The Veterinary Journal 202 (2014) 522–526

Contents lists available at ScienceDirect

The Veterinary Journal

journal homepage: www.elsevier.com/locate/tvjl

Effectiveness of pre-peritoneal continuous wound infusion with lidocaine for pain control following ovariohysterectomy in dogs

Juan Morgaz [a,*], Pilar Muñoz-Rascón [a], Juan Manuel Serrano-Rodríguez [b], Rocío Navarrete [a], Juan Manuel Domínguez [a], José Andrés Fernández-Sarmiento [a], Rafael J. Gómez-Villamandos [a], Juan Manuel Serrano [b], María del Mar Granados [a]

[a] Department of Animal Medicine and Surgery, University of Córdoba, Francisco Santisteban Hospital, Campus de Rabanales 14014, Córdoba, Spain
[b] Department of Pharmacology, Toxicology and Legal and Forensic Medicine, Veterinary Faculty, University of Córdoba, Campus de Rabanales 14014, Córdoba, Spain

ARTICLE INFO

Article history:
Accepted 30 August 2014

Keywords:
Continuous wound infusion
Dogs
Lidocaine
Ovariohysterectomy
Pre-peritoneal space

ABSTRACT

This study compared the post-operative analgesic efficacy of continuous lidocaine administration with that of intramuscular (IM) methadone in dogs undergoing ovariohysterectomy. Thirty-eight dogs were divided randomly into two groups. Following surgery, the lidocaine group (L) received a continuous lidocaine infusion (2 mg/kg/h) through a wound catheter inserted in the pre-peritoneal space; the control group (C) received methadone (0.2 mg/kg IM). A dynamic and interactive visual analogue scale (DIVAS), the Scale-Form Glasgow Composite Measure Scale (CMPS-SF), mechanical wound thresholds, heart rate, respiratory rate and blood pressure were assessed pre-operatively and 2, 4, 6, 18, and 24 h after surgery. The presence of the wound catheter prevented the evaluator from remaining blinded to group allocations. Plasma lidocaine and cortisol levels were measured 2, 6, 18, and 24 h after surgery.

There were no intergroup differences in any pain assessment scale scores at any time point. Stable intravenous lidocaine levels were observed. Four animals in the control group but none in the lidocaine group required rescue analgesia. There were no differences in complication rates between groups. Continuous locoregional lidocaine delivered via a wound catheter between the parietal peritoneum and abdominal muscle offers effective analgesia in dogs during ovariohysterectomy and appears to be a promising analgesic option in veterinary surgery.

Introduction

Post-operative pain control is ethically essential and aids appropriate patient recovery through the avoidance of adverse effects such as loss of appetite, self-mutilation, or behavioural alterations that increase the duration of hospitalisation and consequent costs (Bonnet and Marret, 2005; Wagner et al., 2008). To this end, the use of combinations of drugs with different mechanisms of action within a multimodal analgesic protocol is common in veterinary medicine (Lamont, 2008). Opioids are most commonly used because they are excellent analgesics but they can cause adverse effects such as nausea, vomiting, excessive sedation, dysphoria, and respiratory depression (Pascoe, 2000). Another pharmacological option is local analgesia; local analgesics result in reversible blockade of the Na^+ channel, which prevents action potential propagation along the nerve fibre (Ramsey, 2008). Lidocaine is the most frequently used local analgesic for both locoregional techniques (Jones, 2001; Almeida et al., 2010) and intravenous (IV) administration in veterinary patients (Valverde et al., 2004; Columbano et al., 2012; Tsai et al., 2013).

Wound catheters, also known as 'soaker catheters', are small multiport lines inserted into a wound that enable continuous administration of a local analgesic or administration of a drug as a bolus (Abelson et al., 2009). Although their use as a component in a balanced analgesic protocol has increased in veterinary medicine in recent years, few relevant studies have been reported (Wolfe et al., 2006; Abelson et al., 2009; Hardie et al., 2011). The reported lidocaine dose administered with this technique ranges between 1 and 3 mg/kg/h. (Wolfe et al., 2006; Abelson et al., 2009). In human medicine, the technique has been associated with excellent pain control, significantly decreased opioid requirement, and few adverse effects in celiotomies (Rackelboom et al., 2010; O'Neill et al., 2012). To date, however, no veterinary studies have evaluated the efficacy of wound catheters in celiotomies.

The present study aimed to measure analgesia, requirement for rescue analgesia, and complication rates when using continuous administration of lidocaine through an abdominal wall wound catheter in bitches undergoing ovariohysterectomy and to compare the effects with intramuscular (IM) methadone.

* Corresponding author. Tel.: +34 95 7212647.
E-mail address: v92moroj@uco.es (J. Morgaz).

http://dx.doi.org/10.1016/j.tvjl.2014.08.030
1090-0233/

Materials and methods

Animals

The research was approved by the bioethics committee of University of Cordoba (NR-7313/2012; 29 October 2012), and the owners provided written informed consent for their dogs to take part in the research. Bitches undergoing elective ovariohysterectomy were eligible for inclusion. Pre-anaesthetic assessment, including blood cell count, serum biochemical analysis, and electrocardiography, was performed in each dog prior to enrolment. Dogs were excluded if they were pregnant or lactating, had been diagnosed with coagulopathies, arrhythmias, systemic disease or if they had received any anti-inflammatory or analgesic medication within 10 days prior to surgery.

A prospective power analysis was performed to determine the number of dogs required to document a three-point change in the Glasgow Composite Measure Pain Scale (CMPS), with α of 0.05, β of 0.80, and a standard deviation (SD) of 3.3. The results of this analysis confirmed that no more than 19 dogs were required in each group. The animals were randomly allocated to each group using a random number generator before the start of the research.

After surgery, the lidocaine group (L) was administered lidocaine by constant rate infusion (CRI; 2 mg/kg/h; Lidocaine Braun 5%, BBraun) through the wound catheter using an infusion pump system (BBraun) or an elastomeric pump (Elastomeric Pump, MILA International). The fixed dose of lidocaine was mixed with saline and administered at an infusion rate of 0.9–4.5 mL/h. The control group received IM methadone (0.2 mg/kg) every 4 h after pre-medication.

Anaesthetic protocol and experimental design

Baseline clinical parameters were measured after a 12-h fasting period. The animals were premedicated with medetomidine (3 μg/kg IM; Domitor, Esteve Veterinary) and methadone (0.3 mg/kg IM; Metasedin, Esteve Veterinary). A 20G catheter was placed in the cephalic vein for drug and fluid administration (Ringer's lactate solution, 5 mL/kg/h) during surgery. Anaesthesia was induced with propofol (3 mg/kg IV; Propofol Lipuro, BBraun) 20 min after premedication, and the trachea was intubated and connected to a closed-circle rebreathing circuit. Anaesthesia was maintained with isoflurane delivered in 100% oxygen (15 mL/kg/min). The body temperature was kept between 37 °C and 38.5 °C using a forced-air heating system.

Heart rate (HR), respiratory rate (RR), end-tidal carbon dioxide tension ($EtCO_2$), arterial haemoglobin oxygen saturation (SpO_2), and non-invasive arterial blood pressure were measured during surgery using a VetCare multiparametric monitor (BBraun). Routine ovariohysterectomy was performed by two experienced surgeons using a ventral midline incision extending between the umbilicus and cranial pubis. Abdominal cavity closure varied according to the experimental group. In the L group, the parietal peritoneum was closed using a monofilament absorbable suture in a simple continuous pattern (Monosyn 2/0, BBraun); then a hand-made wound infusion catheter (silicone tube fenestrated with a 22-G needle at 10-mm intervals) was introduced in the plane between the parietal peritoneum and the abdominal musculature (pre-peritoneal space) through a small skin incision placed cranially to the wound. A monofilament absorbable suture closed the rectus abdominis muscle and sheath with a simple continuous pattern, thus covering the wound catheter. In the control group (C), the parietal peritoneum and rectus abdominis muscle were closed together with a simple continuous suture pattern. The subcutaneous and skin layers were closed in a similar manner in both groups.

Pain assessment and rescue analgesia

Pain was evaluated by two investigators experienced in pain assessment at baseline and 2, 4, 6, 18, and 24 h after closing the vaporiser and completing the surgery. Three pain assessment systems were used for evaluation: (1) a dynamic and interactive visual analogue scale (DIVAS; 0–100 mm) (Lascelles et al., 1997; Shih et al., 2008); (2) the Scale-Form Glasgow Composite Measure Scale (CMPS-SF; 0–24) (Shih et al., 2008), and (3) mechanical wound thresholds (MWTs; 0–15 Nw) (Benito-de-la-Víbora et al., 2008). The MWTs were measured using a force gauge (PCE-FM50, PCE Instruments) applied to the surgical wound at three different sites (cranial, intermediate, and caudal), and force was steadily increased until the animal showed pain signs such as crying, abdominal flinching, or movement of the head towards the painful area. The applied force required to elicit a positive response was designated the maximum threshold and measured in newtons (N). To avoid animal injury, the maximum force was limited to 15 N. HR, RR, and arterial pressure were measured simultaneously during pain evaluation.

Animals with a CMPS-SF score of >6 or a DIVAS score of >50 mm were given methadone (0.3 mg/kg IV) as rescue analgesia. Patients were reassessed 30 min later to ensure adequate analgesia and were excluded if they continued to exhibit signs of pain.

Sedation assessment

The level of sedation was measured at baseline and at 2, 4, 6, 18, and 24 h after surgery in both groups on a 0–4 semiquantitative scale, with 0 indicating absent sedation and 4 indicating unconsciousness.

Cortisol and lidocaine levels

Venous mean plasma cortisol levels were obtained at baseline and 2, 6, 18, and 24 h after the completion of surgery using a chemiluminescent competitive solid-phase enzyme immunoassay (Inmmulite, Siemens Medical Solutions Diagnostics). At the same time, plasma lidocaine levels were measured using a modified high performance liquid chromatography (HPLC) method as previously reported (Rofael and Abdel-Rahman, 2002). The HPLC system comprised a Jasco model with UV detection at 210 nm connected to a computer (Jasco Chrompass Chromatography data system). Adverse events suggestive of lidocaine toxicity, including vomiting, muscle tremors, ataxia, hypotension (mean arterial pressure of <60 mmHg), and bradycardia (<40 bpm) were recorded in addition to any complications.

Statistical analysis was performed using SPSS for Windows 15.0 (IBM). Data normality was evaluated using the Kolmogorov–Smirnov test. HR, RR, arterial pressure, DIVAS and CMPS-SF scores, and MWT were compared between groups and across time using a generalised linear mixed model. When significant differences were detected with the generalised linear mixed model, a two-sample unpaired *t* test for comparison between groups at a specific time point or one-way ANOVA for comparison of findings at baseline with those at 2, 4, 6, 18, and 24 h after surgery within each group, was performed. Changes in lidocaine levels over time were analysed using one-way ANOVA with a Tukey test as the post-hoc analysis. Breed, sedation level, complication rate, and requirement for rescue analgesia were compared between groups using Fisher's exact test. Linear regression analysis was performed to establish the best lidocaine CRI according to weight and incision length. All data are expressed as means ± SDs. A *P*-value of <0.05 was considered statistically significant.

Results

Thirty-eight dogs of varying breeds, including Spanish greyhounds (16), mongrels (10), Andalusian wine-cellar rat-hunting dogs (3), Yorkshire terriers (2), German Shepherd dogs (2), Andalusian hounds (2), Border Collie (1), English Springer spaniel (1), and Dalmatian (1), were included in the study. The mean weight of the dogs included was 17.3 ± 7.8 kg, while the mean age was 3 ± 2 years.

Baseline data are shown in Table 1. There were no significant differences in analgesic parameters between the two groups (Table 2). The mean plasma cortisol concentrations did not differ significantly between groups (Fig. 1). In the control group methadone was given at 1 and 5 h after the end of the surgery, not interfering with the pain assessments. Four animals in the C group (4/19, 21.1%; three at 4 h and one at 2 h after surgery) but none in the L group required rescue analgesia

Table 1
Baseline sedation and analgesic assessments of lidocaine (L) and control (C) groups. Values are expressed as means ± standard deviations.

	Group	Baseline
SEDATION	Lidocaine	0 ± 0
	Control	0 ± 0
DIVAS I	Lidocaine	0 ± 0
	Control	0 ± 0
DIVAS II	Lidocaine	0 ± 0
	Control	0 ± 0
DIVAS III	Lidocaine	0 ± 0
	Control	0 ± 0
CMPS-SF	Lidocaine	0 ± 0
	Control	0 ± 0
MWT (N)	Lidocaine	15 ± 0
	Control	15 ± 0
HR (beats per min)	Lidocaine	84 ± 14
	Control	87 ± 22
RR (breath per min)	Lidocaine	24 ± 3
	Control	22 ± 9
MAP (mmHg)	Lidocaine	110 ± 15
	Control	108 ± 18
SAP (mmHg)	Lidocaine	135 ± 25
	Control	142 ± 24
DAP (mmHg)	Lidocaine	88 ± 12
	Control	92 ± 17

DIVAS, dynamic interactive visual analogue scale pain; CMPS-SF, the Scale-Form Glasgow Composite Measure Scale; MWT, mechanical wound thresholds; HR, heart rate; RR, respiratory rate; MAP, mean arterial pressure; SAP, systolic arterial pressure, DAP, diastolic arterial pressure.