RESEARCH PAPER

Comparison of ultrasound- and electrostimulation-guided nerve blocks of brachial plexus in dogs

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Abstract

Objective To compare the effectiveness of ultrasound- and electrostimulation-guided nerve blocks of the brachial plexus and to determine whether ultrasound guidance is feasible in conscious dogs.

Study design Blinded, crossover, experimental study.

Animals Six clinically healthy adult Beagle dogs.

Methods The nerves of the brachial plexus of the right thoracic limb were blocked under ultrasound guidance (UNB) in conscious dogs and under electrostimulation guidance (ENB) in anesthetized dogs with bupivacaine (0.4 mL kg^{-1}, 0.25%). Saline (0.4 mL kg^{-1}) was injected in control animals. Sensory nerve blockade was evaluated by scoring cutaneous sensation in targeted nerves. Motor nerve blockade was evaluated based on weight bearing, conscious proprioception and withdrawal reflex scores. Times to execute the technique in UNB and ENB were compared using t tests ($p < 0.05$). Scores for sensory and motor nerve blockades in each treatment were compared with scores before treatment and with control treatment scores using nonparametric repeated-measures two-way analysis of variance. Time to onset and duration of sensory nerve block were assessed using scores for four sensory nerve functions. A successful sensory nerve block was defined by decreases in scores for these functions. Success rates of nerve blocks were compared among treatments using McNemar's test.

Results In UNB and ENB, onset times of sensory nerve blocks were 1 hour and 1.5 hours, respectively. Onset times of motor nerve blocks were 0.5 hour in both treatments. In UNB and ENB, durations of sensory nerve block were 3 hours and 0.5 hour, respectively, and durations of motor nerve block were 7.5 hours and 6.5 hours, respectively. Success rates did not differ between the techniques.

Conclusions and clinical relevance The UNB brachial plexus block had a shorter onset time and longer duration than ENB. UNB can be performed in conscious dogs or those under mild sedation.

Keywords brachial plexus block, bupivacaine, canine, local anaesthesia, pain management.

Introduction

A peripheral nerve block provides regional anesthesia with few systemic adverse effects. The inclusion of a peripheral nerve block in an anesthetic protocol may facilitate a reduction in the dose rate of anesthetic agents, resulting in less systemic depression, and provide analgesia that persists postoperatively (Wenger et al. 2005). In addition, some surgical procedures can be performed using peripheral nerve blocks without general anesthesia. Methods for locating a peripheral nerve include the use of anatomic landmarks, electrical stimulation and ultrasound imaging. A brachial plexus nerve block using a landmark in dogs was initially described by Tufvesson (1951). Although the procedure can be performed without any specific equipment, the location of target nerves cannot be confirmed. In an electrostimulation-guided nerve block (ENB), a needle is inserted until it is close to a target nerve, which is identified by the observation of muscle contractions elicited in an effector muscle after the application of a low electric current (Pither et al.

1985). ENB of the brachial plexus in dogs has been reported (Futema et al. 2002; Sakonju et al. 2009). A disadvantage of ENB is that intraneural placement of the needle is possible only when a low electric current is used (Bigeleisen 2009). Unfortunately, the intensity of the current used to induce a muscular response may not correspond to the needle-to-nerve distance (Portela et al. 2013).

Ultrasound-guided nerve block (UNB) is popular as the technique allows visualization of the needle and the target nerve, which facilitates the positioning of the needle close to the nerve (Sites & Brull 2006; Marhofer & Chan 2007). The distribution and circumferential spread of a local anesthetic solution around the nerve can be visualized in real time (Sites & Brull 2006; Chan et al. 2007). Therefore, nerve injuries and intraneural injections are less likely to occur (Sites & Brull 2006). Studies of UNB in humans have found increased success rates in comparison with those of techniques using a landmark or ENB (Koscielniak-Nielsen 2008).

The use of UNB of the brachial plexus, femoral and sciatic nerves (Campoy et al. 2010), paravertebral brachial plexus (Rioja et al. 2012) and transversus abdominis plane (Schroeder et al. 2011) has been assessed based on nerve dyeing in dogs and cats (Ansón et al. 2015). Sensory and motor nerve functions have been evaluated during UNB of the sciatic and saphenous nerves (Shilo et al. 2010). However, the current authors were unable to find a published study of the clinical effects of UNB of the brachial plexus in dogs.

The present study was designed to compare UNB and ENB in terms of time to completion of nerve block, time of nerve block onset, and efficacy and duration of nerve block, and to determine whether UNB of the brachial plexus can be achieved in conscious dogs. The study was based on the hypotheses that UNB of the brachial plexus will have a greater success rate than ENB and that UNB can be achieved in conscious dogs.

Materials and methods

Animals

This research protocol was approved by the Institute of Experimental Animal Sciences of Tokyo University of Agriculture and Technology (no. 26-27). The study included six healthy Beagle dogs (4 male, 2 female) with a mean ± standard deviation (SD) age of 7.8 ± 1.6 years, weighing 10.4 ± 2.0 kg, and body condition scores of 3 out of 5. The dogs were free of neurological disease and hematological abnormalities based on neurological and hematological examinations. Animals were maintained in strict accordance with the recommendations in the Guide for the Care and Use of Laboratory Animals of the National Institutes of Health.

Study design

This study was a blinded, crossover, experimental trial. The brachial plexus nerves in the right thoracic limb in six dogs were blocked on four occasions separated by 14 days. Bupivacaine (1 mg kg^{-1}, 0.4 mL kg^{-1}; Marcaine injection 0.25%; AstraZeneca KK, Japan) or an equal volume of normal saline (Otsuka Pharmaceutical Co. Ltd, Japan) for control

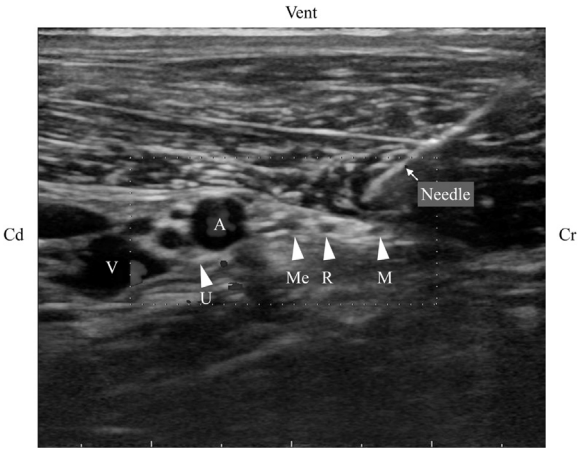

Figure 1 Ultrasound image of the axillary region. The long-axis view of the needle was visualized as hyperechoic to the ventral aspect of the brachial plexus nerves. The solid arrowheads indicate brachial plexus nerves. A, axillary artery; Cd, caudal aspect of the dog; Cr, cranial aspect of the dog; M, musculocutaneous nerve; Me, median nerve; R, radial nerve; U, ulnar nerve; V, axillary vein; Vent, ventral aspect of the dog.