Palmar digital neurectomy in 24 horses using the guillotine technique

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Objective To determine the effectiveness and incidence of complications of palmar digital neurectomy using the guillotine technique in horses presented for lameness originating from sites innervated by these nerves.

Design Retrospective study of 24 clinical cases.

Animals Twenty-four horses undergoing a palmar digital nerve neurectomy between June 1997 and June 2001.

Methods The records of all horses undergoing a uniaxial or biaxial, unilateral or bilateral neurectomy during the defined time period were retrieved. Information retrieved from the record included breed, age, gender, discipline for which the horse was used, history, results of lameness examination, results of perineural anaesthesia, radiographic findings, surgery report, postoperative care, complications and outcome.

Results Seventeen geldings and seven female horses of mixed breeds, ranging in age from 1 to 16 years, that were used for a variety of non-racing, but competitive, athletic disciplines, underwent neurectomy using the guillotine technique during the specified time period. In 23 horses perineural anaesthesia was performed at the University Veterinary Centre to isolate the lameness. Anaesthesia resolved lameness in 18 horses. In five horses there was some residual lameness isolated to sites remote from the distal extremity. The most common radiographic finding was an increase in the number and or size of the synovial fossae of the navicular bone. Twenty-two horses underwent bilateral biaxial neurectomies and two horses with painful trauma-induced neuromas underwent unilateral, uniaxial neurectomy. There were no postoperative complications. All horses were rested for 3 months before returning to work. At least 1 year after surgery, 22 horses were in full work and two horses were not in work because of unrelated problems. Of the horses in work, 17 were considered free of lameness. The other five were competing, but receiving medication for residual lameness associated with sites remote from the distal extremity.

Conclusion Results of this study suggested that palmar digital neurectomy using the guillotine technique provided reliable and consistent resolution of lameness originating from sites innervated by these nerves. There were no significant complications.
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Neurectomy of the medial and lateral palmar digital nerves is an established procedure for treatment of chronic heel pain.[1] Transection of the nerves is suggested to desensitise the palmar aspect of the foot, relieving pain associated with the area.[1] Navicular syndrome is the most common indication for palmar digital neurectomy, [2-4] but the procedure is also used in horses with distal phalangeal fractures, calcification of the collateral cartilages of the distal phalanx and fractures of the navicular bone.[2-5] In horses with navicular syndrome the procedure should be performed in conjunction with corrective hoof trimming and shoeing to reduce abnormal forces on the foot and slow the progression of degenerative changes.[3]

The most common complication of neurectomy is painful neuroma formation. Various modifications of the original procedure have been described, each with the aim of reducing the incidence of this complication. Techniques include guillotine transection to remove a 2 to 4 cm segment of the nerve,[6] silicone capping and epineural capping of the nerve,[7,8] cryoneurectomy,[9] laser neurectomy,[10] injection of neurotoxic agents,[11,12] stainless steel ligatures,[13] and intramedullary anchoring of the nerve.[14] Electrocoagulation and application of radioactivite substances have also been attempted with limited success.[15,16] The guillotine technique has a lower incidence of painful neuroma formation than other techniques and also has the advantages of shorter surgery time, less expense and lower incidence of re-innervation.[4,10]

The purpose of this study was to evaluate the outcome and incidence of complications of using the guillotine technique for palmar digital neurectomy in horses with lameness originating from sites innervated by these nerves.

Materials and methods

Medical records of all horses undergoing palmar digital neurectomy using the guillotine technique at the University Veterinary Centre Camden between June1997 and June 2001 were retrieved. All horses undergoing uniaxial or biaxial, unilateral or bilateral neurectomy were included in the study.

Information retrieved from the records included age, breed and gender of the horse, use of the horse, history, lameness examination findings, results of perineural anaesthesia, radiographic findings, surgery report, postoperative care, complications and outcome.

Surgical technique

Horses were sedated prior to surgery using xylazine (0.3 to 0.5mg/kg, IV). Anaesthesia was induced with guaiphenesin (0.5 to 1mg/kg, IV) given to effect, followed by a bolus of either ketamine (2mg/kg, IV) or thiopentone (5 mg/kg, IV). An endotracheal tube was passed orally and anaesthesia was maintained using halothane in oxygen.

Horses were positioned in dorsal recumbency on a padded surgery table. The forelimbs were extended and secured to the horizontal crossbar of a metal frame using adhesive tape. Local anaesthesia of the digital nerves at the level of the sesamoids was performed to decrease pain associated with the surgical procedure and improve anaesthetic recovery. A 3cm skin incision was made, parallel and axial to the palmar digital nerve, using the neurovascular bundle as a landmark. The jaws of a curved mosquito haemostat were used to separate the subcutaneous

tissues, and to expose and isolate the palmar digital nerve from the adjacent palmar digital artery. After identification, the nerve was elevated from its bed and the distal portion transected sharply using a number 10 scalpel blade. Mosquito haemostats were then placed on the proximal end of the transected nerve to allow traction over a sterile tongue depressor. The nerve was transected under tension using a razor blade so the proximal end recoiled proximal to the incision. Any accessory branches were transected using the same technique. The surgical site was flushed with sterile saline and closed using a simple continuous layer of 2/0 polyglactin 910 in the subcutaneous tissue, and simple interrupted sutures of 0 nylon in the skin. Where the procedure was performed biaxially or bilaterally the same technique was used to transect the remaining nerves. Legs were bandaged from the hoof to the carpus.

Postoperative care

All horses received a single dose of procaine penicillin (20 mg/kg IM) prior to and 12 hours after surgery. Phenylbutasone was administered (4.4 mg/kg orally) prior to and 12 hours after surgery and continued (2.2 mg/kg orally, twice daily) for a further 6 days. Horses were hospitalised for 2 to 8 days following surgery. Postoperative management included bandaging for 2 to 3 weeks, box rest with hand walking for 4 weeks, followed by 2 months in a small yard. Three months after surgery work was recommenced and increased incrementally.

Follow up

Follow up was by telephone conversation or by re-examination at the University Veterinary Centre once the horse had returned to work. A successful outcome was defined as resolution of lameness and return to previous athletic activity

Results

Twenty-four horses from 1 to 16 years of age (mean 8.4 years) were included in the study. There were eleven Thoroughbreds, five Warm Bloods, three Australian Stock Horses, three Arabians and two Quarter Horses. Seventeen were geldings and seven were females. Ten horses were used for 3-day-eventing or show jumping, seven for dressage, three for camp drafting, one for cutting and two for endurance competition. One horse was not yet in work.

Twenty-three horses were primary accession cases and underwent lameness evaluation and perineural anaesthesia at the University Veterinary Centre. Medial and lateral palmar digital nerve anaesthesia was performed bilaterally in 21 of these horses at the mid-pastern level using 1.5 mL 2% prilocaine. In two horses presented for painful neuromas associated with previous trauma to the pastern, perineural anaesthesia was performed uniaxially and unilaterally 2 cm proximal to the neuroma. The remaining horse was referred for palmar digital neurectomy for treatment of navicular syndrome. The diagnosis was made by the referring veterinarian using perineural anaesthesia.

Radiographic evaluation of the distal extremity was performed in 21 horses at the University Veterinary Centre. Radiographic views included dorsopalmar 60 degrees, dorsopalmar 50 degrees and lateromedial. Radiographs were not available for the horse that was referred and were not taken in the two horses with painful neuromas.

There was a variety of lesions identified radiologically. Increased numbers and or size of synovial fossae of the navicular bone were most common and were seen in 19 horses. Other radiographic findings included loss of definition of the corticomedullary margin of the navicular bone (16), ossification of the collateral cartilages of the hoof (12), elongation and enthesiophyte formation of the proximal and or distal borders of the navicular bone (11), medullary cyst of the navicular bone (4), irregularity or calcification of the flexor cortex of the navicular bone (4), enthesiophytes of the wings of the navicular bone (4), rotation of the third phalanx (2), and pedal osteitis (1).

Based on the radiographic findings and response to local anaesthesia of the palmar digital nerves, 22 horses underwent biaxial neurectomies, bilaterally, and two underwent uniaxial neurectomy, unilaterally, for painful neuromas secondary to trauma.

Lameness completely resolved in 18 of the 23 horses undergoing perineural anaesthesia of palmar digital nerves at the University Veterinary Centre. In the remaining five horses, lameness was improved significantly. In these horses residual lameness was isolated by further perineural or intra-articular anaesthesia and radiographs. In all horses with residual lameness, it was associated with sites remote from the distal extremity. Following perineural anaesthesia, a minimum of 7 days rest was recommended prior to surgery to allow inflammation associated with the procedure to subside.

Twenty-one cases were re-examined at the University Veterinary Centre after the procedure. Follow-up on three horses was by telephone conversation. There were no postoperative complications in any of the horses. In the horses presented for re-examination, evidence of re-innervation was assessed by the response to pricking the skin of the heel bulbs with a pen. There was no evidence of re-innervation in any of the horses re-examined. Twenty-two horses were in work or competing at the time of publication. Follow up time ranged from 1 to 3 years. Seventeen horses were followed-up longer than 1 year but less than 2 years after neurectomy. Of these, 11 were competing without lameness, four were competing while receiving medication for lameness associated with sites remote from the distal extremity, one horse was retired after sustaining a carpal fracture and one horse was being used as a broodmare while recovering from septic pedal osteitis, the cause of which was not determined. Follow up greater than 2 years was available in seven horses. Of these six were competing without lameness and one was competing while receiving medication for lameness associated with sites remote from the distal extremity.

Discussion

The most common indication for medial and lateral palmar digital neurectomy is to alleviate pain associated with navicular syndrome.[2-4] This is consistent with the results of the current study, in which 21 horses radiographed at the University Veterinary Centre had changes associated with the navicular bone and lameness completely resolved in 18. Palmar digital neurectomy has also been used in horses with distal phalangeal fractures, navicular bone fractures and calcification of the collateral ligaments.[2-5] In the current study, two horses underwent uniaxial unilateral neurectomy for painful neuromas after trauma.

Many modifications of the original palmar digital neurectomy technique have been described.[6-16] The aim of each modification has been to reduce the incidence of painful neuroma formation and axonal regrowth that can result in re-innervation. Neuromas are thought to be associated with axonal invasion of

fibrous tissue as the proximal portion of the transected nerve attempts to reunite with the distal portion.[17] Lameness associated with painful neuroma formation is the most commonly reported complication after neurectomy, [2] with an incidence of 4 to 25 %.[4,10,11,18,19] In humans the incidence of painful neuroma formation is minimised by sharp transection of the nerve under tension, allowing it to recoil into soft tissue not exposed to trauma, weight bearing, or scarring.[2] Not all of these conditions can be easily met in horses, however, using the guillotine method of neurectomy, the nerve is sharply transected, and by stretching the nerve and removing 2 to 4cm, the proximal portion retracts proximally, away from the surgically traumatised tissue. It has been suggested that combining the guillotine technique with minimal dissection, careful tissue handling and good postoperative care, painful neuroma incidence can be minimised.[4,10]

A study comparing four methods of neurectomy supports the use of the guillotine technique.[10] In this study the guillotine technique had a significantly lower score for nerve regeneration, Schwann cell deterioration and painful neuroma formation when compared to CO_2 laser transection, laser coagulation or perineural capping. The guillotine method of palmar digital neurectomy is described in many texts, however clinical literature reporting the outcome and complications of this procedure are limited. One study compared the guillotine method (10 horses) with an electrocoagulation technique (47 horses) and reported an incidence of painful neuroma of 0% and 6% respectively. [4] There were no painful neuromas in the current study, lending further support to the guillotine method of neurectomy as the preferred technique.

Surgical technique alone is unlikely to prevent formation of painful neuromas and it is imperative that horses undergo adequate postoperative management, including compression bandaging of the surgical sites, strict box rest and small yard confinement.[4,6] The period of confinement of horses in the current study was similar to, or longer than previously reported, to minimise movement at the surgical site while the inflammatory reaction subsided.[4, 6]

Another common complication after neurectomy is re-innervation due to regeneration of the palmar digital nerves. [2,4,17] Clinical studies have shown that removal of a 2 to 4cm section of nerve decreases the likelihood of successful re-innervation and increases the time before this occurs.[17] A recent study showed that re-innervation and lameness, confirmed by palmar digital nerve anaesthesia, occurred in 10% of horses after the guillotine technique compared to a 26% incidence for the electrocoagulation technique.[4] Where re-innervation occurred, it was usually evident within 1 year of surgery.[4] Follow-up on all horses in the current study exceeded 1 year and indicated that re-innervation was an uncommon complication of the guillotine technique. Meticulous dissection during surgery is essential to identify clearly and remove aberrant branches of the palmar digital nerves that may leave residual sensation. Aberrant branches of the palmar digital nerves are reported to occur in 35 to 50% of horses.[17]

To achieve a satisfactory outcome following neurectomy, a complete lameness evaluation, including perineural anaesthesia, should be performed prior to surgery.[17] The owner and veterinarian should be satisfied that lameness resolves following perineural analgesia of the palmar digital nerves at the level where the neurectomy is to be performed.[17] Re-evaluation of the horse 10 minutes after deposition of 1.5 mL prilocaine around the palmar digital nerves limits diffusion and potential desensitisation of other structures in the vicinity.[17] This method gives a reliable indication of the degree of improvement that can be expected after neurectomy.[17]

A view propagated in the literature is that horses with other sites of lameness are not suitable candidates for neurectomy.[2] In the current study there were five horses with residual lameness following perineural anaesthesia of the palmar digital nerves that was isolated to sites remote from the distal extremity. The horses in the current study were middle-aged Thoroughbred geldings used for jumping and eventing, similar to the population identified in other studies.[4,11] It is not uncommon for horses of this age used for these equine disciplines to develop multiple sites of lameness. Our assessment of the horses in this study that had lameness referable to other sites was that, following neurectomy, any residual lameness could be managed. Neurectomy and treatment or management of other sites of lameness, in some cases, allowed horses to continue to compete at a level satisfactory to the owners, however before such horses undergo neurectomy it is essential other sources of lameness are accurately identified and a prognosis discussed with the owner.

The ability of horses to compete athletically following neurectomy has been questioned,[20] and neurectomy is not accepted in some equine disciplines.[2] The rules regarding neurectomised horses should be clarified with each association prior to performing the surgery. Performed correctly, the procedure does not involve the dorsal branch of the digital nerve; horses retain afferent sensation from the dorsal portion of the digit and are able to perform safely.[2] Ongoing daily hoof care is imperative to identify and treat penetrating wounds, bruises or abscesses. [2,17] Undiagnosed hoof abscesses can lead to septic arthritis of the distal interphalangeal joint, loss of hoof wall and deep digital flexor tendon rupture.[17]

Corrective hoof care and medical therapy have traditionally been offered as the first line of therapy for navicular syndrome. Palmar digital neurectomy has been viewed as the end stage treatment for navicular syndrome when other forms of therapy are unable to provide sufficient pain relief,[3] however recent research suggests that neurectomy has biomechanical benefits that may slow progression of the syndrome,[21,22] providing an alternative to the perception that neurectomy is a palliative treatment only.[6] Early surgical intervention may provide a more reliable resolution of lameness, slow the progression of the disease, and allow more consistent use of the horse before other sites of lameness limit its athletic career.

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BOOK REVIEW

***Handbook of Small Animal Practice**, 4th edn. Morgan RV, Bright RM and Swartout MS. Saunders, Elsevier Australia, Marrickville, 2003. 1355 pages. Price AUD379.50. ISBN - 7216 9282 6*

As its title suggests, this small animal medicine text is a practical reference book for small animal practitioners. In its hardcover, convenient, one-volume format the 1355 page text, like most internal medicine books, is divided into sections according to body-systems. There are additional sections on patient evaluation, ophthalmology otology, infectious diseases, behavioural disorders, nutritional disease, toxicology and environmental injuries. The section on patient evaluation is excellent, commencing with a thorough and practical guide to the complete physical examination. Selected diagnostic and therapeutic procedures such as pericardiocentesis, blood pressure measurement, percutaneous tube gastrostomy and bone marrow aspiration are described and illustrated clearly. The inclusion of ophthalmology and dermatology sections improves the book's utility as an `all-round' medical information source. The ophthalmology chapters include useful diagrams of simple surgical procedures such as entropion repair, eyelid sliding skin grafts and repair of prolapsed third eyelid glands. However, readers may be frustrated by the absence of photomicrographs to aid in identification of dermatologic and ocular lesions. The drug formulary is particularly extensive. It contains dose-rates for newer drugs that are not readily available in other texts, and the chapters where each drug is cited are helpfully listed.

Compared with the third edition of the Handbook of Small Animal Practice, in this latest edition, one half of the authors have returned to revise their work and one half have prepared new manuscripts. The outline style and chronology of the book remain the same, and most chapter titles and subjects are similar. The strength of this book lies in its excellent formatting that enables quick and easy information retrieval. In each chapter, the headings for each disease process are the same; definition, causes, pathophysiology, diagnosis, differential diagnosis, treatment and monitoring. Under each heading information is broken down into numbered points and lettered sub-points. This is an excellent template for students preparing examination answers and provides an orderly approach to the investigation of diseases.

Information on specific diseases is logically presented and a succinct overview is given but detail is sometimes lacking, perhaps because of space constraints. For example, in the cardiology section restrictive cardiomyopathies are defined, but no distinction is made between myocardial and endomyocardial forms of the disease. Similarly, treatment options listed for feline aortic thromboembolism are very limited. In the endocrine section there is no information on uncommon adrenocortical diseases such as primary hyperaldosteronism in dogs or cats. There are two other shortcomings of this textbook. Firstly, whether information is accurate or up-to-date varies markedly between chapters due to the multiauthor nature of the book. Secondly, by combining feline and canine diseases information inferred about feline diseases is often incorrect. For example, in the chapter on adrenocortical diseases a low-dose dexamethasone test using 0.01 mg/kg dexamethasone is stated to have 95% sensitivity in the detection of hyperadrenocorticism. Whilst this is true for dogs, the same certainly cannot be said for cats. In the same chapter, important points such as the high incidence of diabetes mellitus in hyperadrenocorticoid cats and the absence of a feline steroid-inducible isoenzyme of alkaline phosphatase isoenzyme are omitted.

With its practical advice, excellent drug formulary and succinct summaries of clinical diseases, this medicine text is likely to be most useful as an accessible, quick-reference guide for practitioners, for new graduates looking to expand their clinical skills and as a study-guide for veterinary students in their clinical training years.

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