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Comparison of Current Techniques for Palmar Digital Neurectomy in Horses

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Posterior digital neurectomy by the guillotine technique resulted in longer duration of cutaneous desensitization of the heels and less neuroma formation compared with perineural capping, CO₂ laser coagulation, or CO₂ laser transection techniques. Authors' address: Marion duPont Scott Equine Medical Center, Virginia-Maryland Regional College of Veterinary Medicine, Virginia Tech, P.O. Box 1938, Leesburg, VA 20177. © 1997 AAEP.

1. Introduction

Palmar digital neurectomy (PDN) is commonly performed for chronic degenerative conditions involving the posterior half of the foot. However, various surgical techniques have been developed in an attempt to reduce postoperative complications, including painful neuroma formation, regeneration of the transected nerve, and incomplete desensitization of the heel or navicular area from aberrant branches.¹ Simple transection, chemotherapy, cryrosurgery, coagulation, perineural capping, and CO₂ transection have all been reported with varying degrees of success.² Variations in the techniques and timing of postoperative follow-up make comparisons among different methods difficult. The purpose of this study was to evaluate the long-term outcome of four surgical techniques for PDN, including guillotine transection, perineural capping, CO₂ laser coagulation, and CO₂ laser transection.

2. Materials and Methods

Six sound, healthy adult horses had one of four PDN techniques performed on each forelimb digital nerve,

so that all four methods were utilized in each horse. The four techniques included guillotine transection to remove 2.5 cm of nerve; perineural capping that covered the proximal stump with epineureum; CO₂ laser transection at 10 W continuous pulsation (26,316 W/cm²); and CO₂ transection followed by coagulation of the proximal nerve stump with the laser beam until it became discolored yellow and crimped in appearance. All techniques were performed during one episode of general anesthesia. Postoperatively all horses were confined to a stall for 30 days followed by turnout on pasture for 330 days. Horses were evaluated every 30 days for (a) area of desensitization, (b) lameness, (c) pain on palpation, (d) sensitivity to hoof testers, and (e) neuroma formation determined by palpation of the proximal nerve end. After 360 days, horses were euthanized and longitudinal and transverse sections were obtained from each surgery site, which included proximal and distal nerve ends. Nerve ends were evaluated microscopically to assess nerve regeneration, neuroma formation, and fibrosis by using a grading system described by Schneider et al.³ A

NOTES

SOFT-TISSUE SURGERY

score of 0–3 was used to describe none, mild, moderate, or marked nerve regeneration and neuroma formation. A Kruskal–Wallis test was used to detect a difference among methods with significance set at $p < 0.05$.

3. Results

All four PDN surgical techniques resulted in pain on palpation of the surgical site at 30 days after surgery. No horse became lame, and response to hoof testers was negative in all horses during the 1-year observation period. The guillotine technique provided the longest duration of cutaneous desensitization to the caudal half of the foot (mean = 306 days), followed by laser transection and coagulation (mean = 300 days), perineural capping (mean = 279 days) and CO₂ laser transection (mean = 270 days), respectively. Skin desensitization was significantly ($p < 0.05$) longer after guillotine transection compared with perineural capping and laser transection but not significantly different from laser coagulation. Scores for nerve regeneration, Schwann cell deterioration, and neuroma formation were lower for guillotine neurectomy compared with the other methods. Guillotine neurectomy had a significantly lower score for neuroma formation and nerve regeneration compared with the other methods. There was no significant difference in neuroma formation among the other three methods. Scores for neuroma formation were 0.83 (range = 0–2) for guillotine, 2.0 (range = 1–3) for CO₂ coagulation, and 2.2 (range 1–3) for perineural capping and CO₂ transection. Scores for nerve regeneration were 1.0 (range 0–2) for guillotine, 1.2 (range = 0–2) for perineural capping, 2.0 (range = 1–3) for CO₂ coagulation, and 2.5 (range = 2–3) for CO₂ transection.

4. Discussion

Guillotine, coagulation, and cryoneurectomy have been reported to have as low as 4% painful neuroma formation. However, in a study with long-term follow-up palmar digital neurectomy completed by guillotine or electrocautery techniques, a return of lameness caused by painful neuroma formation or a return of sensation existed in 34% of the cases.⁴

There are few outcomes reported for perineural capping, although this technique requires increased anesthesia time and nerve handling, which can increase inflammation postoperatively. Our research suggested that increased complications are more likely with perineural capping or laser coagulation compared with the guillotine technique, which should provide a benefit in clinical cases.

The application of a CO₂ laser to the proximal nerve stump has recently been reported in horses as a means of sealing the proximal nerve stump, thereby inhibiting axoplasm flow and nerve regeneration.² In one recent study, 9–10 horses remained sound for 4–23 months after the use of laser neurectomy. We found more axon regrowth after CO₂ laser techniques were utilized than when a guillotine transection of nerves was utilized. This suggests that the neurectomy can be completed with similar success with the guillotine technique without the additional expense of using a surgical laser.

5. Conclusions

We presume that the guillotine method produced less painful neuromas because the nerve was stretched during transection, therefore allowing the proximal stump to withdraw into tissue less affected by surgical trauma. Furthermore, we suggest that the guillotine technique will provide optimal results if adequate nerve length is removed; an atraumatic technique and wound protection are used; and there is an appropriate reduction in patient activity postoperatively.

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