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RESEARCH PAPER

A comparison of epidural analgesia provided by bupivacaine alone, bupivacaine + morphine, or bupivacaine + dexmedetomidine for pelvic orthopedic surgery in dogs

Odette O & Lesley J. Smith

Section of Anesthesiology and Pain Management, Department of Surgical Sciences, School of Veterinary Medicine, University of Wisconsin, Madison, WI, USA

Correspondence: Lesley J Smith, Department of Surgical Sciences, School of Veterinary Medicine, 2015 Linden Drive, Madison, WI 53706, USA. E-mail: smithl@svm.vetmed.wisc.edu

Abstract

Objective To compare the analgesic efficacy of bupivacaine, bupivacaine + morphine, or bupivacaine + dexmedetomidine administered epidurally in dogs undergoing pelvic limb orthopedic surgery.

Study design Prospective, randomized, double blinded clinical trial.

Animals Sixty dogs weighing (mean ± SD) 35 ± 15.7 kg, aged 5 ± 3 years.

Methods Dogs were assigned to receive a lumbosacral epidural containing bupivacaine (B) 0.5%, 1 mg kg^{-1}; B, bupivacaine 0.5%, 1 mg kg^{-1} + morphine 1%, 0.1 mg kg^{-1}; B + M, or bupivacaine 0.5%, 1 mg kg^{-1} + dexmedetomidine 0.05%, 4 μg kg^{-1}; B + D. The anesthetic protocol was standardized. The median expired isoflurane concentration (E'Iso) and requirement for additional induction agent preventing purposeful movement were recorded. Pain was scored using visual analog (VAS) and modified University of Melbourne (UMPS) pain scales. Sedation was assessed using a 0–4 scale. All parameters were recorded preoperatively, and at extubation (t = 0), then at 1, 2, 4, 8, 12, 16, and 20–24 hours. Hydromorphone was administered postoperatively to patients with a VAS ≥ 35 and/or UMPS ≥ 9. Time to first voluntary urination and first motor activity were recorded.

Results Postoperatively, B + D had a lower UMPS pain score than B at t = 1 hour (p = 0.013), but not compared to B + M. The B + D group had a shorter time to urination (p = 0.0131) and a longer time for return of motor function (p = 0.0068). There were no other differences between the treatments.

Conclusion and clinical relevance Epidurally administered B, B + M, or B + D in dogs all provided acceptable analgesia to manage post-operative orthopedic pelvic limb pain. Epidural administration of B + D is an effective alternative to the analgesia provided by B or B + M, but is associated with increased time to return of motor function. The direct neurotoxic effects of epidural dexmedetomidine have not been fully tested.

Keywords analgesia, bupivacaine, dexmedetomidine, dog, epidural, morphine.

Introduction

Elective orthopedic surgeries in dogs are extremely common in both general and surgical referral practices. Patients with cranial cruciate ligament injury are commonly prescribed a non-steroidal

anti-inflammatory drug (Wilke et al. 2005) but will have increased need for management of pain as they undergo surgery. Moderate to severe pain is elicited from both soft tissue and bone manipulation in these patients and may complicate and delay recovery if not well managed.

The epidural administration of various classes of drugs for surgical and post-surgical pain management is widely used in both referral and general practices and was first reported over 40 years ago (Klide & Soma 1968). It is a technique requiring some degree of technical skill, but one that can be readily mastered. Drugs commonly recommended for epidural administration in small animals are opioids (e.g. morphine) and local anesthetics (e.g. lidocaine, bupivacaine) (Fossum et al. 2002). A combination of bupivacaine and morphine was reported to provide better analgesia than morphine alone (Kona-Boun et al. 2006). Opioids modulate pain at the mu receptors of the spinal cord dorsal horn, while local anesthetics block transmission of nerve impulses (Gaynor & Muir 2009). The duration of effect of bupivacaine administered alone in an epidural is approximately 4–6 hours, whereas epidural morphine may have analgesic effects for 12–24 hours (Egger & Love 2009).

Although bupivacaine and morphine are the most common epidural drugs administered in veterinary medicine, epidural dexmedetomidine with a local anesthetic may provide better epidural efficacy and an extended duration of action compared to the use of bupivacaine alone. In one human study, epidural dexmedetomidine plus ropivacaine decreased time to sensory and motor blockade, increased the duration of analgesia, and increased sedation scores (Bajwa et al. 2011). In a comparative study of dexmedetomidine and fentanyl as adjuvants to bupivacaine administered intrathecally to humans, dexmedetomidine was found to be associated with prolonged motor and sensory blockade and a decreased use of rescue analgesics in the first 24 hours post-operatively (Gupta et al. 2011). There have been few published reports regarding the use of epidural dexmedetomidine in dogs (Sabbe et al. 1994; Campagnol et al. 2007), and there are no published reports comparing the use of dexmedetomidine with bupivacaine or morphine in this species.

In addition to potentially better epidural efficacy when dexmedetomidine is combined with a local anesthetic, other advantages of including dexmedetomidine in the epidural are that this drug is readily available, is not a controlled substance, and may not be associated with post-operative opioid-related side effects such as urinary retention (Troncy et al. 2002).

The goal of this study was to determine whether dexmedetomidine administered with bupivacaine increased the duration and/or intensity of analgesia in dogs when given by lumbosacral epidural injection. Our hypothesis was that a combination of dexmedetomidine and bupivacaine administered into the epidural space would provide longer and more effective analgesia than when bupivacaine was administered alone or in combination with morphine.

Materials and methods

Animals

Sixty client-owned dogs scheduled for elective pelvic limb orthopedic surgery at the University of Wisconsin Veterinary Medical Teaching Hospital were enrolled. Informed owner consent was obtained prior to study enrollment, and the study protocol was approved by the Animal Care and Use Committee at the University (SVM Research Animal Resources Center #V01497). The surgical approach was determined by faculty within the orthopedic surgery service. The study population included both male and female dogs, neutered, of various breeds. Exclusion criteria included pyoderma over the lumbosacral area, coagulopathies, uncompensated underlying systemic disease, traumatic fractures, presentation for digit amputation or arthroscopy only, dogs <6 months of age, and dogs with a body condition score $\geq 7/9$. Patients in which administration of a nonsteroidal anti-inflammatory drug (NSAID) was contraindicated for any reason were also excluded. All dogs were judged to be healthy based on physical examination and blood work (packed cell volume, total protein, azostick or a limited chemistry panel). The dogs weighed (mean $\pm$ SD) 35 ± 15.7 kg and were 5 ± 3 years old.

Anesthetic management

Food, but not water, was withheld for 12 hours prior to anesthesia. Pre-anesthetic medication administered to all patients was intramuscular (IM) acepromazine (0.05 mg kg^{-1} (Acepromazine Maleate Injection; Vedco, Inc, MO, USA, 4 mg maximum) and hydromorphone (0.2 mg kg^{-1}) (Hydromor-