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RESEARCH PAPER

Effect of intrafragmentary bupivacaine (haematoma block) on analgesic requirements in dogs undergoing fracture repair

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Abstract

Objective To test the efficacy of intraoperative intrafragmentary administration of bupivacaine (haematoma block) in controlling postoperative pain in dogs undergoing osteosynthesis of long-bone isolated diaphyseal fractures.

Study design Randomized, blinded, placebo-controlled, prospective study.

Animals A total of 23 client-owned dogs with isolated long-bone fractures.

Methods Dogs were allocated randomly to two groups: bupivacaine group (B) or placebo group (P). Group B dogs ($n = 11$) were administered an intraoperative intrafragmentary injection of 0.5% bupivacaine (1.1 mg kg^{-1}) just before fracture fixation, whereas group P dogs ($n = 12$) were administered normal saline. Postoperative pain evaluations using the University of Melbourne Pain Scale (UMPS) and algometer were performed upon arrival to the recovery room and 1, 2, 4, 6, 8, 20 and 32 hours later. Algometer measurements were performed on: the incision site, a healthy region near the fracture line and the contralateral healthy limb. When the pain score exceeded 14 points in the UMPS, rescue analgesia was administered. The time-standardised area under the curve (AUCst) was used to compare UMPS scores and mechanical pain thresholds between the two groups.

Results None of the group B dogs required rescue analgesia, whereas eight of the 12 group P dogs did ($p = 0.001$). The pain threshold AUCst at the incision line was higher in group B [16.3 (2.9–41.6) N] than in group P [5.6 (2.5–17.4) N] ($p = 0.029$). The mean UMPS score AUCst was lower in group B (3.7 ± 1.8) than in group P (9.4 ± 4.6) ($p = 0.016$). In a small number of animals of both groups that were evaluated radiologically, adequate bone healing was noted.

Conclusions and clinical relevance An intraoperative bupivacaine haematoma block is a simple, quick and effective method that can be used to aid in postoperative pain control in dogs submitted to long-bone osteosynthesis.

Introduction

Postoperative pain after osteosynthesis of long-bone fractures in dogs can be very intense. The haematoma block is the intrafragmentary injection of local anaesthetic into the haematoma formed in a fracture. The exact location of the needle can be confirmed by syringe aspiration of blood (Mencio 2010). In human medicine, the haematoma block is considered a quick, effective and safe technique and often used in closed, isolated fractures to reduce procedural (for closed reduction) and post-procedural pain (Funk 1997; Furia et al. 1997). Another study also indicates the effectiveness of haematoma block in

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controlling postoperative pain after orthopaedic surgery in children (Herrera et al. 2004).

Effects of bupivacaine on articular chondrocytes have been studied *in vitro* and *in vivo* (Webb & Ghosh 2009; Park et al. 2011). Intra-articular bupivacaine (0.5%) has resulted in articular cartilage inflammation and synovial membrane changes in rabbit joints (Dogan et al. 2004). In humans, cases of postoperative chondrolysis after intra-articular injection of bupivacaine in arthroscopic procedures have been reported (Petty et al. 2004; Hansen et al. 2007). However, intra-articular administration of a single injection of low-concentration bupivacaine is considered to be safe (Webb & Ghosh 2009). Little is known about the exact effect of bupivacaine on fracture healing. According to an experimental study in rats, bupivacaine seems to have neither harmful nor beneficial effects on early fracture healing (Henry et al. 2002).

The efficacy of haematoma block in controlling postoperative pain has not been studied in dogs. The aim of this study was to test the efficacy of bupivacaine haematoma block performed intraoperatively in dogs undergoing osteosynthesis of long-bone isolated diaphyseal fractures in controlling postoperative pain. The secondary aim was to note potential adverse effects on fracture healing. We hypothesised that the bupivacaine haematoma block would improve postoperative analgesia compared to placebo without causing important adverse effects on fracture healing.

Materials and methods

This was a randomized, blinded, placebo-controlled, prospective study. The protocol of the study was approved by the Institution's Ethical Committee. Dogs aged > 6 months, characterized as American Society of Anesthesiologists (ASA) physical status II–III, with isolated diaphyseal long-bone fractures were included in the study. Dogs with intra-articular fractures or any other accompanying severe injuries were excluded because of potential confounding pain issues. Informed consent was obtained from all owners of the dogs for participation of their animal in the study. The animals were randomly allocated, according to a random number table, to two groups: bupivacaine group (B) and placebo group (P). Dogs assigned to group B were administered 1.1 mg kg^{-1} bupivacaine (Bupivacaine Hydrochloride; Baxter 0.5% w/v, Bieffe Medital S.P.A., Italy) via an intrafragmentary injection intraoperatively. Dogs assigned to group P were administered normal saline intraoperatively (Sodium Chloride 0.9%; Vioser, Greece) of a volume equal to the volume of bupivacaine administered to group B via an intrafragmentary injection.

For each animal included in the study, the following data were assessed preoperatively: scoring of soft tissue damage [1-mild: minimal soft-tissue damage, superficial abrasion and/or contusion, simple or mild fracture pattern, 2-moderate: deep abrasion, localised skin and muscle contusion, moderate fracture pattern, 3-severe: extensive skin contusion or crushing, severe damage to underlying muscle, severe fracture pattern (modified from Oestern & Tscherne 1984)]; affected bone(s) (humerus, radius, ulna, femur, tibia); location of the fracture line (distal, middle or proximal diaphysis); number of bone fragments (simple or comminuted); presence or absence of fragment displacement; communication between the fracture site and the environment (open or closed); direction of the fracture line (transverse, oblique or spiral) and method of fixation to be applied (plating, intramedullary pinning with use of orthopaedic wire). Dogs in which external osteosynthesis would be applied were excluded from the study. As a part of the preanaesthetic examination, 'mental status' [as described in the University of Melbourne Pain Scale (UMPS) (Firth & Haldane 1999)], heart and respiratory rate were assessed and recorded to be used for postoperative comparison and UMPS scoring. Preoperatively and before any preanaesthetic medication was administered, animals were also submitted to pain threshold measurements using an algometer (Vetalgo Algometer; Bioseb, BP 32025, F-13845 Vitrolles Cedex). These preoperative assessments were performed with the animals under the influence of carprofen (Rimadyl; Pfizer Hellas, Greece) 2 mg kg^{-1} intravenously (IV) twice daily started approximately at the time of diagnostic imaging and administered for the last time on the night before surgery. Dogs were fasted for approximately 12 hours before induction of anaesthesia and access to water was allowed for up to 1 hour before induction.

Preanaesthetic medication included administration of 0.05mg kg^{-1}acepromazine (Acepromazine; Alfasan, The Netherlands) and 0.2 mg kg^{-1} morphine (Morphine sulfate; Famar SA, Greece) intramuscularly (IM). Carprofen 4 mg kg^{-1} IV was also administered shortly before induction of anaesthesia. Lactated Ringer's (L-R, Lactated Ringer's Injection; Vioser, Greece) was administered intraoperatively at 10 mL kg^{-1} $hour^{-1}$. Propofol

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