A Review of Recent Studies Concerning Diagnostic Analgesia of the Equine Forefoot (21-Nov-2003)

J. Schumacher1, M. C. Schramme2, Jim Schumacher3, F. DeGraves4, R.K. W. Smith5 and M. Coker6

1,4,6Department of Clinical Sciences, College of Veterinary Medicine, Auburn University, AL, USA.
2 The Department of Clinical Sciences, College of Veterinary Medicine, Cornell University, Ithaca, NY, USA.
* Presenter.
3 The Department of Veterinary Surgery, University College, Belfield, Dublin, Ireland
5 The Department of Food Animal and Equine Medicine and Surgery, Royal Veterinary College, University of London, UK.

1. Introduction
In recent years, clinical observations, anatomical studies, and results of clinical trials have helped to clarify interpretation of the results of regional, intra-articular, and intrabursal analgesia of the forefoot of horses. In this manuscript, we present a summary of current knowledge of the use of analgesia to localize sites of pain in the forefoot of lame horses.

2. Anesthesia of the Palmar Digital Nerves
For many years, clinicians have believed that a positive response to anesthesia of the palmar digital nerves of lame horses localizes pain to the palmar third of the foot, including the palmar aspect of the distal interphalangeal (DIP) joint [1]. Easter et al., [2] found, however, that anesthesia of the palmar digital nerves just proximal to the bulbs of the heel alleviated lameness caused by endotoxin-induced pain in the DIP joint, indicating that the palmar digital nerves innervate the entire DIP joint. This report corroborated an anatomical study that demonstrated that the dorsal branches of the palmar digital nerves do not innervate the DIP joint [3].

Some clinicians describe the proper site for anesthesia of the palmar digital nerves to be anywhere from the proximal margin of the ungular cartilage to the mid pastern region, [4] but others believe that it is important to anesthetize the nerves near the proximal margin of the ungular cartilage [5,6]. One theoretical advantage of anesthetizing the palmar digital nerves as far distally as possible is that anesthesia of the dorsal branches of the palmar digital nerve is more likely to be avoided [6]. According to the results of the studies by Sack [3] and Easter et al., [2] however, the dorsal branches are unlikely to contribute much more than sensory innervation to the dorsal aspect of the coronary band and dorsal laminae of the foot. We believe that deposition of local anesthetic solution in the mid or proximal portion of the pastern might result in analgesia of the proximal interphalangeal (PIP) joint of some horses [a]. To avoid the possible complication of desensitizing part of the PIP joint, we recommend that each palmar digital nerve be anesthetized by depositing subcutaneously no more than 1.5 ml of local anesthetic solution at, or distal to, the proximal margin of the ungular cartilage.

3. Semi-ring Block
A semi-ring block, performed after a negative response to a palmar digital nerve block, is unlikely to result in a positive response, because the dorsal branches of the palmar digital nerves contribute little to sensation within the foot [3]. The palmar digital nerve block will already have anesthetized the entire foot, with the exception of the dorsal portion of the coronary band and the dorsal laminae of the foot.

4. Abaxial Sesamoid Nerve Block
Anesthesia of the palmar digital nerves and their dorsal branches, at the level of the proximal sesamoid bones (i.e., an abaxial sesamoid nerve block), desensitizes the foot, the PIP joint, the middle phalanx and associated soft tissues, the distal and palmar aspects of the proximal phalanx, and possibly, the palmar portion of the metacarpophalangeal joint [7,8].
Performing the nerve block at the base of the proximal sesamoid bones decreases the likelihood of partially desensitizing the metacarpophalangeal joint [7,8]. Using a small volume of local anesthetic solution (i.e., ≤ 2 ml) and directing the needle distally, rather than proximally, also decreases the likelihood of partial analgesia of the metacarpophalangeal joint.

5. Analgesia of the Distal Interphalangeal Joint

By using a dorsal parallel approach (rather than the commonly used dorsal perpendicular approach), administering local anesthetic solution into the DIP joint is easily accomplished (Fig. 1) [9]. Mepivacaine HCl administered into the DIP joint desensitizes the DIP joint, [2] the navicular bursa, [10] and the toe region of the sole [11,12]. When a large volume of mepivacaine HCl (i.e., 10 ml) is administered, the heel region of the sole is also desensitized [12].

Figure 1. By using a dorsal parallel approach, administering local anesthetic solution into the DIP joint is easily accomplished. - To view this image in full size go to the IVIS website at www.ivis.org . -

Local anesthetic solution, administered into the DIP joint, may desensitize subsynovial nerves that supply sensory fibers to the navicular bone and its collateral sesamoidean ligaments [13] or the palmar digital nerves, which lie in close proximity to the palmar pouch of the DIP joint [10]. In addition, Gough et al., [14] found that local anesthetic solution diffused from the DIP joint into the navicular bursa in a study using cadavers.

A negative response to intra-articular analgesia of the DIP joint may not eliminate the navicular bone and its related structures as the source of lameness. In a study of 102 horses with chronic foot pain, Dyson [15] found that 21% of horses failed to respond to intra-articular analgesia of the DIP joint but improved significantly after intrabursal analgesia of the navicular bursa. A recent study showed that lesions of the deep digital flexor tendon (DDFT) at the level of the tendon's insertion to the distal phalanx were more effectively desensitized by administration of local anesthetic solution into the navicular bursa than by analgesia of the DIP joint [16]. Some of the lame horses in Dyson's study [15] that responded to analgesia of the navicular bursa but were unresponsive to analgesia of the DIP joint may have had lesions in the insertion of the DDFT rather than disease of the navicular bone and its related structures.

Ten milliliters of mepivacaine HCl administered into the DIP joint desensitizes the entire sole, but a smaller volume of mepivacaine HCl (i.e., < 6 ml) is unlikely to desensitize the heel portion of the sole [12]. If lameness is improved by a palmar digital nerve block, evaluation of the gait after intra-articular analgesia of the DIP joint with a low volume of mepivacaine HCl (i.e., ≤ 6 ml) may help to determine if pain in the soft tissues of the heel region is the cause of lameness [12,17]. Pain is unlikely to originate from the sole of the heel if lameness is ameliorated by analgesia of the DIP joint using a low volume of mepivacaine HCl.

6. Analgesia of the Navicular Bursa

A study comparing various techniques for inserting a needle into the navicular bursa showed that a method described by Verschooten et al., [18] was the most accurate approach [19]. Using this approach, a 20-gauge, 8.9 cm (3.5 in), disposable, spinal needle is inserted between the bulbs of the heel just above the coronary band, and the needle is advanced along a sagittal plane aiming for a point 1 cm below the coronary band, midway between the toe and the heel (Fig. 2). The spinal needle is advanced until the tip of the needle contacts bone, and a mixture of local anesthetic solution (2 - 3 ml) and a radiographic contrast medium (0.5 - 1 ml) is injected. Further flexing the lower portion of the limb may decrease resistance to injection. The foot is then examined radiographically immediately after injection of the bursa. Radiographic identification of the contrast medium within the bursa is evidence of a successful bursal injection.

Figure 2. A study comparing various techniques for inserting a needle into the navicular bursa showed that a method described by Verschooten et al., [18] was the most accurate approach [19]. - To view this image in full size go to the IVIS website at www.ivis.org . -

A positive response to administration of local anesthetic solution into the navicular bursa indicates disease of the navicular bursa, disease of the navicular bone and/or its supporting ligaments, [17] solar toe pain, [20] or disease of the DDFT [15]. Even though analgesia of the DIP joint results in analgesia of the navicular bursa, [10] analgesia of the navicular bursa does not result in analgesia of the DIP joint [15,17,21-23]. Analgesia of the navicular bursa may help to differentiate pain...
associated with disease of the DIP joint from pain associated with disease of the navicular bone and associated structures. Pain arising from the DIP joint can likely be excluded as a cause of lameness when lameness is attenuated within 10 min by analgesia of the navicular bursa [23].

There are at least two possible explanations for the observation that analgesia of the navicular bursa does not cause analgesia of the DIP joint: (1) the site of direct contact between the palmar pouch of the DIP joint and the palmar digital nerves is located at a region proximal to the origin of the deep branches that innervate the DIP joint and the navicular bursa, and the site of direct contact between the navicular bursa and the palmar digital nerves is located distal to these branches (Fig. 3) [10,23]; and (2) local anesthetic solution may diffuse more slowly from the navicular bursa to the DIP joint than from the DIP joint to the navicular bursa.

Many investigations [13,14,17,24,25] found a significant difference between the extent of diffusion from the DIP joint to the navicular bursa and the extent of diffusion from the bursa to the DIP joint. In one study, four times more Luxol-fast, blue dye, and mepivacaine HCl diffused from the DIP joint into the navicular bursa (65%) than vice versa (12.5%) [13]. In a cadaver study, significantly more mepivacaine HCl was found in the navicular bursa after injection of the DIP joint with mepivacaine HCl than the converse [14].

In addition to experimental findings concerning the effect of analgesia of the navicular bursa, clinical observations indicate that a positive response to intra-articular analgesia of the DIP joint and a negative response to intrabursal analgesia of the navicular bursa incriminate pain within the DIP joint as the cause of lameness [22]. This clinical observation is valid if solar pain can be eliminated as a cause of lameness [11,12,20].

7. Effect of Time on Interpretation of Analgesia of the DIP Joint or Navicular Bursa
Some clinicians have assumed that improvement in lameness observed within 10 min after injection of the DIP joint with local anesthetic solution indicates that lameness is caused by DIP joint pain alone. Improvement observed more than 10 min after injection, on the other hand, would be caused by diffusion of local anesthetic solution into the navicular bursa or around the nerves providing sensory innervation to the navicular bone and its associated structures [21,26]. This assumption seems to be invalid, because a positive response to intra-articular analgesia of the DIP joint has been observed to occur within 5 - 8 min of injection in a majority of horses with navicular disease or experimentally induced navicular bursal pain [10,22,27].

Results of several trials indicate that the effect of intra-articular analgesia of the DIP joint or intrabursal analgesia of the navicular bursa on lameness should be assessed soon after injection (i.e., within 10 min), because after this period, the structures that are desensitized by diffusion of the anesthetic solution become uncertain [12,20,23].

8. Diagnostic Analgesia of the Digital Portion of the DDFT
In a study of 72 horses with foot pain, significant abnormalities of the digital portion of the DDFT were identified in 30 of the horses using magnetic resonance imaging [16]. An abaxial sesamoid nerve block abolished or improved lameness in all 30 horses, but palmar digital nerve block, analgesia of the DIP joint, and analgesia of the navicular bursa all ameliorated lameness in only two-thirds of these horses. Because lameness caused by disease of the DDFT within the foot often failed to improve significantly after analgesia of the palmar digital nerves, the DIP joint, and the navicular bursa, we believe that a portion of the DDFT within the foot receives its sensory supply from more proximal deep branches of the medial and lateral palmar digital nerves that enter the digital sheath. Improvement of lameness in horses with similar lesions of the DDFT after intrathecal analgesia of the digital synovial sheath has been described [28].

Performing intrathecal analgesia of the digital sheath of the DDFT on horses with lameness that is unchanged after analgesia of the palmar digital nerves but resolves after an abaxial sesamoid nerve block may be useful. Resolution of lameness after intrathecal analgesia of the DDFT sheath justifies clinical suspicion of a lesion of the digital portion of the DDFT.

Clinicians should be aware that techniques of diagnostic analgesia of the horse's foot might provide misleading information concerning the site of pain causing lameness because of possible variations in digital neurological anatomy or misdirection.
of a needle during administration of local anesthetic solution. Results of articular, bursal, or regional analgesia of the foot should be interpreted with at least some degree of skepticism.

Footnote

References


17. Dyson SJ, Kidd L. Comparison of responses to analgesia of the navicular bursa and intraarticular analgesia of the distal


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