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Objective—To determine reasons for epidural catheter placement among horses examined at a veterinary teaching hospital, efficacy of epidural administration of analgesics, duration of catheter placement, reasons for catheter removal, and complications encountered.

Design—Retrospective study.

Animals—43 horses.

Procedure—Medical records were reviewed.

Results—A total of 50 epidural catheters were placed in the 43 horses. Underlying conditions included fractures, lacerations, septic arthritis, myositis, perineal injuries, and cellulitis. Horses ranged from 2 to 21 years old and weighed between 365 and 795 kg (803 and 1,749 lb). Median duration of catheter placement was 96 hours (range, 1.5 to 480 hours). The response to epidural drug administration was reported as positive in 34 horses and negative in 4. There was no apparent response in 2 horses, and response could not be determined in 3. Three temporary patient-related complications associated with epidural catheter administration were observed. Technical problems associated with the epidural catheters included dislodgement of the catheter itself (7 catheters) or of the adapter or filter (5), obstruction (5), and leakage (5). Twenty-two catheters were removed because of resolution of the underlying condition, and 10 were removed because of complications. For 6 catheters, the reason for catheter removal was not recorded. The remaining 12 catheters were in place when the horses were euthanized.

Conclusions and Clinical Relevance—Results suggest that epidural catheterization can be used successfully for repeated epidural delivery of analgesics and anesthetics in horses with various clinical conditions. Complications associated with epidural catheters or epidural drug administration were infrequent and transient. (J Am Vet Med Assoc 2003;222:1394–1398)

Providing effective analgesia in horses with orthopedic and soft-tissue injuries remains challenging because of the limited efficacy of currently available analgesic agents and the risk of adverse effects associated with their use.1 For example, nonsteroidal anti-inflammatory drugs are effective for the treatment of mild to moderate pain in horses, but long-term administration of these drugs can be associated with potentially deleterious gastrointestinal tract and renal effects.2 Similarly, IV and IM administration of opioid analgesics have been associated with ileus and behavioral changes in horses.3,4

Epidural administration of analgesics has been reported to provide effective analgesia for orthopedic and soft-tissue injuries in several species,5–10 and the effects of epidural administration of α2-adrenoceptor agonists, opioids, dissociative agents, and local anesthetics, alone or in combination, have been evaluated in horses in various studies.11–13 Reported advantages of epidural administration of opioids and α2-adrenoceptor agonists, compared with IV or IM administration, include extended duration of analgesia and reduced incidence and severity of sedation.13,14

Use of epidural catheters for repeated administration of analgesics or local anesthetics has been described in several species, including horses.5,7,11,12,15,16 However, to the authors’ knowledge, no retrospective study on the clinical use of epidural catheters for repeated drug administration in horses has been reported. The purposes of the study reported here, therefore, were to determine reasons for epidural catheter placement among horses examined at a veterinary teaching hospital, efficacy of epidural administration of analgesics, duration of catheter placement, reasons for catheter removal, and complications encountered.

Criteria for Selection of Cases

Medical records of horses examined at the Ontario Veterinary College between January 1998 and August 2001 were reviewed. Horses were included in the present study if an epidural catheter had been inserted.

Procedure

Information obtained from the medical records included breed, sex, age, weight, patient abnormalities, rationale for clinician request for epidural catheter placement, timing of placement of the epidural catheter with respect to onset of the primary injury, duration of epidural catheter placement, drugs administered via the epidural catheter, and concurrently administered analgesics and medications.

The individual performing epidural catheterization and specifics regarding the technique used to place and secure the epidural catheter were not recorded in any of the medical records. During the study period, however, it was standard practice that anesthesia clinicians or residents performed epidural catheterization on client-owned horses treated at the Ontario Veterinary College Large Animal Teaching Hospital. In general, epidural catheterization was performed as previously described17,18 with commercially available epidural catheter kits.19 Kits
used during the study period included a 17-gauge, 3.5-
inch Tuohy needle, 19-gauge epidural catheter, 0.22-μm
filter, and 20-gauge Tuohy Borst adapter.

Overall clinician interpretations of the response to
drugs administered via the epidural catheter were
recorded as positive (ie, improvement in the condition
that prompted epidural catheter placement), negative
(ie, development of complications associated with
drug administration via the epidural catheter), no response
(ie, no change in the condition that prompted epidural
catheter placement), or inconclusive (ie, no comments
on response to epidural drug administration) on the
basis of comments recorded in the daily records and
discharge summaries. Multiple outcomes were possible
for each horse. For example, if a negative response was
recorded following the initial administration of drugs
via the epidural catheter, but a positive response was
recorded following subsequent drug administration,
both responses were included in the present study.

Complications related to the epidural catheters
were obtained from the medical records and categorized
as technical complications (ie, complications associated
with the catheter itself or with the adapter or filter) or
patient-related complications. The reason for catheter
removal was classified as resolution of the condition
that had prompted epidural catheter placement, a lack
of response to epidural drug administration, develop-
ment of a catheter-related complication, or unknown.

Results

Forty-three horses met the criteria for inclusion in
the study. This included 21 Thoroughbreds, 8 Standard-
bred horses, 3 Paints, 3 Quarter Horses, 1 Belgian, 1 Canadian Sport Horse, 1 Tennessee
Walking Horse, and 1 Trakehner. There were 23 mares, 5
stallions, and 16 geldings. Horses ranged from 2 to 21
years old and weighed between 365 and 795 kg (803 and
1,749 lb). Information on 1 of these horses, which
developed upward fixation of the patella during the period in
which morphine was administered epidurally, has been
published previously.19

A total of 50 epidural catheters were placed in the
43 horses. Thirty-seven horses had a single catheter
placed, 5 horses had 2 catheters placed, and 1 horse
had 3 catheters placed.

Management of pain (43 catheters) and minimiza-
tion of straining (6 catheters) were the most commonly
recorded reasons for epidural catheter placement. Median
duration of catheter placement was 96 hours
(range, 1.5 to 480 hours).

Drugs administered via the epidural catheter included
morphine sulphate (26 horses; 0.04 to 0.26 mg/kg
[0.018 to 0.12 mg/lb]), a combination (11 horses) of
morphine sulphate (0.1 to 0.33 mg/kg [0.045 to 0.15
mg/kg]) and detomidine hydrochloride (0.009 to 0.027
mg/kg [0.004 to 0.012 mg/lb]), lidocaine hydrochloride
(3 horses; 0.06 to 0.2 mg/kg [0.027 to 0.09 mg/lb]),
xylazine hydrochloride (2 horses; 0.15 mg/kg [0.068
mg/lb]), and a combination (1 horse) of lidocaine (0.2
mg/kg) and xylazine (0.15 mg/kg). All 7 horses with a
forelimb injury were given morphine alone epidurally,
whereas 17 of the horses with a hind limb lesion were
given morphine alone, and 9 were given a combination
of morphine and detomidine. The rationale for selection
of the specific drugs given epidurally in each horse could
not be determined from the medical records.

The total volume of injectate used for delivery of
drugs varied and was frequently not recorded in the
medical records. When morphine was used, it was
combined with 0.9% NaCl solution. The volume used
ranged from 10 to 40 mL in 12 horses with lesions of
the hind limb or pelvis and from 20 to 100 mL in 4
horses with lesions involving the forelimbs.

The response to epidural drug administration was
recorded as positive for 34 of the 43 horses (Table 1).
Positive responses were recorded for 6 of the 7 horses
with a forelimb lesion, 20 of the 26 horses with a hind
limb or pelvic lesion, all 6 horses with a rectal or recto-
vaginal tear or rectal prolapse, and the 2 horses with
perirectal edema and nephritis. The response to epidural
drug administration was inconclusive in 3 horses. One of
these was a horse with a forelimb injury (fracture of the
proximal phalanx) that was euthanatized 3 hours after
epidural catheter placement; this was judged to be too

Table 1—Underlying condition and response to epidural drug administration in 43 horses in which an epidural catheter was placed

<table>
<thead>
<tr>
<th>Condition</th>
<th>Location of injury</th>
<th>Response to epidural drug administration</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No. of horses</td>
<td>Forelimb</td>
</tr>
<tr>
<td>Fracture</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Middle phalanx</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Proximal phalanx</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Sesamoid</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Third metacarpal bone</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Pelvis</td>
<td>2</td>
<td>NA</td>
</tr>
<tr>
<td>Scapula</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Laceration or wound</td>
<td>7</td>
<td>0</td>
</tr>
<tr>
<td>Septic arthritis or osteitis</td>
<td>6</td>
<td>1</td>
</tr>
<tr>
<td>Cellulitis or tenosynovitis</td>
<td>6</td>
<td>0</td>
</tr>
<tr>
<td>Rectal or rectovaginal tear</td>
<td>5</td>
<td>NA</td>
</tr>
<tr>
<td>Rectal prolapse</td>
<td>1</td>
<td>NA</td>
</tr>
<tr>
<td>Perirectal edema</td>
<td>1</td>
<td>NA</td>
</tr>
<tr>
<td>Perirectal abscess</td>
<td>1</td>
<td>NA</td>
</tr>
<tr>
<td>Myositis</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Nephritis</td>
<td>1</td>
<td>NA</td>
</tr>
<tr>
<td>Vesicular calculus</td>
<td>1</td>
<td>NA</td>
</tr>
</tbody>
</table>

short a time to evaluate the response to drug administration. The other 2 were horses with hind limb lesions for which response to epidural drug administration could not be determined from the medical records. The response to epidural drug administration was recorded as no change in 1 horse with a pelvic fracture given a combination of morphine (0.1 mg/kg) and detomidine (0.01 mg/kg [0.005 mg/lb]) and in a second horse with hind limb septic pedal osteitis given morphine (0.1 mg/kg). The response to epidural drug administration was recorded as negative in the remaining 4 horses. This included 1 horse with a vesicular calculus that developed hind limb weakness and became recumbent following epidural administration of lidocaine (0.2 mg/kg) and xylazine (0.15 mg/kg), 1 horse with a hind limb mid-body sesamoid fracture that developed upward fixation of the patella during the time that morphine (0.1 mg/kg) was administered, and 2 horses (1 with a pelvic fracture and 1 with a perirenal abscess) that developed generalized muscle tremors following epidural administration of morphine (0.1 mg/kg). The horse that became recumbent stood 3 hours after epidural drug administration and recovered without complications. The upward fixation of the patella in the 1 horse resolved spontaneously with discontinuation of epidural morphine administration. The muscle tremors observed in the other 2 horses were associated only with administration of the initial dose of morphine; both of these horses subsequently received multiple doses of morphine via the original epidural catheter with no adverse consequences reported.

Epidural catheters were placed between 6.5 hours and 111 days after the initial injury. The 2 horses that had no response to epidural administration of analgesic drugs had catheters placed 36 hours and 25 days after the initial injury.

Technical complications associated with the catheter or catheter accessories were reported for 22 of the 50 catheters. These technical problems included dislodgement of the catheter itself (7 catheters), dislodgement of the catheter adapter or filter (5), obstruction of the catheter (3), and leaks associated with the catheter, adapter, or filter (3).

Patient complications related to the epidural catheters were reported for 3 horses that developed inflammation or signs of increased sensitivity associated with the epidural catheter site. *Pseudomonas aeruginosa* was cultured from the catheter entry site in 1 of these horses; however, bacterial culture of the catheter itself failed to yield any growth. For the remaining 2 horses, bacterial culture of the catheter and catheter entry site failed to yield any growth.

Twenty-two catheters were removed because of resolution of the condition that prompted epidural catheter placement, and 10 were removed because of complications. For 6 catheters, the reason for catheter removal was not recorded. The remaining 12 catheters were in place when the horses were euthanatized; information regarding the epidural catheter site was not included in the postmortem report for these horses.

Of the 10 catheters that were removed because of complications, 6 were removed because of technical complications, and 4 were removed because of patient-related complications. Three of the 4 catheters removed because of patient-related complications were removed because of inflammation at the catheter site, and 1 catheter was removed because the horse developed a fever of unknown origin, and the attending clinician requested removal of all indwelling catheters. All 4 of these horses were receiving antimicrobials prior to identification of inflammation or fever. Five of the 6 catheters that were removed because of technical complications were removed following catheter dislodgement, and 1 was removed after the catheter became obstructed. Methods by which the remaining catheter-related complications were resolved were not stated in the medical records.

In 6 horses, more than 1 epidural catheter was placed. In 5 of these 6, the initial catheter was removed because of catheter dysfunction (obstruction or dislodgement), and in 1, the initial catheter was removed because of inflammation at the catheter site, and a second catheter was placed 22 days later. In the horse in which 3 catheters were placed, the second catheter was removed following an improvement in the patient’s level of comfort. However, a subsequent deterioration in the patient’s condition resulted in a third catheter being placed 6 days after removal of the second catheter.

Drugs administered IV or IM during the period in which epidural catheters were in place included nonsteroidal anti-inflammatory analgesic drugs (flunixin meglumine, phenylbutazone, and ketoprofen) in 41 horses and antimicrobials (a combination of an aminoglycoside and a β-lactam antimicrobial, cephalosporins, and trimethoprim-sulfonamides) in 38 horses. No nonsteroidal anti-inflammatory analgesic drugs were administered following admission to 1 horse with lacerations and 1 horse with a fracture of the third metacarpal bone. The latter horse was euthanatized within 2 hours after admission to the teaching hospital. Of the 5 horses that did not receive antimicrobials, 2 were euthanatized shortly after epidural catheter placement because of a poor prognosis for recovery (1 horse with a fracture of the third metacarpal bone and 1 horse with a fracture of the proximal phalanx). The remaining 3 horses in which antimicrobials were not administered included horses with rectal edema, a pelvic fracture, and myositis.

**Discussion**

Results of the present study suggest that epidural catheterization can be used for repeated epidural delivery of analgesics and anesthetics in horses. In this study, epidural catheters were placed in horses with a wide variety of injuries and lesions. Drugs administered via the epidural catheters included opioid analgesics, local anesthetics, and α2-adrenoceptor agonists; 34 of the 43 horses reportedly had a positive response to epidural drug administration. Only 4 of the 43 horses reportedly had a negative response to epidural drug administration, and none of these horses developed permanent complications. Only 3 horses developed patient-related complications, which was consistent with the low prevalence of such complications reported previously.

Importantly, however, daily assessments of the severity of pain experienced by treated horses and the response to treatment recorded in the medical record were made by clinicians who were not blinded to the treatment given. This represents a major

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A variety of drugs and drug combinations were selected for epidural administration in horses in the present study. As mentioned previously, it was not possible to determine, from the medical records, the rationale for selection of the specific drugs administered to individual horses. However, the rationale for selection of various drugs used for spinal-mediated analgesia and the mechanisms of action of those drugs have been described in the literature. Morphine, the most commonly administered analgesic in this study, is a μ receptor agonist that has previously been reported in experimental and clinical studies to be an effective analgesic in horses. Advantages cited for the epidural administration of morphine include a prolonged duration of analgesia without motor impairment or alterations in heart rate or blood pressure. Pharmacokinetic studies have demonstrated that morphine, which is hydrophilic, is the preferred opioid when exposure to a large segment of the spinal cord is desired. In a clinical situation, therefore, when a thoracic or forelimb injury is present, morphine is generally selected for spinal-mediated analgesia rather than more lipophilic opioids such as fentanyl and oxymorphone. Use of morphine in combination with the δ2-adrenoceptor agonist detomidine reportedly results in profound hind limb analgesia with a moderate degree of sedation in horses. As controlled studies comparing the efficacy of morphine versus a combination of morphine and detomidine in horses have not been published, one could speculate that the sedation expected by combining detomidine with morphine may have influenced the selection of this combination, versus morphine alone, in horses in this study. Epidural administration of lidocaine, xylazine, and the combination of lidocaine and xylazine has been shown to result in perineal analgesia, an effect mediated via blockade of sodium channel nerve transmission and activation of δ2-adrenoceptors. Comparative studies have demonstrated that the combination of xylazine and lidocaine results in a longer duration of analgesia than lidocaine or xylazine alone.

The reason for the apparent lack of response to epidural administration of morphine in 2 horses in the present study was not determined, although there are several potential explanations, including administration of an inadequate dose and faulty catheter placement resulting in delivery of morphine outside of the epidural space. Alternatively, the method used by the attending clinicians to assess the quality of analgesia may not have permitted detection of an improvement.

Although most horses in the study had positive outcomes, several had negative outcomes that were potentially associated with epidural drug administration. Hind limb weakness in the horse that became recumbent after administration of a combination of lidocaine and xylazine was suggested in the medical record to be a result of cranial migration of the lidocaine caused by administration via an epidural catheter whose tip was located further cranially than the sacroccocygeal junction. Bilateral upward fixation of the patella was attributed to epidural morphine administration in 1 horse in this study, and it was suggested that the muscle relaxation associated directly or indirectly with epidural morphine administration was responsible for this gait alteration. In the 2 horses in which muscle tremors were observed following the initial administration of morphine via the epidural catheter, administration of subsequent doses of morphine resulted in no adverse effects. It is, therefore, unlikely that the response was related to the morphine, because it was not repeatable. In both horses, however, no definitive cause of the muscle tremors was determined. Interestingly, while pruritus is a well-recognized adverse effect of epidural opioid administration in humans, this was not observed in any horses in this study. This potentially was a result of the low prevalence of this adverse effect and the limited number of horses in the present study.

Another interesting finding of this study was the great variation in the timing between the onset of the primary injury and the time of epidural catheter placement for the purpose of providing analgesia. In most horses, the time between the primary injury and placement of an epidural catheter for administration of analgesics did not appear to negatively affect the response, as evidenced by the number of positive outcomes in horses with a long interval between the primary injury and epidural catheter placement. Although a painful stimulus is applied to tissues, anatomic and physiologic alterations to the pathways involved in pain sensation occur, which lead to hypersensitivity. These changes can lead to alterations in the effectiveness of analgesic drug administration. Unfortunately, it is not possible to determine from the present study what effect, if any, the duration of pain before epidural administration of analgesics had on the response to treatment. However, the long interval (25 days) between injury and the epidural administration of drugs in 1 of the horses in this study may have played a role in the lack of response to treatment that was observed.

In this study, 6 catheters had to be removed because of dysfunction. Dislodgement of the catheter was the most common technical complication. In a previous study of the analgesic properties of several drugs in horses, 4 of 6 horses lost or removed the epidural catheter during the 3-week study period. A recent study in dogs also found catheter dislodgement to be the most common complication associated with long-term epidural catheter maintenance. In a retrospective study of long-term epidural catheter maintenance in humans, the overall incidence of epidural catheter dislodgement was reported to be 13%. When epidural catheters are used to manage labour pain in humans, the incidence of catheter dislodgement has been reported to be as high as 54%. It has been suggested that epidural catheter migration or dislodgement occurs for 2 reasons. First,
secure fixation of a catheter at the skin exit site may pre-dispose to catheter migration, as the skin and subcutaneous fat can move easily over the deeper tissues, pulling the catheter out of the epidural space. Second, the catheter is thought to loosen following retrograde movement of epidural injectate around the outside of the catheter. In the present study, epidural catheter dislodgement may have been related to rigid skin fixation of the catheter end and patient movement. Migration may also have been associated with rubbing of the catheter site or the adhesive surgical drape on the surrounding environment. Unfortunately, it was not possible to determine the method of catheter fixation in these horses on the basis of our review of the medical records.

In the present study, 5 of the 50 epidural catheters reportedly became blocked, and another 5 developed leaks. The cause of blockage was not indicated in the medical records; however, a loss of patency of epidural catheters in general is thought to be a consequence of a local inflammatory response and fibrosis resulting from the presence of the catheter itself. In human patients, epidural catheter leakage reportedly is common, and in 1 study, leakage was the most common reason for premature discontinuation of epidural catheterization. Poor connections of the catheter is thought to loosen following retrograde pulling of the catheter out of the epidural space. Second, within the epidural space. In the present study, 5 of the 50 epidural catheters reportedly became blocked, and another 5 developed leaks. The cause of blockage was not indicated in the medical records; however, a loss of patency of epidural catheters in general is thought to be a consequence of a local inflammatory response and fibrosis resulting from the presence of the catheter itself. In human patients, epidural catheter leakage reportedly is common, and in 1 study, leakage was the most common reason for premature discontinuation of epidural catheterization. Poor connections of the catheter attachments have been linked to leaking; therefore, assessing the integrity of the catheter components is important when leaks are observed or analgesia fails.

The incidence of inflammation and infection at the epidural catheter site was low in the present study, which is consistent with findings in dogs. Routine surgical preparation of the epidural catheter site is standard practice in our hospital prior to the placement of any catheter. In addition, a sterile adhesive surgical drape is applied over the epidural catheter in at least some instances. Both these practices likely decreased the incidence of epidural catheter site infection in the present study; however, the concurrent administration of broad-spectrum antimicrobials for treatment of the primary injury likely also played a role.

References