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RESEARCH PAPER

Comparison of lidocaine, lidocaine–morphine, lidocaine–tramadol or bupivacaine for neural blockade of the brachial plexus in fat-tailed lambs

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Abstract

Objective To evaluate the onset time and duration of action of lidocaine, lidocaine–morphine, lidocaine–tramadol or bupivacaine for a neural blockade of the brachial plexus in fat-tailed lambs.

Study design Prospective, randomized, crossover, experimental study.

Animals Seven healthy female fat-tailed Ghezel lambs weighing 27.0 ± 2.2 kg (mean ± SD).

Methods Each lamb was administered four treatments for brachial plexus block (BPB): lidocaine 2% (5 mg kg^{-1}) (LID), lidocaine 2% combined with morphine (0.1 mg kg^{-1}) (LIDMO), lidocaine 2% combined with tramadol (1 mg kg^{-1}) (LIDTR) or bupivacaine 0.5% (1.25 mg kg^{-1}) (BUP), for a total treatment volume of 0.25 mL kg^{-1}. The brachial plexus was located with a peripheral nerve stimulator, and the treatment volume was injected in increments. Treatments were randomized and separated by at least 7 days. Onset and duration of a sensory block of the distal thoracic limb were evaluated using superficial and deep pin pricks and pinching of the skin with haemostatic forceps.

Results The mean duration of sensory block was 100 ± 38 minutes in LID, 103 ± 35 minutes in LIDMO, 79 ± 28 minutes in LIDTR, and 335 ± 134 minutes in BUP. The mean duration of sensory and motor blocks in BUP were significantly longer compared with other treatments ($p < 0.05$). No clinical signs of local anaesthetic toxicity were noticed, and the rectal temperature did not differ significantly from baseline values in any treatments.

Conclusions and clinical relevance The addition of morphine or tramadol to lidocaine did not affect the duration of antinociception of lidocaine for brachial plexus block in fat-tailed lambs. Administration of bupivacaine provided a prolonged duration of action without obvious adverse effects.

Keywords brachial plexus block, bupivacaine, lambs, lidocaine, morphine, tramadol.

Introduction

Brachial plexus block (BPB) has become an increasingly popular regional nerve block technique in humans (O'Donnell et al. 2009) and in veterinary patients to provide analgesia of the distal thoracic limb (Duke et al. 1998; Wenger et al. 2005; Mahler & Reece 2007; Mosing et al. 2010). This technique may be used as a part of a balanced anaesthetic protocol and can play an important role in the immediate post-operative analgesia.

Brachial plexus block can be achieved by injecting a local anaesthetic agent around the brachial plexus nerves at the approximate level of the scapulohu-

meral joint. A peripheral nerve stimulator can be used to locate accurately the radial, median, ulnar, musculocutaneous and axillary nerves (Skarda & Tranquilli 2007a), and this technique enhances the chances of successful BPB in small animals and may allow a reduction in the dose of local anaesthetic agent (Futema et al. 2002; Wenger et al. 2005; Mahler & Reece 2007; Sakonju et al. 2009; Mosing et al. 2010).

In animals raised for food production, local and regional anaesthetic techniques are preferred over general anaesthesia because the techniques are low cost, require minimal equipment and are less likely to be associated with hypoventilation or regurgitation (Skarda & Tranquilli 2007b). A brachial plexus block has been described in sheep, goat and calves (Moens 1995; Estebe et al. 2000; Iwamoto et al. 2012). In sheep, the four ventral nerve roots of the sixth, seventh and eighth cervical (C_6, C_7 and C_8) and first thoracic (T_1) spinal nerves contribute to the brachial plexus (Ghoshal 1975).

Lidocaine is a local anaesthetic agent of intermediate duration of action when used as a single injection. Various methods, such as continuous infusion of a local anaesthetic agent via catheters and the use of different adjuvants to local anaesthetic solutions, have been employed to extend the local anaesthetic action (Antonucci 2001; Mahler & Reece 2007). Continuous peripheral nerve blocks have been used to provide a period of extended analgesia in humans; however, this technique requires catheter insertion and maintenance, an infusion system and close monitoring of the patient (Moens & Caulkett 2000).

Several studies have evaluated the efficacy of different drugs as adjuvants to local anaesthetic agents in BPB to achieve a more prolonged analgesia. A variety of adjuvants including epinephrine (Eledjam et al. 1991), alpha$_2$-agonists (Esmaoglu et al. 2010) and opioids (Bazin et al. 1997; Candido et al. 2002) have been used for BPB in an attempt to provide effective peri-operative analgesia.

The addition of tramadol to local anaesthetic agents for BPB has been studied in human patients with results that demonstrated an improved quality and duration of a local anaesthetic block (Kaabachi et al. 2009). Bupivacaine is a long-acting amino-amide local anaesthetic agent which has been used for BPB in dogs (Duke et al. 1998; Futema et al. 2002; Wenger et al. 2005; Mahler & Reece 2007), sheep (Estebe et al. 2000) and cats (Mosing et al. 2010).

The objective of the study reported here was to determine if the addition of morphine or tramadol influences the onset time and duration of action of lidocaine for a neural blockade of the brachial plexus in fat-tailed lambs. The hypothesis was that the addition of morphine or tramadol would increase the duration of action of lidocaine for BPB in fat-tailed lambs. A brachial plexus block with lidocaine alone or bupivacaine alone was included for comparison.

Materials and methods

The Institutional Animal Care and Use Committee of the School of Veterinary Medicine, Shiraz University, Iran approved the protocol for this project. Seven healthy, mean ± standard deviation (SD) 5.6 ± 0.3 months, female fat-tailed Ghezel lambs weighing 27.0 ± 2.2 kg with a body condition score of 2.8 ± 0.3 (scale of 0–5) were used in a randomized, crossover design.

The lambs were confined to indoor pens and fed alfalfa, concentrate (grain mix) and water *ad libitum* and were allowed an acclimation period of 2 weeks prior to the beginning of the study. Health status was established on the basis of a thorough clinical examination, complete blood count and total protein. Faecal sample examination revealed no parasite infestation. Each lamb was randomly administered all four treatments (seven lambs per treatment) for BPB. The sequence of drugs administered was randomized for each sheep by writing equal numbers of lidocaine (LID), lidocaine combined with morphine (LIDMO), lidocaine combined with tramadol (LIDTR) and bupivacaine (BUP) on 28 pieces of paper and then blindly selecting one for each lamb. After each treatment, the right or left limb was identified by a capital letter abbreviation of R and L. Each limb was used on two occasions, with at least 7 days between the experiments.

Animals in the treatment LID were administered lidocaine hydrochloride (5 mg kg^{-1}; 20 mg mL^{-1}; Caspian Tamin, Pharmaceutical Co., Iran); treatment LIDMO lidocaine (4.8 mg kg^{-1}) combined with morphine (0.1 mg kg^{-1}; Darou Pakhsh Co., Iran); treatment LIDTR lidocaine (4.6 mg kg^{-1}) combined with tramadol (1 mg kg^{-1}; Exir Pharmaceutical Co., Iran); and treatment BUP bupivacaine hydrochloride (1.25 mg kg^{1}; 5 mg mL^{-1}; Merck Company, Lyon Cedex, France). Lidocaine–morphine and lidocaine–tramadol solutions were freshly prepared by adding morphine (10 mg mL^{-1}) or tramadol (50 mg mL^{-1}) to 2% lidocaine immediately before use. The total volume of the drug(s) injected was 0.25 mL kg^{-1}. The pH of the anaes-