

RESEARCH PAPER

Comparison of bupivacaine and dexmedetomidine femoral and sciatic nerve blocks with bupivacaine and buprenorphine epidural injection for stifle arthroplasty in dogs

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Abstract

Objective To compare the quality of anesthesia and analgesia from femoral and sciatic nerve blocks (FS) with bupivacaine and dexmedetomidine with that from an epidural injection (EPI) with bupivacaine and buprenorphine in dogs undergoing unilateral stifle arthroplasty.

Study design Prospective, blinded, randomized, clinical comparison.

Animals Twenty-six dogs weighing 36 ± 10 kg and aged 5 (1–11) years.

Methods Dogs were randomly assigned to either FS [$n = 13$; bupivacaine 0.5% (0.5 mg kg^{-1}) plus dexmedetomidine ($0.1 \mu\text{g kg}^{-1}$) for each nerve] or EPI [$n = 13$; bupivacaine 0.5% (1 mg kg^{-1}) plus buprenorphine ($4 \mu\text{g kg}^{-1}$)]. Data collected included intraoperative cardiopulmonary variables and postoperative pain scores (Glasgow Composite Pain Scale), sedation scores, opioid consumption, time to urination and time to return of various behaviors. Rescue analgesia (hydromorphone 0.05 mg kg^{-1}) was administered intravenously whenever pain scores were $\geq 6/24$. Subsequent data from rescued dogs were excluded from further analysis.

Results No differences were found for any of the variables evaluated during and after anesthesia. Over 60% (nine dogs in FS, eight dogs in EPI) of patients from either group did not need additional analgesia within the 24 hour observational period. Three and four patients in FS and EPI, respectively, that required rescue analgesia did so within the first 30 minutes after extubation; only one patient in EPI required supplemental analgesia more than 4 hours after extubation. One patient in each group did not urinate spontaneously for 24 hours.

Conclusions and clinical relevance Both techniques have the potential to provide sufficient analgesia for up to 24 hours in approximately two-thirds of dogs. Careful observation for signs of pain and preparedness to intervene is still recommended. The incidence of urinary retention was low in both groups. These techniques show promise for providing high-quality analgesia for stifle arthroplasty.

Keywords bupivacaine, buprenorphine, dexmedetomidine, epidural, femoral nerve block, sciatic nerve block.

Introduction

Peripheral and neuraxial regional anesthetic techniques are used to augment intraoperative and

postoperative analgesia for stifle surgery in dogs (Campoy et al. 2012). Simultaneous block of the femoral and sciatic nerves with local anesthetics can produce complete regional anesthesia and analgesia for stifle surgery. In species other than dogs, the addition of α_2 -adrenoceptor agonists, such as dexmedetomidine, to local anesthetic agents has been used to intensify and prolong the conduction block produced (Brummett et al. 2008; Yoshitomi et al. 2008). Epidural injection of local anesthetic solution, often in conjunction with an opiate, is an alternative locoregional technique for providing anesthesia and analgesia for stifle surgery. Morphine is often chosen as the opioid adjunct to the local anesthetic in the epidural injectate (Kona-Boun et al. 2006). The two approaches may be different in the quality of analgesia they produce and the side effects that they generate (Campoy et al. 2012).

When the femoral nerve is blocked at the inguinal region, there is an inherent potential of puncturing the femoral vessels (Mahler & Adogwa 2008), although the incidence and impact are unknown. Additionally, this technique, when combined with a sciatic nerve block, has the potential to produce an incomplete block in those individuals where supplementary fibers from the obturator nerve, providing sensory innervation to the stifle, are present (O'Connor & Woodbury 1982), or as a result of a technical failure. No neurological complications related to peripheral nerve blocks were observed in a retrospective study of 256 dogs (Vettorato et al. 2012).

Epidural injection may produce less uniform analgesia due to gravitationally induced dispersion of the injectate within the epidural space related to changes in posture after the injection is administered (Gorgi et al. 2006). Furthermore, epidural injection of local anesthetics has been reported to elicit adverse side effects, such as hypotension associated with segmental sympathetic block (Bosmans et al. 2011a,b). The bilateral motor paralysis produced by the administration of epidural local anesthetic solutions may delay the return to ambulation. Lastly, epidural injection of μ -opioid agonists (primarily morphine) has been reported to cause urinary retention in dogs with an incidence ranging from anecdotal to 3.5% or greater (Rawal et al. 1983; Herperger 1998; Troncy et al. 2002; Kona-Boun et al. 2003; Campoy et al. 2012). As an alternative to morphine, buprenorphine is a high-affinity partial μ -opioid agonist with potentially similar analgesic effects when administered epidurally (Smith & Yu 2001). Interestingly, in humans, urinary retention

was less frequent after epidural injection of buprenorphine than after epidural injection of morphine (Wolff et al. 1986).

We therefore set out to compare the quality of anesthesia and analgesia produced by a femoral and sciatic nerve block technique using bupivacaine and dexmedetomidine (FS) with that of a single injection epidural technique using bupivacaine and buprenorphine (EPI) in dogs undergoing unilateral elective stifle arthroplasty (tibial plateau leveling osteotomy). We hypothesized that: 1) the FS patients would demonstrate better antinociception and analgesia indicated by lower intra- and postoperative opioid consumption and lower postoperative pain scores; 2) the incidence of intraoperative hypotension and pressor requirements would be significantly lower in FS; 3) ambulation and time to first food intake would occur earlier in FS than in EPI; and 4) the incidence of urinary retention would be greater in EPI.

Materials and methods

This study was approved by the Institutional Animal Care and Use Committee of Cornell University (no. 2013-0044). With informed owner consent, 26 canine patients weighing (mean \pm standard deviation, SD) 36 ± 10 kg, with a median (range) age of 5 (1–11) years and undergoing elective unilateral stifle arthroplasty were enrolled in this study. Each was assigned randomly (closed envelope after random allocation of ballots in a 1:1 ratio) to one of two groups, namely combined femoral and sciatic nerve blocks (group FS; $n = 13$) or epidural injection (group EPI; $n = 13$).

Patients assessed to be American Society of Anesthesiologists (ASA) physical status I or II were considered to be eligible. Exclusion criteria included orthopedic disease in a limb other than the one undergoing stifle arthroplasty, neurological disease, intractable behavior, pregnancy, coagulopathy, skin infection at the site of injection, a history of liver, renal or gastrointestinal disease or any contraindication for the use of the non-steroidal anti-inflammatory drugs or local anesthetic agents. Physical examinations and hematology and serum chemistry analyses were performed on all dogs. The following variables were recorded for each dog prior to premedication: age, weight, sex, heart rate (HR) and oscillometric noninvasive blood pressure (NIBP) (Cardell Max 12 HD; Midmark Corporation, OH, USA), with the cuff placed around the antebrachium of the uppermost thoracic limb while the dog was in lateral recumbency,

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