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CASE REPORT

Horses and other equids

Opioid-free anaesthesia protocol for standing spinal surgery in a horse

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Abstract

Opioid-free anaesthesia is a growing field in human and veterinary medicine. Several adverse effects have been reported related to the administration of opioids in horses, including the propensity to produce excitement, ataxia and gastrointestinal stasis. However, opioids have traditionally been the mainstay of pain relief in both the human and veterinary field. The feasibility of an opioid-free anaesthesia protocol in a horse that underwent multiple subtotal spinous process ostectomies is reported here. Instead of traditional opioid therapy, a detomidine continuous-rate infusion and a bilateral ultrasound-guided erector spinae block was performed to provide analgesia. The authors concluded that opioid-free surgical anaesthesia protocols may be feasible in horses undergoing multiple subtotal spinous process ostectomies. Gaining experience with these protocols may be advantageous when the use of opioids is to be avoided.

BACKGROUND

The increased awareness of patient welfare and the continuous search into optimising surgical conditions has made analgesia research gain relevance.

Alpha-2 adrenoreceptor agonists are routinely administered for standing sedation in equine patients,[1–3] together with an opioid. However, the analgesia provided by this approach might be limited for some procedures (like spinal surgeries), as often acute pain responses can be seen.[4]

Local anaesthesia techniques are often combined with standing sedation protocols for a wide variety of surgical procedures to optimise the pain control.[5–7] Those techniques can be performed blind, with assistance of an electric nerve stimulator or ultrasound guidance.

There is recent growing evidence showing that ultrasound-guided locoregional techniques are more precise than blind techniques.[8,9]

In veterinary and human medicine, the erector spinae plane (ESP) block is an ultrasound-guided locoregional block that desensitises the area involved in spinal surgeries, which correspond to the epaxial muscles situated above the transverse processes involved in dorsoventral motion and lateral bending of the spine.[10–13]

In horses, the spinal muscles form a muscular complex known as the erector spinae complex, which occupies the space between the transverse and spinous processes of the vertebrae in the cervical, thoracic and lumbar areas.[14]

The ESP complex is surrounded by the thoracolumbar fascia, located on the dorsal surface of the transverse processes, which marks the ESP block injection site. The spread (cranial and caudal) of the local anaesthetic along this fascia desensitises the dorsal rami of the relevant spinal nerves.[27,30]

ESP injections have recently been studied in horse cadavers,[15] and there is only one report of its clinical use in horses undergoing dorsal spinous process ostectomy and desmotomy under general anaesthesia.[16] The present case report describes the first ultrasound-guided ESP block in a standing horse as part of an opioid-free neuroleptoanalgesic protocol in a patient undergoing multiple subtotal ostectomy of dorsal spinous processes.

CASE PRESENTATION

A 10-year-old, 400-kg, Irish, sport male neutered horse presented to the Royal Veterinary College on 30 July 2021, for surgical treatment of impinging dorsal spinous processes. It had previously responded positively to intramuscular interspinous medication with corticosteroid performed by the referring veterinary surgeon. On the day of the procedure, the pre-anaesthetic examination was unremarkable. The patient was classified as per the American Society of Anaesthesiologists II.

On the day of the procedure, an intravenous (IV) catheter was aseptically placed in the jugular vein following desensitisation of the skin with a subcutaneous injection of 1 mL of mepivacaine (Intra-Epicaine; Dechra Veterinary Products, UK). Preoperative broad-spectrum antibiotics (trimethoprim/sulfamethoxazole, 20 mg/kg IV) and an anti-inflammatory (phenylbutazone, 4 mg/kg IV) were administered.

The patient was administered detomidine (Domidine 10 mg/mL; Dechra Veterinary Products, UK) at a loading dose of 10 µg/kg IV and then as a continuous-rate infusion at 10 µg/kg/h for 10 minutes. No alterations on pulse rate (PR) were noticed at this stage, apart from sinus bradycardia, which remained within physiological limits (PR: 35 beats per minute). After that the dose of detomidine was decreased to 2.5–5 µg/kg/h for the duration of the procedure.

In preparation for the surgery, hair was clipped bilaterally from the dorsal midline, 15 cm from each side, from the ninth thoracic (T9) to the fifth lumbar vertebrae (L5). After aseptic preparation of the skin, ultrasound-guided ESP with 2% lidocaine hydrochloride (Hameln Pharmaceuticals UK) was performed bilaterally, targeting the transverse process of T13 and T18. A total of four injections, with a volume of 20 mL (0.05 mL/kg) each one, were administered (Figure 1).

A convex transducer (5 MHz) was used to visualise the transverse process of T13 and T18, the anatomical landmarks. The transducer was positioned parasagittally and oriented longitudinally, lateral to the dorsal midline at the level of the epaxial muscles, until the transverse processes of T13 and T18 were identified (Figure 2).

With the target site on the screen, an 18-gauge 20-cm spinal needle was advanced in-plane caudocranially to the most caudal aspect of the transverse process (Figure 3). With the bevel orientated ventrally, the needle was advanced until the bevel touched the transverse process. When the operator was satisfied with needle placement, the lidocaine solution was injected and hydrodissection of the thoracolumbar fascia was observed (Figure 4).

Under sedation and local anaesthesia, a combined cranial wedge ostectomy (T14–T18) and interspinous ligament desmotomy (ISLD, T12–T14, T18–L1) using an osteotome and mallet were performed successfully using radiographic guidance. The ISLD stab incisions were closed with 0 ethilon suture material in a cruciate pattern. The midline ostectomy incision was closed in three layers, using staples for the skin. A sterile stent was sutured over the incision and an adhesive dressing was placed over the top.

The level of sedation, PR and respiratory rate were monitored throughout the procedure. If there was an increase of the PR over 15%, sudden changes in the plane of sedation or any movement of the horse relating to the surgical manipulation noted, a top-up dosage of 5 µg/kg of detomidine was administered.

A top-up dosage of 5 µg/kg of detomidine was administered 140 minutes after the lidocaine injections due to an increase of 27% in the PR and a slight movement of the horse during surgical manipulation. Ten minutes after the administration of bolus, 40 ml of 2% lidocaine was splashed in the surgical area with the aim of prolonging the duration of the block, just before the closure of the incision.

No other surgical complications or alterations of PR occurred during the procedure.

LEARNING POINTS/TAKE-HOME MESSAGES

- Ultrasound-guided erector spinae plane block was effective as part of multimodal plan of anaesthesia for spinal standing surgery in a horse.
- Given the longer duration of nerve blockade offered by bupivacaine, it may offer more effective intraoperative and postoperative pain control compared with lidocaine.
- Locoregional anaesthesia techniques may be used as an alternative to the traditional opioids-based therapy to provide anaesthesia in standing procedures in horses.

OUTCOME AND FOLLOW-UP

In the immediate postoperative period, physiological parameters, such as PR and respiratory rate, remained stable and within baseline values and no evidence of pain was detected on direct wound palpation. Therefore, the horse was subjectively considered comfortable and painless. Moreover, the horse showed excellent appetite and had adequate urine and faecal output.

The patient remained in the hospital 3 days after surgery. Daily dressing changes revealed no swelling, heat or discharge associated with the surgical sites.

Postoperative medication consisted of phenylbutazone (4 mg/kg once daily) and trimethoprim/sulfamethoxazole (20 mg/kg twice a day) intravenously.

A new adhesive dressing was applied before discharge from the hospital the fourth day and oral phenylbutazone (4 mg/kg once daily) and trimethoprim/sulfamethoxazole (20 mg/kg twice a day) were prescribed for the next 5 days.

DISCUSSION

This case report describes a successfully opioid-free anaesthesia protocol for the management of multiple subtotal ostectomy of dorsal spinous processes in a horse.

Currently in equine practice, opioids, α-2 agonists, nonsteroidal anti-inflammatory drugs and local anaesthetics are the main drugs used to provide analgesia to a patient.

Nonsteroidal anti-inflammatory drugs such as phenylbutazone and flunixin meglumine may alleviate mild to moderate postoperative pain in horses, but they have been shown to be ineffective in controlling intraoperative nociception when administered as a sole agent.[17]

Different studies have demonstrated that opioids may enhance both the sedative and analgesic effects of alpha-2 adrenoreceptor agonists.[32] However, the debate on the safety of these agents is still open.

The combination of an α-2 adrenoceptor agonist and opioid has been the mainstay for sedation to facilitate standing procedures in horses for years.[29] Butorphanol is a k-agonist opioid widely used in equine practice. There is evidence that the combination of butorphanol and α-2 agonists, such as

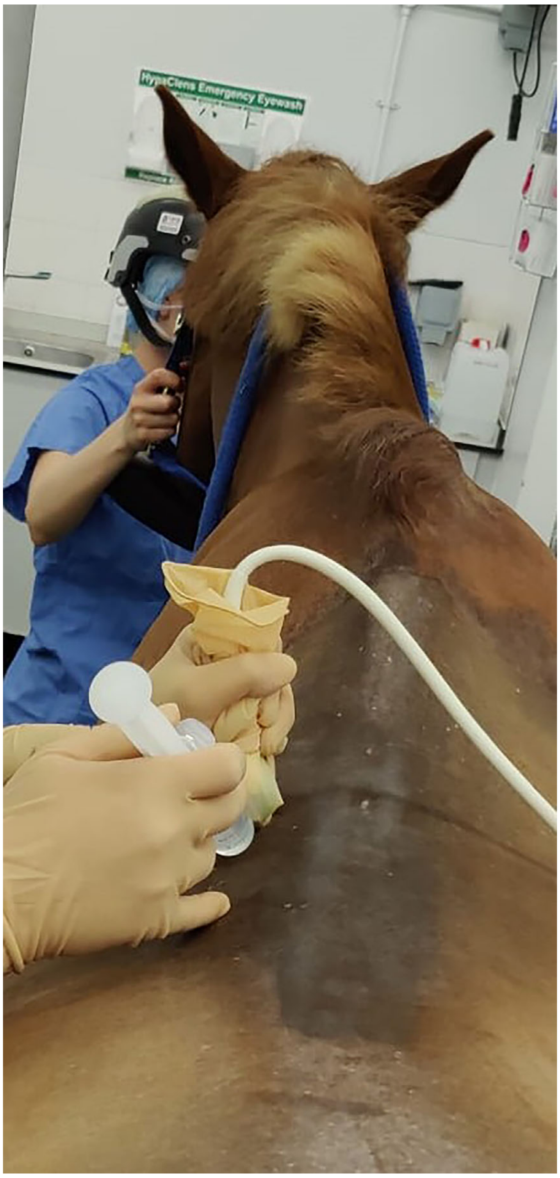

FIGURE 1 Operator performing the 'in-plane' ultrasound-guided technique to inject the local anaesthetic in the target interfascial plane.

detomidine or romifidine, produces an optimal level of sedation but provides limited surgical analgesia.[18]

The potential side effects of opioids have limited their widespread use in the past. Signs of excitement, such as head shaking, continuous pacing and gastrointestinal hypomotility are the most feared adverse effects. These complications are rare at analgesic doses, but they can occur at much higher doses (0.5–1 mg/kg morphine) than those used clinically.[19]

The influence of the opioid on the level of sedation in standing procedures is controversial. The effect of butorphanol on the level of sedation achieved, when combined with an α-2 agonist still remains debated in the literature. Most importantly, butorphanol has shown to increase the level of ataxia in horses sedated with romifidine.[20]

Methadone might be a suitable alternative to butorphanol in horses. In one study in healthy horses undergoing elective surgery, methadone was shown to enhance sedation from alpha-2 adrenoceptor agonists. It has also been shown to decrease noise response while maintaining good postural stability.[21] However, the analgesic effects of methadone and its duration remain to be investigated in the equine population.

Morphine provides analgesia, although it has been associated with some dose-dependent adverse effects. In one study of conscious healthy horses, morphine (0.05 and 0.1 mg/kg IV) did not show any antinociceptive effect, assessed by hoof withdrawal reflex latency.[22] In another study, administration of morphine (0.5 mg/kg IV) twice daily produced gastrointestinal tract dysfunction for 6 hours in healthy horses; however, the dose of morphine selected for the study was higher than the recommended dose for clinical use in horses.[23]

There is also a negative impact on motility due to pain and inflammation (via spinal and supraspinal pathways, as well as by upregulation of local neurogenic inhibitory pathways), which could increase the probability of developing ileus.[28,29]

Further research into different analgesic treatments is required to allow for good analgesia while avoiding adverse effects.

Local anaesthetics may provide adequate anaesthesia while avoiding the possible adverse effects of opioids. Additionally, they are low cost, making them a popular choice. Lidocaine, mepivacaine and bupivacaine are routinely used in equine practice. Local anaesthetics work by blocking the voltage-gated sodium channels, preventing propagation of depolarisation through the nerves; therefore, desensitising the area and providing effective anaesthesia.[24]

In Bautista et al.'s study, a lidocaine-dye mixture of 0.2 mL/kg was injected at the level of the 16th transverse process. The horses in which the injectate reached the thoracolumbar fascia (85% of the injections), the spread had a cranio-caudal dimension of 4.8 ± 1.3 vertebral bodies. Epidural spread was found in 20% of the horses. Therefore, this must be taken into consideration when performing an ESP block.

The contribution of epidural spread of local anaesthetic to the overall analgesia is uncertain.[9] The potential for spread of local anaesthetics towards the regions responsible for the motor innervation of the limbs represents an important risk factor[26], especially in sedated horses where falls or claudication can put the horse and the operators at serious risk.

It is critical to be prepared for potential complications; therefore, all of the equipment for a rapid induction of general anaesthesia was prepared in the event of the horse becoming recumbent, including calculated doses of induction agent, endotracheal tubes of different sizes and oxygen supply.

To minimise the risk of epidural spread during the ESP block, correct visualisation of anatomic landmarks is crucial. Another factor that may influence the amount of epidural spread is the volume of local anaesthetic administered. In our study, the lower volume used (compared with Bautista et al.'s study) aimed to reduce the amount of epidural spread.

In this case, the correct plane of sedation and analgesia was achieved with the combination of α-2 agonists and ultrasound-guided ESP block with lidocaine. The lighter plane of sedation and the reaction to surgical manipulation at 140 minutes after the ESP block could be explained by the duration of effect of lidocaine. Lidocaine has a fast onset of

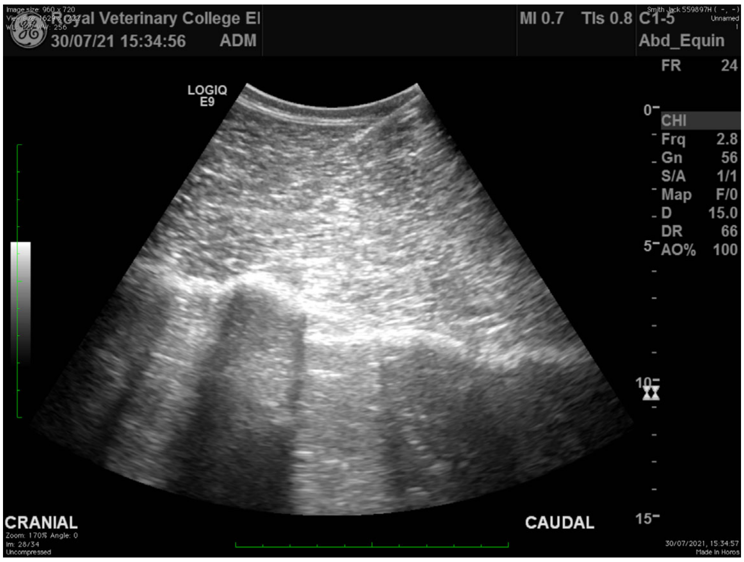

FIGURE 2 Acoustic window of the dorsal thoracic region at a depth of 15 cm with the transducer oriented parasagitally over the transverse processes of 13th and 12th thoracic vertebrae.

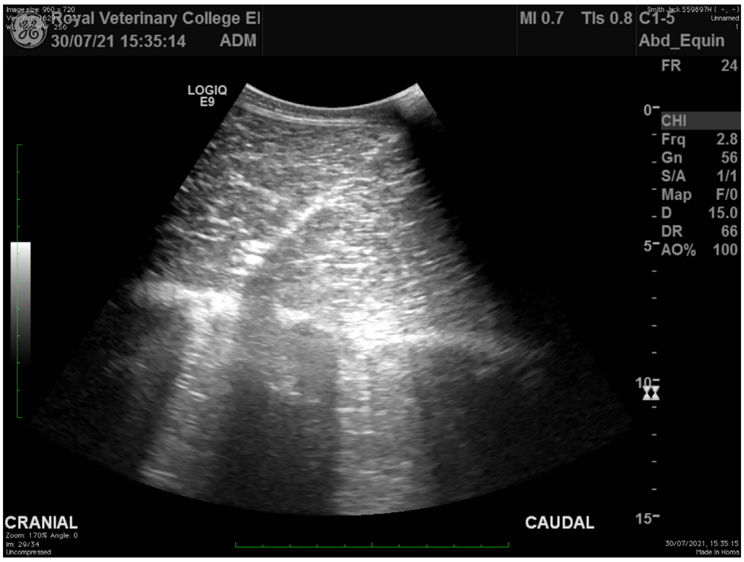

FIGURE 3 Ultrasound image of the dorsal thoracic region at a depth of 15 cm, with the transducer oriented parasagitally and the tip of the needle positioned in the transverse process of the 18 thoracic vertebrae at the level of the thoracolumbar fascia.

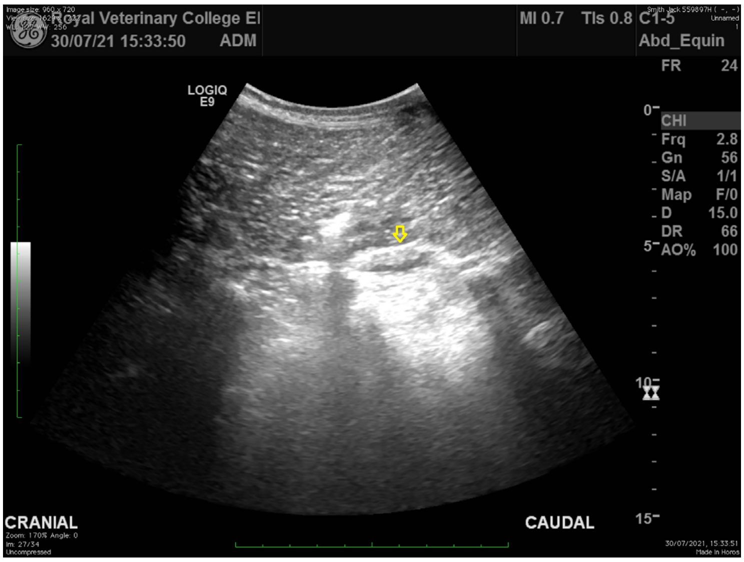

FIGURE 4 Distribution of local anaesthetic (yellow arrow) in the erector interfacial plane between the transverse processes of the thoracic vertebrae.

action of about 2–5 minutes after injection. However, duration of anaesthesia may only last up to 2 hours without epinephrine. Bupivacaine has a similar mechanism of action, but with a slower onset of 5–10 minutes after injection and effects lasting 4–8 hours.[24]

The faster onset of action and the lower cost of lidocaine when compared with bupivacaine make lidocaine a more popular option for local anaesthesia in equine practice. However, the shorter duration of the effect might be disadvantageous for long procedures.

The authors believe that the longer duration of nerve blockade provided by bupivacaine may result in a more effective perioperative pain control compared to lidocaine.

However, in this case, the increased cost was a limitation for its use.

The most important limitation of this case report is the ability to assess pain. The lack of reliability of the equine pain scales during sedation, and the lack of evidence about this topic are two important factors. In this case, it was decided to rely on changes in the PR, reaction to surgical manipulation or changes in the level of sedation as signs of pain, but other clinicians may prefer to rely on other parameters for pain assessment.

Postoperative pain measurement was attempted with a multifactorial numerical rating composite pain scale.[25] Unfortunately, the restless nature of the horse made this scale impossible to use as exaggerated responses to auditory stimulus negatively affect the reliability of this pain scale.

As previously mentioned, physiological parameters remained stable and within baseline values and no painful responses were detected on direct wound palpation; therefore, the horse was subjectively considered comfortable and painless. However, the splash block performed at the end of the procedure may have interfered with the assessment of the influence of the ESP block in the postoperative period.

AUTHOR CONTRIBUTIONS

Bartolome Rico Perez wrote the case report and performed the anaesthesia, Alexander Hawkins and Andrew Fiske-Jackson performed the surgical procedure and Carolina Palacios Jimenez revised the manuscript.

CONFLICT OF INTEREST STATEMENT

The authors declare they have no conflicts of interest.

ETHICS STATEMENT

Ethical approval was not required for this case.

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