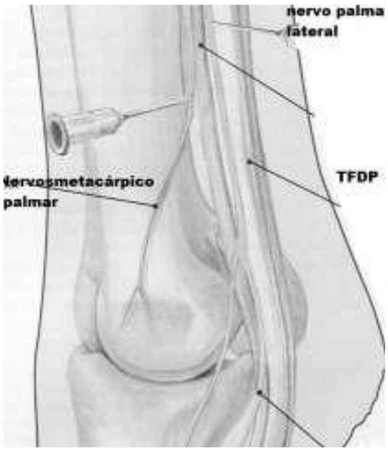
For anesthetic infiltration, the animal member was flexed and through bilateral palpation, taking as anatomical the distal end of the lateral and medial metacarpal metacarpal, the nerves were identified and then 6 ml of 0.5%bupivacaine, per applied by nerve, in the axial sense of the bone, as shown in Figure 3.

c) Ulnar nerve

The ulnar nerve is located in a depression between the ulnar carpal flexor muscle and lateral ulnar at a depth between 0.5 and 1.5 cm.

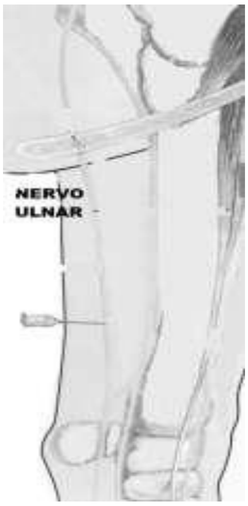
For the execution of the infiltration, the limb was kept in anatomical position and the anesthetized nerve on the forearm's caudal face, about 10 cm proximal to the carpal accessory bone, among the cited muscles, as seen in Figure 4. This nerve was infused 10 ml of 0.5%bupivacaine.

Figure 3 - Lateral view of the distal innervation of the equine limb, being the place of 0.5% bupivacaine infiltration into the lateral metacarpal nerve indicated by the needle.



Source: Moyer et al. (2007)

Figure 4 - Medial view of proximal innervation of the equine limb, the place of infiltration of the anesthetic on the ulnar nerve is indicated by the needle.



Source: Moyer et al. (2007)

d) Median nerve

The median nerve was anesthetized on the caudo-medial face of the limb, distal to the humerus-ralnar joint, in the proximal third of the radio, in the region where the ventral edge of the posterior superficial pectoral muscle inserts into the radio. The proximal needle was directed laterally through the fascia, near the radio surface or border of the radio, at a depth of three to five centimeters, injecting 10 ml of 0.5%Bupivacaine as illustrated in Figure 5.

Figure 5 - Medial view of proximal innervation of the left limb of the equine, the place of 0.5% Bupivacaine Infitude on the median nerve is indicated by the needle.

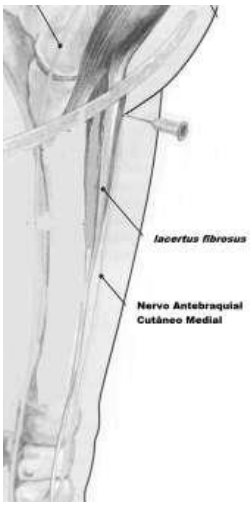
Source: Moyer et al. (2007)

e) **Cutaneous muscle nerve**

The cutaneous muscle nerve, also called medial cutaneous forebutal nerve, was infiltrated, in the cranial medial face, in the proximal third of the forearm, immediately distal from the dorsal appearance of the ulnar humerus joint, where it can be palpated when crossing the lacertus fibrosus (bicipital aponeurosis). Distal to Lacertus fibrosus in the medial aspect of the forearm, the skin muscle nerve forms two branches that can be anesthetized halfway between the humerus-ralnar and carpal joint (cranial and about 10 cm proximal to the nut). One of the branches passes the cranial aspect of the cephalic vein and the other in the cranial aspect of the ancillary cephalic vein, as seen in Figure 6.

Due to the possibility of variation in nerve positioning in relation to the veins, the deposition of the local anesthetic was performed subcutaneously, both cranial and caudal the cephalic and accessory cephalic veins. For this nerve, a volume of 10 ml of 0.5% bupivacaine was infused.

Figure 6 - Medial view of proximal innervation of the left chest member, the place of 0.5% bupivacaine infiltration is indicated by the needle.



Source: Moyer et al. (2007)

- **Experimental description**

The animals were subjected, at each moment (m) of the experiment, to analgesia with 0.5% bupivacaine of one or two nerves (when medial and lateral) of the thoracic limb. Perineural blockages were performed chronologically in the sense of this-depth, described in Table 1.

To obtain an experimental standardization, the left thoracic limbs (M.T.E.) were chosen for the perineal blocks, respecting a minimum interval of seven days between blockages. The minimum range between evaluations was 15 days.

Table 1 - Moments of perineal blockages

MOMENTO (M)	NERVE
1	Medial and lateral palmar nerve
2	Medial and lateral metacarpic nerve
3	Ulnar nerve
4	Median nerve
5	Muscle-cutaneous nerve

Source: Prepared by the author

The order of procedures performed at each moment was: moving evaluation and clinical examination, perineural anesthetic block (perineural analgesia techniques), new clinical examination, postural reactions assessment and postalgesia perineural statistical analysis.

- **Movement Evaluation and Clinical Examination**

At each experimental moment, the animals underwent moving evaluation and pre and post perineural block clinical examination.

The evaluations were performed with the moving animals on the asphalt, on horizontal plane and analyzed at step and trot, being the animal conducted at all times, during a twenty meter route in a straight line. The objective of this assessment was to analyze comparatively (before and after perineural block) two support sequences for each animal, while and trot, seeking to identify some change in equine movement and kinesiology after perineural analgesia.

The clinical examinations were performed by two veterinary doctors active in the clinic of equine, evaluating the spatial notion that each animal had in relation to the member submitted to perineural infiltration, being classified the animals in with or without change of motion at the moment after the blockade.

- **Evaluation of postural reactions**

The evaluation of the postural reactions of the horses was composed of the following evidence, adapted from evidence cited by Richards (2008), Reed (2003) and Borges et al. (2000):

a) Dors-flexion proof

With the static animal and in quadrupedal position the left thoracic limb was flexed, resting on the soil the dorsal surface of the hull and timed three times the time of functional restoration in hundredths of a second, obtaining two averages of time, one and another after Perineural block, as seen in Figure 7.

Figure 7- Performing the Dorsiflexion Proof

Source: Personal Archive

b) **Member cross**

This test consisted of positioning the limb submitted to perineural analgesia (left thoracic limb) over the other, keeping it on the ground, being also timed three times the time of restoration to normal posture, before and after blocking, seen in Figure 8.

Figure 8 - Member's crossing test

c) Landslide test

The test consisted of placing the left chest limb on a wooden surface with fifteen centimeters high wheels. When placing the limb on the wood, it had the function of sliding laterally and the equine immediately remove the limb. This test was also evaluated through time sockets, obtaining two averages of time, one pre and another after the perineural blockade, as seen in Figure 9.

Figure 9 - Performing the landslide test

Source: Personal Archive

d) Obstacle test

The obstacle test consisted of evaluating the equine's ability to overcome without overthrowing, a 2 meter wide and 15 centimeter tall wooden obstacle, and the animal is subjected to cross this obstacle to step three times before and after blockade , seen in Figure 10.

Figure 10 - Performing the obstacle test

Source: Personal Archive

- Statistical analysis

The experimental design used was the entirely randomized 2x5 factorial scheme, with 2 types of blockages (before and after), 5 nerves (palmar, metacaropic palmar, ulnar, median and cutaneous muscle) and 6 repetitions. For statistical analyzes were considered the observations of the claudication tests. The data obtained were submitted to variance analysis and the averages were compared by the T test to 5%for flexion back lameness, limb crossing and sliding. All statistical procedures were performed through SAS, version 9.0. Already in tests with obstacles, the data were analyzed descriptively and expressed in percentages, using the Microsoft Excel program.

3 RESULTS AND DISCUSSION

The techniques of perineal infiltration of the chest member of equine are feasible as described by Schumacher et al. (2008) and Moyer et al. (2007), but the use of neurolocalizing in the proximal nerve was not satisfactory, considering the initial intensity of the 5 mA electrical stimulus. In the ulnar and median nerves none of the animals enabled the intensity intended as initial, and the horses only accepted from 2 mA to 0.5 mA. In the muscle-cutaneous nerve, 4 animals (57% of sampling) also did not allow the initial use of 5 mA. This finding differs from Credie et al. (2011) and Riverón et al. (2009), since they cited the use of anesthetized dog brachial plexus and scodro et al. (2011) in palm nerves of horses.

Ulnar, median and cutaneous nerves of the horses have more myelinized nerve fibers of the larger Aβ-type type, with approximately 10 μm diameter. These denser and myelinized fibers quickly convey sensations to the spinal cord (6-30 m/s), which is fundamental for the integration of sensory information with the reflexes of locomotion (Schumacher et al., 2007; Drevemo et al. 1999). This fact already causes high anesthetic (proximal) anesthetic blocks with sedation animals to be reviewed using neurolocalizing, as the reaction to electrical stimulus can cause accidents with the anesthetist or professional, citations not available in the current literature and that make use unfeasible to use of equipment in proximal blockages in the clinical routine of lamewriting animals.

Regarding clinical evaluations with the moving animals on the asphalt, on horizontal plane and analyzed at step and trot, it was noted that neither evaluators observed a difference before and after the palm nerves infiltration and metacarpic palmares. In relation to the ulnar, median and cutaneous nerve, respectively 6 of the 7 horses (85%), 5 of 7 (71%) and 3 of 7 (42%) stumbled and dragged tweezers after the anesthetic administration.

Analyzing the use of neurolocalizing and clinical evaluations, it was noted that the results obtained through the approach of the muscle-cutaneous nerve diverged from the median and ulnar nerve. This can be explained by lower amounts of Aβ fibers in this nerve in relation to ulnar and median, and there is need for future histopathological studies to hire this fact. Still, the difference in results may be associated with the variation of nerve branches that pass the cranial aspect of the cephalic vein and the other in the cranial aspect of the accessory cephalic vein (Schumacher et al., 2008; Moyer et al., 2007). However, being provided for such variability, the deposition of the local anesthetic was performed in the subcutaneous tissue, both cranial and caudal the cephalic and accessory cephalic veins, minimizing such an error.

The results of the time of the time of postural reactions of horses submitted to the blockade of the palmar, metacarp, ulnar, median and skin muscle with 0.5% Bupivacaine before and after proof of back flexion, crossing and sliding are described in Table 2.

Table 2 - Average time (hundredths of second) of the postural reactions of horses submitted to the palmar, metacarpic, ulnar, median, skin muscle, with bupivacaine 0.5% before and after flexion, crossing and slip

Block	Nerve				
	Palmar	Metacarpic	Ulnar	Median	Skin Muscle
			Dors Flexion Proof (PDF)		
Before	109,43	121,90	148,94	110,89	125,61
After	110,05	108,76	86,33	220,83	120,50
R	P>0,9569	P>0,4198	P*<0,0001	P*<0,0003	P>0,6397
			Member cross test (PCM)		
Before	142,52	108,10	107,67	110,61	142,94
After	121,43	103,10	120,89	160,67	111,61
R	P>0,3648	P>0,6631	P>0,4106	P*<0,0097	P*<0,0175
			Sliding Proof (PD)		
Before	120,38	79,76	96,44	92,22	115,28
After	140,29	88,52	86,28	92,44	96,28
R	P>0,3610	P>0,3250	P>0,2345	P>0,9784	P*<0,0170

*P>0,05 In the T test has no statistical difference. The tests that presented significant difference are highlighted in gray.

The percentage of animals that promoted a drop in the obstacle before and after anesthetic administration with 0.5 % of the median, metacarp, palmar, ulnar and muscle-cutaneous nerves are represented in Figure 11 and 12.

There was no significant difference (p> 0.05) for the PDF, PCM and PD tests before and after the Palmares and Metacarpic perineural blockade. Although they are not the same nerves, these results corroborate with those obtained by Richard (2008) in relation to the digital palmar nerve, in a proprioceptive loss assessment study through the same postural evidence in horses submitted to neurectomy. Regarding the PO test, in the measurement before and after the time of anesthetic infiltration in the Palmar nerve, 1 of the 7 animals promoted drop in the obstacle (14%), with no difference.

Considering the infiltration of perineural bupivacain in the palm metacarpic, it was noted a difference between the moment before infiltration, when 14 % overthrew the obstacle and after, which 42 % promoted the fall, which proves its importance in motor innervation of the suspension ligament of Billet, often neglected at the medical clinic of horses.

Figure 11-Animal percentage promoted drop in obstacle before anesthetic administration with 0.5 % of the muscle-cutaneous, median, ulnar, metacarpal nerves palmar and palmar nerves.

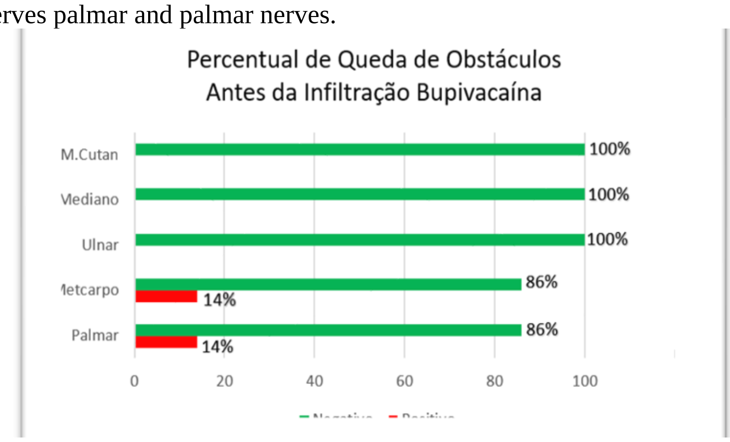
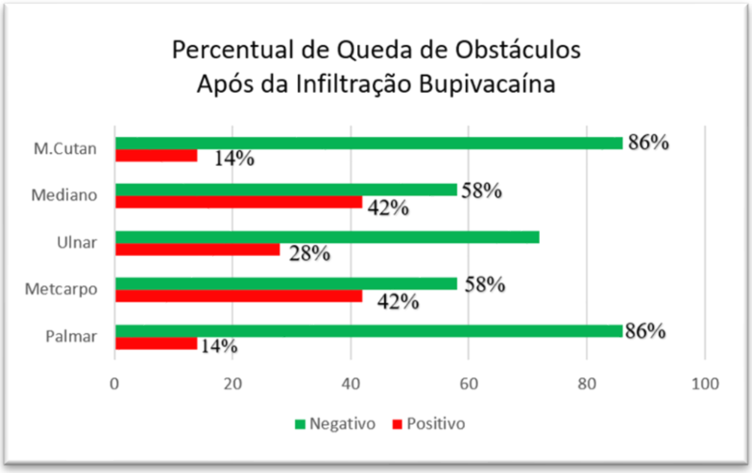


Figure 12-Pontage of animals that overthrew the obstacle before anesthetic administration with 0.5 % of the muscle-cutaneous, median, ulnar, metacarpal nerves palmar and palmar nerves.



There was no significant difference in PCM and PD tests before and after perineural blockade of the ulnar nerve. However, there was a significant difference before and after blocking in the PDF test, plus two animals (28%) promote obstacle drop during the PO test.

In the median nerve blockade, significant difference was observed before and after the block in the PDF and PCM tests. There was no significant difference in the PD test. In the PO test none of the animals overthrew the obstacle before the Bupivacaine administration, while after the blockade three overthrew the obstacle (42%), highlighting the animal's difficulty in raising the limb during the past.

There was a significant difference in PCM and PD tests in the muscle-cutaneous nerve block. Regarding the PO test, before the block no animal had toppled the obstacle, but after the lock an animal knocked down (14%), showing less specificity for such test.

The study of proprioception refers to the body's ability to detect the movement and the position of the joints (from Lahunto, 1983). It is important in daily movements and especially in sports movements that require spatial coordination. In sports horses, neurolytic blockages or anesthetic blocks before competitions are common, especially in those evidence not controlled by the International Equestrian Federation (FEI), such as cowgirl and marching.

The present study shows that there is no risk of proprioceptive loss only in the analgesic infiltrations of the palm nerves in horses. Horses infiltrated the palm metacarpic nerve, even without visual deficit identification and negative results for PDF, PCM and PD tests, should be monitored, as 42% were positive after blocking for PO test, which may take some Animals stumbling into heels or quickly need to advance from low obstacles.

The research contributes as an initial stone of a long walk in the detection of clinical safety of perineal blockages in equine thoracic limbs, as the literature always brings the analgesic quality in the blockade, disregarding the somatossensory system, which in collaboration with vision, has vital Importance in the coordination of movement, action of the antagonist, synergistic and fasteners agonist muscles, so that the equine athlete does not have falls for proprioceptive deficits and risk to the Horse Horse.

4 CONCLUSION

From this research it was possible to conclude that the anesthetic block of the medial and lateral palmar nerve has no risk of proprioceptive deficit or locomotion of horses submitted to this type of procedure. However, from the palmar metacarpal nerve block, including ulnar, median and skin muscle, significant proprioceptive deficits have been observed that can endanger the horse/knight, contraindicating the use of neurolytic agents and perineal anesthetics in athlete horses during sports activity.

REFERENCES

ALVES,A.L.G.;FONSECA,B.P.A.;THOMASSIAN,A.;NICOLETTI,J.L.M.;HUSSNI,C.A.;SILVEIRA,A.B. LOMBALGIA EM EQUINOS. Braz. J. vet. Res. anim. Sci., São Paulo, v. 44, n. 3, p. 191-199, 2007.

BALLER, L.S.; HENDRICKSON, D.A. Management of equine orthopedic pain. Veterinary Clinics of North America: Equine Practice, v.18, n.1,p.117-131,2002.

BERG, R. Regiones del miembro torácico,regiones membri thoracici. In: BERG, R. Anatomía topográfica y aplicada de los animales domésticos. Madrid: Editorial AC. 1978. p. 295-346.

BORGES, Alexandre Secorun; MENDES, Luiz Cláudio Nogueira; KUCHEMBUCK, Márcio Rubens Graf. Exame neurológico em grandes animais. Parte II-Medula espinhal: eqüino com incoordenação motora. Revista de Educação Continuada em Medicina Veterinária e Zootecnia do CRMV-SP, v. 3, n. 2, p. 03-15, 2000.

CREDIE, L.F.G.A.; FUTEMA, F.; ESTRELLA, J.P.N. *et al*. O uso do estimulador de nervos periféricos na anestesia regional em medicina veterinária. Clin. Vet., v.16, p.62-68, 2011.

De LAHUNTA A, 1983. Veterinary neuroanatomy and clinical neurology, 156-174. 2nd ed., WB saunders company, Philadelphia, USA.

DREVEMO, S. et al. Nerve block and intra-articular anaesthesia of the forelimb in the sound horse. Equine Veterinary Journal, v. 31, n. S30, p. 266-269, 1999.

DRIESSEN,B.;SANDELLA,M.;ZARUCCO,L. Development of a techinique for continuous perineural blockade of palmar nerves in the distal equine thoaracic limb.Veterinary Anesthesia and Analgesia,v.35,p.432-448,2008.

DYSON, S. J. Forelimb lameness in horse 1: an approach to diagnosis. Equine Pract., London, v. 8, p. 176-186, 1986.

ESCODRO, P.B. Técnicas de Dessensibilização dos Nervos Digitais em Eqüinos. Botucatu,2001, 25p. Monografia apresentada no Curso de Especialização em Cirurgia e Anestesiologia Veterinária. Faculdade de Medicina Veterinária e Zootecnia-UNESP-Botucatu.

ESCODRO,P.B. Avaliação da eficácia e segurança clínica de uma formulação neurolítica injetável para uso perineural em equinos. 2011. 147f. Tese (doutorado)- Instituto de química e Biotecnologia. Universidade Federal de Alagoas.

ESCODRO,P.B.,TONHOLO,J.,THOMASSIAN,A.,NASCIMENTO,T.G.,VILANI,R.G.O.C.Considerações acerca dos fármacos neurolíticos na medicina equina. Revista Brasileira de Medicina Equina, a.6,n.35,p.26-31,2011.

ESCODRO, Pierre Barnabé et al. ESTUDO COMPARATIVO ENTRE BUPIVACAÍNA 0, 5% E ROPIVACAÍNA 0, 5% NO BLOQUEIO DOS NERVOS PALMARES DE EQUINOS HÍGIDOS. Archives of Veterinary Science, v. 20, n. 2, 2015.

GAYNOR, J.S.; HUBLELL, A.E. Perineural and spinal anesthesia. Veterinary Clinics of North America: Equine Practice. v.7, n.3, p.501-520, 1991.

GETTY, R. Equino-Sistema Nervoso. In: Sisson e Grossman Anatomia dos Animais Domésticos.Rio de Janeiro:Guanabara Koogan,5 ed., v.1, 1986, p.592-656.

GILBSON, K.T.; STASHAK, T.S. Using perineural anesthesia to localize equine lameness. Vet. Med. v.84, n.11, p.1082-1086, 1989.

GÜNDTIZ, S. et al. Peripheral nerve block with phenol to treat spasticity in spinal cord injured patients. Spinal Cord, v. 30, n. 11, p. 808, 1992

GUTIÉRREZ, M. S. A. Tratamiento del dolor: técnicas locorregionales. Bloqueos. Oncol., v. 28, n. 3, p.144-146, 2005.

KAINER, R. A. Anatomia clínica del pie equino. Vet. Clin. North Am. Equine Pract., v.5, p.1-27, 1989.

KEG, P.R.; BELT, A.J.M.; VAN, D.E.N.; MERKEN, H.W. *et al*. The effect of regional nerve blocks on the lameness caused by collagenase induced tendinitis in the medimetacarpal region of the horse: a study using gait analysis and ultrassonography to determine tendon healing. Journal Veterinary Medicinal, v.39, n.5, p.349-363, 1992.

LAMOUNT, L. Anestésicos Locais. In DOHERTY,T. e VALVERDE, A. Manual de Anestesia e Analgesia em Equinos. São Paulo: ROCCA, 2008.p.144-154.

LIPTON,S. Neurolysis: pharmacology and drug selection. In: *Care*. J.B.Lippincott Co, 1993, p.343-358.

LOPES, M.A.F. Detecção de claudicação em equinos com um equipamento portátil à base de sensores inerciais sem fio. Revista Brasileira de Medicina Equina,a.7,n.37, p.10-16,2011.

LUNA, S.P.L. Anestesias perineurais e regionais em equinos. Revista de Educação Continuada do CRMV-SP. São Paulo, fasc.1, v.1, p.24-30, 1998.

MOYER, W.;SCHUMACHER,J.;SCHUMACHER,J. A Guide to Equine: Joint Injection and Regional Anesthesia. Pennsylvania: Veterinary Learning Systems, 2007.

NICOLETTI, J. L. M. et. al. Estudo comparativo experimental da injeção perineural do álcool benzílico 0,75% e do álcool etílico absoluto nos nervos palmares de equinos. Braz. J. Vet. Res. Anim. Sci., São Paulo, v. 44, n. 6, p. 401-407, 2007.

QUAN, D.; BIRD, S. J. Nerve conduction studies and electromyography in the evaluation of peripheral nerve injuries. The university of Pennsylvania orthopedic journal, v.12, p.45-51, 1999.

REED,S.M. Neurologic Exam. Journal of Equine Veterinary Science,v.23,n.11, p.484-492,2003.

RIBEIRO, G. H.C. Anatomia, biomecânica e principais patologias do membro distal de equinos: quartela e casco. (TCC). Goiânia, 2013.

RICHARDS, B. R. T. Evaluación de la propiocepción en equinos con neurectomia de los nervios digitales palmares, 2008. 33f. Trabajo final de curso – Universidad Austral de Chile, Valdivia, 2008.

RIVERÓN, A. A. O. et. al. Comparación clínica de ropivacaína y bupivacaína para bloqueo de plexo braquial por abordaje axilar mediante neuroestimulación, Ver. Mex. Anestesiol., v. 32, n. 1, p. 7-13, 2009.

ROSS, M.W.; DYSON, S.J. Diagnosis and management of lameness in the horse. St. Louis: Saunder Company, 2003

SAID, A.H., KHAMIS, Y, MAHFOUZ, M.F et al. Clinicopathological studies on neurectomy in equids. Equine Vet. J., v.16, n 5, p.442-46, 1984.

SCHUMACHER, J.; CASTRO, F.A. Anestesia dos membros.*In* DOHERTY,T. e VALVERDE, A. Manual de Anestesia e Analgesia em Equinos. São Paulo: ROCCA, 2008.p.241-254.

STASHAK, T. Claudicação em Equinos Segundo Adams. 5 ed. São Paulo: Rocca, 2006.

TARANTINO F. 2003 Sistema proprioceptivo. Disponível em: www.efisioterapia.net/articulos/leer92.php. Acesso em 11 de setembro de 2018.