

## RESEARCH PAPER

# Perioperative analgesic effects of an ultrasound-guided transversus abdominis plane block with a mixture of bupivacaine and lidocaine in cats undergoing ovariectomy

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## Abstract

**Objective** To evaluate the perioperative analgesic effects of a transversus abdominis plane (TAP) block with a mixture of lidocaine and bupivacaine administered to cats undergoing ovariectomy.

**Study design** Controlled, randomized, prospective, blinded clinical study.

**Animals** A group of 20 healthy cats.

**Methods** Robenacoxib (2 mg kg<sup>-1</sup>) was administered subcutaneously 0.5 hour before intramuscular (IM) administration of ketamine (5 mg kg<sup>-1</sup>), methadone (0.1 mg kg<sup>-1</sup>) and dexmedetomidine (0.01 mg kg<sup>-1</sup>). General anesthesia was induced with intravenous (IV) propofol and maintained with isoflurane. An ultrasound-guided TAP block was performed by injecting 0.5% bupivacaine (0.2 mL kg<sup>-1</sup>) diluted in a total volume of 1.5 mL 2% lidocaine bilaterally (TAP group,  $n = 10$ ) or the same volume of saline solution bilaterally in controls (CTR group,  $n = 10$ ). During surgery, a 20% increase in heart rate and respiratory frequency was treated with IV fentanyl (0.001 mg kg<sup>-1</sup>). Before premedication and at 1, 2, 3, 4, 6, 8, 12, 16, 20 and 24 hours after extubation, pain was assessed with a simple descriptive pain scale, that ranged from 0 (no pain) to 4 (intense pain). For pain scores  $\geq 3$ , IM methadone (0.1 mg kg<sup>-1</sup>) was administered. Data were analyzed with the Friedman or the analysis of variance (ANOVA) test, and  $p < 0.05$  was considered statistically significant.

**Results** Only two cats in the CTR group were administered one dose of fentanyl during surgery. At 2, 6, 8, 12, 16, 20 and 24 hours after surgery, the pain score was higher in the CTR group. A mean dose of  $0.5 \pm 0.2$  mg kg<sup>-1</sup> methadone was administered to all cats in the CTR groups within 24 hours. Methadone was not administered to the TAP group (pain score  $< 3$ ).

**Conclusions and clinical relevance** Ultrasound-guided TAP block can be a reliable adjunctive technique, providing analgesia for up to 24 hours in cats undergoing ovariectomy.

**Keywords** analgesia, cats, local anesthetic, transversus abdominis plane block.

## Introduction

Locoregional anesthetic techniques have gained widespread practice in veterinary anesthesia for the management of perioperative pain (Schroeder 2013). The main goals of locoregional anesthesia are to provide preemptive and multimodal perioperative analgesia in combination with other analgesic drugs, to decrease the stress response to surgical trauma, to reduce the potential for the development of central sensitization and to reduce the anesthetic requirements and autonomic responses to surgical stimuli (Rioja Garcia 2015; Romano et al. 2016). Lidocaine and bupivacaine are the most commonly used local anesthetics in cats (Wright 2002; de Vries & Putter 2015), but the advantages of their use

should always be weighed against the careful dosing required to avoid toxicity because of the relatively small size and reduced metabolic capability of these animals (Taylor & Robertson 2004). Indeed, cats have a peculiar metabolism characterized by a low capacity for hepatic glucuronidation resulting from the absence of specific enzymatic isoforms (Court & Greenblatt 2000; Court 2013). It is for this reason that certain drugs can have long half-lives in cats (e.g. carprofen), other drugs are toxic (phenolic drugs, e.g. acetaminophen) and yet others, such as morphine, may be less effective because of the lack of active metabolites in feline patients (Taylor et al. 2001; Lascelles et al. 2007).

The transversus abdominis plane (TAP) block is a locoregional anesthetic technique that provides, in dogs, a sensory blockade of the abdominal muscles, subcutaneous tissues, skin and parietal peritoneum (Portela et al. 2014; Castaneda-Herrera et al. 2017). Local anesthetic is injected between the internal abdominal oblique and transversus abdominis muscles, into the fascial plane, anesthetizing the afferent branches of the ventral thoracic and lumbar nerves innervating the abdominal wall (Jankovic 2009; Schroeder et al. 2011). The block is performed bilaterally for efficacy on the median line; in humans, it is indicated for a wide range of abdominal procedures such as caesarean section (Belavy et al. 2009), hysterectomy (Carney et al. 2008), appendectomy (Niraj et al. 2009) and cholecystectomy (El-Dawlatly et al. 2009). In veterinary anesthesia, the TAP block has been documented in dogs undergoing mastectomy (Portela et al. 2014) and in a Canadian lynx exploratory laparotomy (Schroeder et al. 2010). In human patients, the block can be practiced blindly, using the anatomic landmark called Petit's triangle, also known as the inferior lumbar triangle (Jankovic, 2009), or under ultrasound (US) guidance, a technique that has been recently introduced, especially for pediatric patients (Abu Elyazed et al. 2016; Venkatraman et al. 2016). In dogs, the US-guided technique is the only approach described, to date, that best identifies the correct site of drug deposition to avoid accidental intraperitoneal injection (Schroeder et al. 2011; Drozdzyńska et al. 2017). To the best of our knowledge, the TAP block has not been reported in cats.

The aim of this clinical investigation was to evaluate the intra- and postoperative analgesic efficacy of a TAP block in cats undergoing ovariectomy. Our hypothesis was that TAP block would reduce the requirement for postoperative analgesia. To test our

hypothesis, we assessed pain with a simple descriptive scale (SDS) at regular intervals up to 24 hours post-operatively in cats undergoing ovariectomy with or without a TAP block.

## Materials and methods

The study was approved by the ethical committee for clinical studies in animals of the Department of Emergencies and Organs Transplantation of the University of Bari (No. 13/2016). After the first eight cats (four in each group) had completed the study, a power calculation was performed on the difference in postoperative pain at 8 hours after extubation. The power calculation was performed using a two-tailed *t* test with power of 0.95, alpha error of 0.05 and effect size of 4 (calculated based on the mean and standard deviation of the two preliminary groups) (G\*Power version 3.0.10; University of Düsseldorf, Germany) (Paul et al. 2009). The results of the analysis indicated that eight cats per group would be sufficient to detect differences between the two groups for postoperative pain at 8 hours after extubation. However, we assigned 10 cats to each group to account for potential losses because of individual case management.

## Animals

After the owners gave their written consent, 20 adult female mixed-breed cats weighing more than 3 kg were included in this controlled, prospective, randomized, blinded clinical study. Inclusion criteria included a physical status of 1 according to the American Society of Anesthesiologist classification that was based on history, physical examination and a complete blood count. Any cat with systemic disease, cardiac arrhythmias, pregnancy, or one that was aggressive, obese or debilitated was excluded from the study. In order to allow the observer to become familiar with the animals, they were hospitalized 16 hours before surgery and fasted overnight with free water access until premedication.

## Anesthesia and monitoring

Robenacoxib (2 mg kg<sup>-1</sup>; Onsior 20 mg mL<sup>-1</sup>; Novartis, Italy) was administered to all cats subcutaneously 30 minutes prior to premedication. Premedication consisted of an intramuscular (IM) injection of ketamine (5 mg kg<sup>-1</sup>; Ketavet100 100 mg mL<sup>-1</sup>; Intervet, Italy) dexmedetomidine (0.01 mg kg<sup>-1</sup>; Dexdomitor 0.5 mg mL<sup>-1</sup>; Orion,

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