Veterinary
Anaesthesia and Analgesia
Formerly the Journal of Veterinary Anaesthesia

Veterinary Anaesthesia and Analgesia, 2014, **41**, 430–437 doi:10.1111/vaa.12133

RESEARCH PAPER

Analgesic and gastrointestinal effects of epidural morphine in horses after laparoscopic cryptorchidectomy under general anesthesia

Manuel Martin-Flores*, Luis Campoy*, Marc A Kinsley†, Hussni O Mohammed‡, Robin D Gleed* & Jonathan Cheetham*

*Department of Clinical Sciences, College of Veterinary Medicine, Cornell University, Ithaca, NY, USA

†College of Veterinary Medicine, Cornell University, Ithaca, NY, USA

‡Department of Population Medicine and Diagnostic Sciences, College of Veterinary Medicine, Cornell University, Ithaca, NY, USA

Correspondence: J Cheetham, Box 32, Department of Clinical Sciences, College of Veterinary Medicine, Cornell University, Ithaca, New York 14853, USA. E-mail: jc485@cornell.edu

Abstract

Objective To evaluate the hypothesis that epidural morphine (0.1 mg kg^{-1}) decreases pain in horses after laparoscopic surgery without adversely affecting gastrointestinal (GI) motility.

Study design Randomized clinical trial.

Animals Eighteen horses undergoing laparoscopic cryptorchidectomy under general anesthesia.

Methods Horses were randomly assigned to receive either epidural morphine (0.1 mg kg^{-1}) or no epidural before the start of surgery. Pain behaviors were assessed during the first two post-operative days using a numerical rating scale. Barium-filled spheres were administered through a nasogastric tube before anesthesia. GI motility was assessed by recording manure production, by quantitating the spheres in the manure, and by abdominal auscultation of intestinal sounds. Heart rates and cortisol concentrations were also measured during the post-operative period.

Manuel Martin-Flores and Jonathan Cheetham contributed equality.

Results Pain scores increased for 12 hours after surgery in the control group and were significantly higher than in the morphine group for the first 6 hours. Pain scores remained unaltered in the morphine group throughout the observation period. Heart rate and plasma cortisol concentrations did not differ between groups or with time. No signs of colic were observed in any horse.

Conclusion and clinical relevance Epidural morphine (0.1 mg kg^{-1}) did not adversely affect GI motility in horses after laparoscopic surgery under general anesthesia.

Keywords analgesia, anesthesia, epidural, equine, gastrointestinal, morphine.

Introduction

Systemic administration of opioids to horses has been associated with reduced gastrointestinal (GI) motility (Senior et al. 2004; Boscan et al. 2006). Consequently, many clinicians are reluctant to prescribe opioids perioperatively to avoid exacerbation of ileus. Opioids, including morphine, can be administered into the epidural space from which they diffuse readily to interact with opioid receptors in the dorsal horn of the spinal cord (Chiari &

Eisenach 1998). The dose rate of morphine needed to produce a given level of analgesia may be less when injected epidurally compared to other parenteral routes. Reducing the dose rate may result in a lower prevalence and severity of systemic side effects, such as decreased GI motility, associated with activity of the drug at receptors outside the spinal cord (Bennett & Steffey 2002).

Epidural morphine (0.1 mg kg^{-1}) provided analgesia for horses undergoing standing laparoscopic ovariectomy (Van Hoogmoed & Galuppo 2005). A higher dose rate of epidural morphine (0.2 mg kg^{-1}) administered to healthy, unmedicated horses increased mean GI transit time by approximately 5 hours without detectable decreases in GI sounds or signs of colic (Sano et al. 2011).

Gastrointestinal function is influenced in clinical patients by a variety of factors, including surgical stimulation, pre-anesthetic fasting, and co-administered drugs. The analgesic and GI effects of epidural morphine have not been systematically evaluated in clinical equine patients subjected to abdominal surgery under general anesthesia. The hypothesis of this study was that administration of epidural morphine (0.1 mg kg^{-1}) to anesthetized horses before the start of laparoscopic surgery for correction of cryptorchidism would 1) reduce post-operative pain and 2) not decrease GI motility during the first 2 post-operative days.

Materials and methods

All horses undergoing laparoscopic cryptorchidectomy at the Equine Hospital of Cornell University between April 2005 and September 2008 were eligible for inclusion in the study. This project was approved by the Institutional Animal Care and Use Committee, and informed client consent was obtained from the owners of all animals enrolled. All horses were considered healthy based on a physical examination. Except during surgery and anesthesia, the horses were housed in conventional loose boxes bedded with shavings. Each horse was hospitalized for a total of 4 days and provided with water *ad libitum*. Food was withheld overnight prior to induction of anesthesia. The evening before surgery, 200 barium-filled plastic spheres (LDPE Barium Filled Ball; Precision Plastic Ball Company, IL, USA) were administered with water and mineral oil (1:1 v/v; 9 mL kg^{-1}) by nasogastric tube. These spheres served as markers of GI transit (Lippold et al. 2004) and their presence in the manure was verified radiographically.

Anesthesia and surgical procedures

On the morning of surgery, a 14-gauge catheter was placed in the left jugular vein, and each horse received potassium penicillin (22,000 IU kg^{-1}) intravenously (IV) pre- and 6 hours post-operatively and phenylbutazone (4 mg kg^{-1}) IV pre-operatively and 2 mg kg^{-1} IV every 12 hours post-operatively. Horses were sedated with xylazine (0.7 mg kg^{-1}; AnaSed; Lloyd Inc., IA, USA) IV and anesthesia was induced with midazolam (0.1 mg kg^{-1}; Midazolam hydrochloride; Hospira Inc., IL, USA) and ketamine (2.2 mg kg^{-1}; Ketaset; Fort Dodge Animal Health, IA, USA) IV. After orotracheal intubation, anesthesia was maintained with isoflurane in oxygen. Monitoring consisted of an electrocardiogram (ECG), heart rate (HR), pulse oximetry, invasive arterial blood pressure and end-tidal carbon dioxide pressure ($P_E'CO_2$) and isoflurane concentration ($F_E'Iso$). Ventilation was controlled to maintain partial pressure of arterial carbon dioxide ($PaCO_2$) between 38 and 42 mmHg. A balanced electrolyte solution (Plasma-lyte A, Baxter Healthcare Corporation, IL, USA) was administered IV throughout anesthesia at approximately 5 mL kg^{-1} $hour^{-1}$. Dobutamine was infused as necessary to maintain mean arterial pressure (MAP) above 70 mmHg.

The absence of at least one scrotal testicle was confirmed immediately after induction of anesthesia with the animals in lateral recumbency. Then each horse was assigned randomly to one of two treatment groups by removing labels from an opaque envelope: epidural morphine (0.1 mg kg^{-1}) or no epidural (control). Unilateral and bilateral cryptorchid horses were assigned a treatment by separate block randomization. The puncture site (sacro-coccygeal area) of all horses was clipped, regardless of treatment group. An 18-gauge 8.75 cm (3.5 inch) Tuohy needle (Perifix Tuohy epidural needle; B Braun Medical Inc., PA, USA) was inserted perpendicular to the skin and correct placement was verified by the loss-of-resistance to air technique. All horses assigned to receive epidural morphine were injected with preservative-free morphine (0.1 mg kg^{-1}; Preservative free morphine, 1% compounded by the Pharmacy of Cornell University Hospital for Animals and diluted with sterile saline to a final volume of 0.04 mL kg^{-1}). Insertion of the epidural needle was performed by one investigator before the horses were positioned in dorsal recumbency. In all cases, epidural administration of morphine was completed at least 35 minutes before

