The Effect of Volume of Local Anesthetic Administered into the Coffin Joint on Solar Toe or Heel Pain

Jim Schumacher, DVM; Michael Schramme, DMV, MRCVS;*
John Schumacher, DVM; Fred De Graves, DVM, PhD; Ruedi Steiger, DVM;
Roger Smith, VetMB, PhD, MRCVS; Mike Coker, DVM

Local anesthetic administered into the distal interphalangeal (DIP) joint is less effective in alleviating solar pain in the heel region than in the toe region. The analgesic effect increases with time after injection, and 10 ml of local anesthetic solution is more effective than 6 ml in alleviating pain in both regions. Authors' addresses: Department of Farm Animal and Equine Medicine and Surgery, Royal Veterinary College, University of London, Hawkshead Lane, North Mymms, Herts AL9 7TA, UK (Schramme and Smith); Department of Large Animal Surgery and Medicine, College of Veterinary Medicine, Auburn University, AL 36849-5522 (Schumacher, Schumacher, De Graves, Steiger, and Coker). *Presenter

1. Introduction

Clinical distinction between horses suffering from navicular disease and horses suffering from palmar heel pain arising from other structures in the heel is often difficult.[1] It has been suggested that analgesia of the distal interphalangeal (DIP) joint may be helpful in making this distinction, by localizing lameness to that joint[1] and/or to the navicular apparatus.[2] Recently, however, pain in the toe region of the sole was shown to be abolished by injection of local anesthetic solution into the DIP joint.[3] It is therefore important to know whether lameness due to pain in the heel region of the sole can also be abolished by injection of local anesthetic into the DIP joint. The effect of local anesthetic in the DIP joint on solar pain, induced in the toe and heel region of horses, was examined. A range of volumes (5–10 ml) of local anesthetic solution has been reported for diagnostic analgesia of the DIP joint.[2,3] To test the hypothesis that pain arising from both the toe and heel regions of the sole would be alleviated, irrespective of whether a large or small volume of local anesthetic solution was used, we assessed the effect of injecting 6 and 10 ml of local anesthetic into the DIP joint, on lameness caused by solar pain in the heel or toe region.

2. Materials and Methods

Seven horses with no signs of forelimb lameness were shod with custom shoes in both forelimbs. Each shoe had a three-eighths–16 inch nut welded to the inside of each branch at the angles of the sole (heel region), and to the inside of each branch at the dorsal margin of the sole (toe region). Flat-tipped set-screws, inserted through the nuts at the toe or the heel of one foot, were tightened so that each horse was obviously lame (i.e., with a marked head nod at walk). Horses were recorded on videotape at walk and trot on a hard surface before and after application of set-screws, and at 10, 20, and 30 min after injection of 2% mepivacaine hydrochloride into the DIP joint of the lame forelimb. After the 30-min evaluation, the set-screws were removed and any residual lameness was abolished by perineural analgesia of the palmar nerves at the level of the proximal sesamoid bones. Two set-screws were then applied to the opposite region of the sole in the opposite forefoot, and the same sequence was repeated.

In the first trial, 6 ml of 2% mepivacaine hydrochloride was administered into the DIP joint, and in the second trial, 10 ml was administered. The second trial was performed when each horse had been free of residual lameness for at least 24 h.

Five investigators, who were unaware of the foot or region of the sole selected for set-screw application, the volume of mepivacaine hydrochloride used, or the time since administration, evaluated gaits recorded on videotape from both trials, and assigned a lameness score to each gait of each horse. Effects of treatment on lameness score were evaluated using the Cochran-Mantzel-Haenszel method applied

to repeated measurements. P-values ≤ 0.05 were considered significant.

3. Results

After administration of 6 ml of mepivacaine hydrochloride into the DIP joint, median lameness scores did not decrease significantly for lameness caused by set-screws applied to the heel region of the sole. Lameness scores did, however, decrease significantly at all observations for lameness caused by set-screws applied to the toe region of the sole, and the median lameness score continued to decrease at each observation up to 30 min after injection. At 30 min after administration of 6 ml of mepivacaine hydrochloride into the DIP joint, lameness was absent or inconsistent and difficult to detect at the trot in two out of seven horses with set-screws applied to the toe region, and yet lameness was still apparent in all horses with set-screws applied to the heel region. After administration of 10 ml of mepivacaine hydrochloride into the DIP joint, median lameness scores were significantly lower at all observations for lameness caused by set-screws applied to either the heel or toe regions of the sole. The median lameness score continued to decrease at each observation up to 30 min after injection. At 30 min after injection of 10 ml of mepivacaine hydrochloride into the DIP joint, lameness was absent or inconsistent and difficult to detect at the trot in 6 of seven horses with set-screws applied to the toe region and four of seven horses with set-screws applied to the heel region of the foot.

4. Discussion

Results of this study showed that:

1) Lameness created by set-screw pressure in the heel region of the sole was less likely to be attenuated by administration of local anesthetic into the DIP joint than was lameness created by set-screw pressure in the toe region of the sole
2) Attenuation of lameness was more effective with 10 ml than with 6 ml of local anesthetic
3) Attenuation of lameness increased with time after injection.

The palmar digital (PD) nerves course along the medial aspect of the ungular cartilages in close proximity to the palmar pouch of the DIP joint. Local anesthetic solution administered into the DIP joint may, therefore, anesthetize the PD nerves at this level and the structures innervated by them.[4] The difference in effect of local anesthetic in the DIP joint between pain in the toe region of the sole and pain in the heel region of the sole may be explained by the specific innervation of these regions by different sensory branches of the PD nerves. Distal to the level of the coronary band, the PD nerves run dorsad through the parietal groove of the third phalanx and are responsible for the innervation of the corium of the hoof wall and the sole in the toe region of the foot.[5] Proximal to this level, the PD nerves give off superficial branches that supply the laminar and solar corium of the heels and quarters.[5] We suggest that these superficial branches supplying the heels originate from the PD nerves proximal to the site of abutment between the PD nerves and the palmar pouches of the DIP joint.

The more obvious improvement in lameness after administration of 10 ml of local anesthetic compared to administration of 6 ml may be the result of either increased diffusion of local anesthetic across the synovial membrane or distension of the palmar pouches of the DIP joint, causing them to contact the PD nerves and their branches more intimately and more proximally. In our study, 6 ml of local anesthetic solution administered into the DIP joint did not affect lameness caused by pain in the heel region of the sole, and in another study, 5 ml of local anesthetic in the DIP joint alleviated pain associated with amphotericin-B induced navicular bursitis.[6] Therefore, injection of 6 ml or less of local anesthetic solution into the DIP joint may help the clinician to distinguish between pain arising from the DIP joint or the navicular apparatus and pain arising from the heel of the foot. Administration of more than 6 ml of local anesthetic solution into the DIP joint may not distinguish between pain arising from the DIP joint or the navicular apparatus and pain arising from the solar surface of the foot.

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