Continuous peripheral neural blockade to alleviate signs of experimentally induced severe forelimb pain in horses

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Objective—To investigate the efficacy and safety of a low-volume, single-catheter, continuous peripheral neural blockade (CPNB) technique to locally deliver bupivacaine to alleviate signs of severe forelimb pain resulting from experimentally induced tendinitis in horses.

Design—Randomized controlled experimental trial.

Sample—14 horses and 5 forelimbs from equine cadavers.

Procedures—Horses underwent collagenase-induced superficial digital flexor tendonitis in the midmetacarpal region of 1 forelimb. To deliver analgesia, a closed-tip catheter was placed from lateral to medial, approximately 12 cm distal to the accessory carpal bone, between the suspensory ligament and accessory ligament of the deep digital flexor tendon. Success of catheter placement and anesthetic delivery was documented ex vivo in 5 forelimbs from equine cadavers. Effective analgesia in affected forelimbs of horses from continuous (n = 7) versus intermittent (7) local anesthetic delivery (intermittent peripheral neural blockade; IPNB) was compared over a 3-day period.

Results—Horses that received CPNB in the affected forelimb were less lame than horses that received IPNB. A lower proportion of CPNB-treated horses had behavioral and physiologic signs of pain, compared with IPNB-treated horses. Neither technique completely blocked the sensation of pain or resulted in swelling in the distal portion of the forelimb, vasodilation, or an increase in lameness. After removal, Staphylococcus aureus was cultured from 1 catheter tip.

Conclusions and Clinical Relevance—For short-term treatment, CPNB was more effective than IPNB for reduction in signs of severe pain in the distal aspect of the forelimb of horses. (J Am Vet Med Assoc 2011;238:1032–1039)

Although objective data are lacking that prove that the effects of severe pain are detrimental for horses, it is known that to avoid the development of support-limb laminitis, an increase in comfort on the affected limb should be provided. In experimental and clinical studies, the efficacy and safety of epidural analgesia in the reduction of signs of severe hind limb pain in horses has been demonstrated; as such, catheters are commonly placed to allow repeated epidural administration. In the forelimb, no local treatment is used clinically to provide postoperative analgesia.

Continuous regional anesthesia is used to control signs of pain in human and small animal patients. Clear, objective data support its use postoperatively, with a decrease in signs of pain, a decrease in dose and frequency of administration of pain medication, and faster rehabilitation. In horses, a method has been described experimentally for CPNB. The CPNB technique in horses reduced hoof-withdrawal response to both pressure and electrical stimulation. Despite its possible value, equine clinicians have been wary of the technique. This may be because of vasodilation and swelling that have occurred in the distal aspect of the limb and concern that complete lack of pain may lead to limb overuse and subsequent damage to an already injured limb. A third concern, especially important to the equine orthopaedist, is that catheters and drug delivery devices may introduce infectious agents.

The purpose of the study reported here was to perform a randomized controlled experimental trial to investigate the efficacy and safety of the CPNB technique in treating horses for signs of severe pain resulting from experimentally induced tendinitis in the distal aspect of the forelimb. Modifications to the technique were made to reduce the cost of instrumentation, to lessen the likelihood of complete neural blockade of

**Abbreviations**

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Definition</th>
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<tr>
<td>ALDDFT</td>
<td>Accessory ligament of the deep digital flexor tendon</td>
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<tr>
<td>CPNB</td>
<td>Continuous peripheral neural blockade</td>
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<td>IPNB</td>
<td>Intermittent peripheral neural blockade</td>
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<tr>
<td>SDFT</td>
<td>Superficial digital flexor tendon</td>
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<td>SL</td>
<td>Suspensory ligament</td>
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the distal portion of the forelimb, to minimize the risk of nerve injury during catheter placement, and to allow anesthetic delivery more proximally in the metacarpus. We hypothesized that CPNB would be safe and would result in lower lameness scores and fewer horses with behavioral and physiologic signs of pain at rest.

Materials and Methods

Horses—Anatomic studies to document success of injectate delivery were performed on forelimbs of adult Thoroughbreds and Standardbreds (n = 5) that had been euthanized for a different study. For the in vivo trial, young adult Thoroughbred or Thoroughbred crossbred horses that had undergone experimentally induced tendonitis for another study were used (median age, 4 years [range, 3 to 8 years]; median body weight of 535 kg [1,180 lb] with a range of 415 to 565 kg [910 to 1,240 lb]). All horses were acclimated to housing and handling areas for a minimum of 10 days prior to the beginning of this study. The study was approved by the university’s Institutional Animal Care and Use Committee.

Ex vivo catheter placement and anatomic studies—Limbs for anatomic studies were harvested at the level of the proximal aspect of the antebrachium. Prior to forelimb harvest, 2 large stay sutures were placed in a cruciate pattern through the muscles and skin of the caudal antebrachium to maintain normal anatomy of the structures in the distal portion of the forelimb.

While the forelimb was maintained in an extended weight-bearing position, a 20-gauge, closed-tip, flexible polyamide nylon catheter from an epidural catheter kit® was placed approximately 12 cm distal to the accessory carpal bone (Figure 1). The catheter kit included an epi-
dural needle (Tuohy tip) for catheter insertion and an adapter for slip tip or Luer lock connection to the proximal end of the catheter. A small (stab) vertical skin incision was made laterally between the SL and the ALDDFT. The introducer needle was inserted through the stab incision, with the rounded side directed toward the palmar surface. The lateral palmar fascia was punctured and the introducer needle advanced, from lateral to medial, between the SL and ALDDFT, so that the distal end was adjacent to or through the thinner medial palmar fascia. After confirmation of correct needle placement by palpation of the nerve tip medially, beneath the skin, the stylet was removed and the catheter inserted. The introducer needle was carefully removed, leaving the distal end of the catheter deep to the medial palmar fascia and the more proximal catheter holes deep to the lateral palmar fascia. The introducer needle was passed from the dorsolateral aspect of the metacarpus, subcutaneously, to exit the existing stab incision. The catheter was passed retrograde through the introducer needle to exit the skin at the dorsolateral aspect of the metacarpus, where it was secured via a single suture through the skin and butterfly made of porous, nonelastic tape. The catheter was trimmed so that the proximal free end could reach the middle of the antebrachium, and the clamp adapter was attached. A single interrupted suture was placed through the skin to close the stab incision.

In 2 forelimbs, 7 mL of new methylene blue was injected via the catheter, and the forelimbs were dissected for identification of dyed structures. In 3 forelimbs, 7 mL of new methylene blue was injected via the catheter, and the forelimb was frozen and sectioned in 1-cm increments in the transverse plane for identification of dyed structures. When the palmar nerves were not dyed blue, the distance between the nerve and dyed tissue was measured in millimeters.

In vivo catheter placement for continuous versus intermittent analgesia—Forelimb selection (left or right) was made by a coin toss for the first horse and then alternated for each subsequent horse in the trial. Tendonitis induction was performed daily in pairs; therefore, choice of CPNB or IPNB was made each day by coin toss on the first horse, and the alternate treatment was performed on the second horse of that day. Horses were sedated with detomidine (0.01 mg/kg [0.005 mg/lb], IV) and butorphanol (0.01 mg/kg, IV). Local anesthesia was achieved through median nerve and ulnar nerve blockade with 5 mL (100 mg) of 2% lidocaine and 5 mL (25 mg) of 0.5% bupivacaine at each site and subcutaneous placement of 0.3 mL of heparin (1,000 U/mL) to the catheter lumen after placement to confirm catheter patency and to prevent intraluminal clot formation by contaminating blood during collagenase injection for tendonitis induction.

Collagenase-induced core lesions were created in the tensile region of the midmetacarpal region of the SDFT of 1 forelimb. The duration from local median nerve and ulnar nerve blockade to completion of tendonitis induction was approximately 1 hour. After lesion induction, a 7-mL bolus injection of bupivacaine was given via the catheter, and phenylbutazone (4.4 mg/kg [2 mg/lb], IV) was administered (t = 0 hours). Over the following 3 days, 10 mL of 0.5% bupivacaine was delivered via the catheter, either continuously via a battery-powered infusion disk at the rate of 0.14 mL/h or intermittently via manual injection with bupivacaine boluses of 0.85 mL every 6 hours.

The forelimbs were bandaged with a compression wrap over the metacarpus. The catheter and infusion disk or injection port were incorporated within the bandage along the distal and lateral aspect of the antebrachium, so that observers could not differentiate between groups (Figure 1). The horses were confined individually to box stalls, and phenylbutazone (2.2 mg/kg [1 mg/lb], IV) was administered that evening at t = 8 hours. The following morning, phenylbutazone (3.3 mg/kg [1.5 mg/lb], IV) was administered followed by phenylbutazone (2.2 mg/kg, PO) every 12 hours for 3 days and then every 24 hours for 4 days. Twenty-four hours after pump cessation for CPNB or the final bupivacaine administration for IPNB, the catheter was removed. Bacterial culture of the catheter tip was performed if there was pain on palpation or swelling of the catheter insertion site at the time of removal.

In vivo data collection—Ultrasongraphy was performed 24 hours after lesion induction to confirm successful formation of an SDFT core lesion. Bandage changes and examination of the forelimbs were performed daily. Sensitivity to digital palpation, swelling, and presence of increased heat at the catheter insertion site were evaluated at each bandage change, and forelimbs were digitally photographed. In CPNB-treated horses, the continued and normal function of the pump was confirmed every 12 hours, and in IPNB-treated horses, continued catheter patency was confirmed at each bolus administration every 6 hours.

Horses were video recorded at 1 hour prior to and 6, 12, 18, 24, 30, 36, 48, 60, 72, 84, and 96 hours after tendonitis induction in the same pattern as follows: toward the stationary video camera, in a left-hand quarter circle past the videographer, and then in a large, right-hand semicircle back to their starting point, walking away from the videographer. At completion of the study, video clips were digitized and placed in a random sequence on a master compact disk. Two board-certified surgery specialists (JC and SLF) and 1 surgery resident (HLR) graded the randomized clips. Each observer was blinded to treatment group and time point. Lameness was graded on an 11-point simple descriptive scale (0 to 10; Appendix).

During video recording, lameness was scored by the nonblinded investigator (data not used in statistical analysis). Heart rate, respiratory rate, appetite, attitude, posture, and the presence of sweat along the neck and flank were evaluated in the stall prior to each lameness evaluation and video recording. A notation for resting behavioral or physiologic signs of pain was made in the medical record if the horse had a heart rate > 48 beats/min, respiratory rate > 20 breaths/min, decrease in appetite, dull or agitated mentation, or abnormal sweating along the neck or flank or if it held the affected forelimb abnormally (eg, pawing or pointing). Additionally, if any variable was indicative of severe distress (heart rate > 60 beats/min, respiratory rate > 32 breaths/min, extreme agitation, persistent recumbency,
marked sweating, or repeated lifting of the forelimb) or the lameness grade was > 7, horses received butorphanol (0.01 to 0.02 mg/kg [0.005 to 0.009 mg/lb], IM, as needed) and were excluded from statistical analysis beyond that time point. If additional analgesia did not improve signs of severe pain, percutaneous median nerve and ulnar nerve blockade were repeated.

At completion of this study, all horses were evaluated for lameness, swelling, pain on digital palpation, and other forelimb abnormalities every 12 hours until the time of euthanasia for a different experiment. Compulsive bandages over the metacarpus were maintained for a total of 4 weeks. Horses were euthanized by pentobarbital overdose at 3 (n = 2), 5 (2), 9 (8), and 17 (2) weeks after the completion of this trial. The treated forelimb was collected, dissected, and grossly evaluated for any abnormalities at the catheter site.

**Statistical analysis**—A summary lameness score was created for each horse, at each time point, by calculation of the median score assigned by the 3 blinded observers. Lameness data were reported as a median (95% confidence intervals) for the entire trial and median (range) for each individual time point. The summary lameness score was evaluated for interaction of treatment group and time by 2-way ANOVA. When lack of interaction was determined, the main effects were compared in the repeated-measures ANOVA, followed by individual evaluation at each time point with the Wilcoxon rank sum test. Nominal data (yes or no) for behavioral or physiologic signs of pain at rest were tested for differences in proportion with the Fisher exact test. Statistical analysis was performed by use of commercially available software programs. To test the hypothesis that CPNB-treated horses would have lower lameness scores and a lower proportion of behavioral signs indicative of pain, 1-sided P values < 0.05 were considered significant. Weighted \( \kappa \) coefficients > 0.8 were considered as very good agreement.

**Results**

**Ex vivo catheter placement and anatomic studies**—Catheter placement was successful in all equine cadaver forelimbs. Lateral and medial subcutaneous swellings occurred in all forelimbs following 7-mL bolus injection. The palmar vasculature and nerves were not grossly damaged in any forelimb. All forelimbs had dye present within the palmar fascia, between the SL and the ALDDFT, with the greatest amount of dye in this space located abaxially, just deep to the palmar fascia, medially and laterally (Figure 2). Dye was present adjacent to (5/5) and staining (1/5) the lateral palmar nerve and adjacent to (5/5) and staining (1/5) the medial palmar nerve. In each instance where the medial palmar nerve was not stained, dye was within 2 mm of the nerve. In all forelimbs, dye was present superficial to the palmar fascia in the subcutaneous plane (laterally greater than medially).

**In vivo catheter placement**—In 1 horse (horse 1), initial placement of the catheter was not successful; after removal of the introducer needle, the catheter could easily be advanced, as if it were in a cavity, and synovial fluid was retrieved from the catheter. The catheter was removed and replaced successfully 1 cm farther distally. The following day, during ultrasonographic examination of the tendonitis lesion, it was observed that there was anechoic fluid distending the distal part of the carpal canal. Otherwise, catheter placement was successful in all forelimbs. There was subcutaneous swelling (laterally greater than medially) in all forelimbs following bolus injections of bupivacaine.

Hemorrhage during catheter placement occurred in forelimbs of 2 horses (horses 7 and 8), and it was the impression of the investigator that hemorrhage began when the introducer needle was fully advanced to the medial palmar fascia, suggesting that penetration of the medial palmar vein had occurred. Hemorrhage caused blood to back up into the catheter, but did not result in swelling and did not dictate change in technique.

Induction of SDFT tendonitis was successful in all horses. Diffuse swelling and warmth in the forelimb, centered along the palmar aspect of the middle portion of the metacarpus, were present in all horses. One horse (horse 8) required additional compression bandaging to control swelling that extended proximally to the caudal aspect of the carpus from 30 to 48 hours following tendonitis induction. Light digital palpation along the catheter insertion site was tolerated in all horses, except for the horse (horse 14) that required catheter replacement. There was no appreciable change in swelling in the forelimb between horses with excessive hemorrhage and those without. No horses developed swelling of the forelimb below the distal aspect of the metacarpus, either during bupivacaine administration or after.

The catheter used to deliver CPNB was dislodged with failure of the skin insertion site suture at \( t = 48 \)
hours in 1 horse (horse 14) during a bandage change. The catheter was replaced without difficulty, and the same pump was attached to the new catheter. The following day, there was swelling, heat, and pain on palpation at the level of catheter insertion (laterally greater than medially) and an increase in lameness (score, 4/10). Ultrasonographic examination revealed that the swelling had a diffuse heterogeneous pattern and lack of effusion within the carpal canal. The catheter was removed, and bacterial culture of the catheter tip resulted in growth of *Staphylococcus aureus*. The catheter was not replaced, and the data from the horse were excluded from statistical analysis from that time point onward. The horse was treated with broad spectrum antimicrobials for 3 days, and the heat, pain, and swelling resolved. No lameness was observed throughout the remainder of the study, and the horse received lameness scores of zero at 72, 84, and 96 hours by the nonblinded investigator.

Two CPNB-treated horses (horses 10 and 12) had cessation of pump action observed at 48 hours. The pump was disconnected, the catheter was forcibly flushed with 0.5 mL of heparin (1,000 U/mL), and the pump was reconnected. For each of these horses at the time of pump disconnection, approximately 1 mL of bupivacaine flowed from the pump, equivalent to the amount that should have been dispensed over the previous 7 hours. The summary lameness score (blinded) for each of these 2 horses at 48 hours was not different from each horse’s lameness score at adjacent time points, 36 and 60 hours.

Other than in 1 horse (horse 14), catheters were not dislodged. At catheter removal, catheters maintained their in situ orientation with an acute bend where they had a transition from the dorsolateral subcutaneous tunnel to the space between the ALDDFT and SL. No gross abnormalities were detected in any forelimbs after completion of the study during the 3 to 17 weeks prior to postmortem examination. No abnormalities were detected on gross anatomic dissection of the catheter site.

**In vivo data collection**—Starting at approximately t = 6 hours, 1 horse (horse 5) developed a large colon impaction that caused an increase in heart rate and respiratory rate, decreased appetite, dull mentation, signs of abdominal pain, and abdominal distention; this horse required medical treatment during the first 3 days of the trial. Because detomidine and butorphanol were repeatedly administered to control signs of abdominal pain, data from the horse were excluded from all statistical analysis. Otherwise, no horses had signs of distress or severe lameness (score > 7) that required rescue analgesia at any time point.

While at rest in their stalls, 3 IPNB-treated horses (horses 2, 6, and 13) received a pain assessment of yes on 7 total occasions, all within the first 24 hours: horse 6 for pawing, horse 2 for pawing and tachycardia (60 beats/min), and horse 13 for tachycardia (52 beats/min). All other IPNB-treated horses and all CPNB-treated horses (other than the horse with severe colic) received a pain assessment of no at all time points, resulting in a significantly (1-tailed *P* = 0.013) higher proportion of IPNB-treated horses with behavioral scores that indicated signs of pain.

There was no significant (2-sided *P* = 0.831) interaction of time and treatment (CPNB vs IPNB) on summary lameness scores. When the main effects were tested, summary lameness scores of CPNB-treated horses (median, 1 [93% confidence interval, 1.3 to 1.9]) were significantly (1-tailed *P* < 0.001) lower than that of IPNB-treated horses (median, 2 [95% confidence interval, 1.9 to 2.6]) during the course of the study. When each time point was individually tested, CPNB-treated horses had significantly lower lameness scores than IPNB-treated horses at 8 hours (median, 2 [range, 0 to 4] vs median, 4 [range, 3 to 5]; 1-tailed *P* = 0.014) and 12 hours (median, 2 [range, 0 to 3] vs median, 3 [range, 2 to 5]; 1-tailed *P* = 0.037). At 18 hours, CPNB-treated horses had lower lameness scores (median, 1.5 [range, 0 to 2]) than those of IPNB-treated horses (median, 3 [range, 1 to 5]), but this difference was not significant (1-tailed *P* = 0.055). There was no significant difference in lameness scores between CPNB- and IPNB-treated horses at all other time points (0, 6, 24, 30, 36, 48, 60, 72, 84, and 96 hours; **Figure 3**). Weighted κ coefficients were > 0.8 for all observers (SLF and JC [weighted κ = 0.804], SLF and HLR [weighted κ = 0.843], and JC and HLR [weighted κ = 0.850]).

**Discussion**

Experimental assessment of signs of pain in horses is often done with an avoidance reaction such as hoof-withdrawal response to heat, pressure, and electrical stimulation. Although hoof-withdrawal response is useful, especially in testing a nerve block, it may not represent clinically relevant pain. Induction of synovitis through intra-articular injection of autologous...
lameness grades were lower. Not more pronounced in CPNB-treated horses, where aging would have been equal between the 2 groups, if absent or mild lameness; however, any effect of bandaging. Although this is unlikely to have changed the outside of the circle, it may have led to a decreased though investigators felt the increase in lameness during assessment of most lameness grades, it may have resulted in increased lameness detection of horses with absent or mild lameness; however, any effect of bandaging would have been equal between the 2 groups, if not more pronounced in CPNB-treated horses, where lameness grades were lower. The CPNB technique described by Driessen et al. involves placement of 2 catheters, 1 medially and the second laterally; deep to the palmar fascia, alongside the medial and lateral palmar nerves in a proximal to distal direction. Proximal skin entry is approximately at the level of the carpometacarpal joint, and the catheter is advanced distally 8 cm for the medial catheter and 11.5 cm for the lateral catheter. After catheter placement, a 5-ml bolus dose of bupivacaine is given followed by an infusion of 0.5% bupivacaine at 4 mL/h. Minor modifications to this technique were made for several reasons. First, by use of 1 catheter and 1 pump, the cost of instrumentation was reduced. Second, to reduce the likelihood of complete nerve block, a substantially decreased dose of bupivacaine was used. Although anesthetic infusions were performed for only 3 days and vasculature diameter in the distal aspect of the forelimb was not measured, another possible benefit of a lower bupivacaine dose is reduced likelihood of swelling and vasodilation in the distal aspect of the limb. Third, by placing catheters transversely between the ALDDFT and SL, dorsal to the medial and lateral palmar nerves rather than adjacent and parallel to them, the risk of contacting the nerves with the introducer needle or catheter was reduced, thereby reducing the risk of injury to the nerves and subsequent paresis or neuretoma formation. Finally, modification in technique allowed for more proximal placement of the catheter exit holes along the metacarpus.

The use of IPNB was selected as a control rather than a true negative control, such as a continuous infusion of saline (0.9% NaCl) solution. Without planned local analgesia of some form, it was expected that many or all horses in the control group would meet the requirements outlined for rescue analgesia. In short, IPNB was expected to be effective, but less so than CPNB. This was confirmed, as rescue analgesia was not required in either group, suggesting that IPNB may also be effective for pain reduction. Superior pain control of CPNB may be because continuous analgesia provides better pain relief and prevents wind-up, where there is centrally mediated sensitization to pain because of repeated painful stimulation at the peripheral nerves leading to increased sensation of pain with the same stimuli.

Two horses had pump failure that was detected at 48 hours and appeared to have begun at approximately 41 hours. Neither horse had a change in lameness score (lameness score of 1) at 48 hours, compared with the lameness score at 36 and 60 hours. Although this could be interpreted as lack of a CPNB effect, it is more likely a combination of diminishing lameness at 48 hours with experimentally induced tendonitis and the positive effect of reduced wind-up secondary to continuous analgesia. It is possible that the lameness reduction of anesthetic infusion was due to local effects of bupivacaine bathing the tendon rather than a reduction in nerve transmission. Because the catheters were approximately 4 cm proximal to the lesion and bupivacaine was infused at only 0.14 mL/h, the authors feel this is unlikely in the CPNB group. Additionally, bupivacaine was deposited between the ALDDFT and the SL and would have to diffuse past the palmar nerves, prior to reaching the SDFT. In IPNB-treated horses, bolus injections of 0.85 mL of bupivacaine were administered via the catheter, and if a local effect could have occurred, it would be more likely in this group.

Swelling in the distal portion of the limb is a reported complication of CPNB and was not detected.
in the horses of the study presented here. However, the experimentally induced tendonitis may have made it difficult to detect catheter- or infusion-related swelling, as forelimb swelling, centered on the palmar aspect of the middle portion of the metacarpus, is a consequence of tendonitis. Additionally, because of expected swelling, all horses were bandaged with a supportive wrap to the metacarpal region, which may have minimized catheter- or anesthetic-related swelling.

No attempt was made to document complete loss of pain perception, sensation, or proprioception, and given the low dose of anesthetic used, it was not expected to occur. However, 3 CPNB-treated horses and 1 IPNB-treated horse received a summary lameness score of zero after they had lameness in the first 24 hours of the study, when lameness was expected to be more pronounced. Although it is tempting to interpret this as possible complete lack of pain, 1 blinded observer had assigned a score of 1 in each horse, suggesting that some pain was still perceived, albeit mild.

Hemorrhage during catheter placement occurred in 2 horses. In each instance, hemorrhage began during palpation of the introducer needle beneath the skin medially and was assumed to be a result of laceration to the medial palmar vein. On anatomic specimens, the medial vein was not injured, but it was not surprising that it was punctured in vivo, as veins are the dorsal-most structure in the distal limb (relative to the artery and nerve) and the medial vein lies directly in the path of needle insertion between the SL and ALDDFT. Although not ideal, the investigators felt this was a mild complication with minimal to no clinical consequence: no swelling, pump cessation, or difficulty of intermittent injections occurred in horses that had hemorrhage. Two complications occurred that were potentially serious. One catheter was advanced into the distal aspect of a distended carpal canal during catheter placement. This was immediately recognized; the catheter was removed and successfully replaced farther distally, and no additional complications occurred. Another catheter had positive bacterial culture results for S. aureus after removal. It should be noted that this catheter had been accidentally removed at 24 hours and then replaced at the same level through the same stab incision. The horse was treated with broad-spectrum antimicrobials for 3 days, and no additional complications occurred.

In conclusion, this study demonstrates the efficacy of peripheral neural blockade by local catheter delivery for the short-term reduction of severe signs of pain over 3 days in 14 horses with experimentally induced tendonitis of a forelimb. Continuous infusion of 0.5% bupivacaine at 0.14 mL/h resulted in significantly lower lameness scores and a lower proportion of horses with behavioral and physiologic signs of pain than infusion of a proportional volume of bupivacaine every 6 hours. This was achieved with a very low dose of local anesthetic that did not cause total loss of pain sensation. The technique was easily applied, and catheters were not dislodged with normal limb movements. The described technique is appropriate for clinical use when a short-term reduction in distal limb pain is desired and should be tested for safety and efficacy prior to longer-term applications. The clinician should consider strongly the risk of microbial contamination to the tissue surrounding the catheter when selecting horses for CPNB and may consider prophylactic antimicrobials while catheters are in place to minimize the risk of catheter-related soft tissue infection.

References
18. Kalpravidh M, Lumb WV, Wright M, et al. Analgesic effects...


### Appendix

Simple descriptive scale for grading lameness observed at a walk.

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<thead>
<tr>
<th>Score</th>
<th>Lameness characteristics</th>
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<tr>
<td>0</td>
<td>Sound</td>
</tr>
<tr>
<td>1</td>
<td>Uneven gait; rare head nod</td>
</tr>
<tr>
<td>2</td>
<td>Uneven gait; occasional head nod (or consistent nod only on turning)</td>
</tr>
<tr>
<td>3</td>
<td>Consistent head nod, mild (or occasional severe head nod)</td>
</tr>
<tr>
<td>4</td>
<td>Consistent head nod, moderate</td>
</tr>
<tr>
<td>5</td>
<td>Consistent head nod, severe; heel on ground throughout stride</td>
</tr>
<tr>
<td>6</td>
<td>Consistent head nod, severe; heel touches ground briefly every step</td>
</tr>
<tr>
<td>7</td>
<td>Consistent head nod, severe; heel touches ground occasionally</td>
</tr>
<tr>
<td>8</td>
<td>Consistent head nod, severe; heel touches ground rarely</td>
</tr>
<tr>
<td>9</td>
<td>Consistent head nod, severe; heel never touches ground</td>
</tr>
<tr>
<td>10</td>
<td>Swinging limb; toe never touches ground</td>
</tr>
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