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Analgesic Effects of Acupuncture in Comparison with Tramadol and Meloxicam in Cats Undergoing Ovariohysterectomy

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Abstract

Background: Acupuncture has shown to have analgesic effect in animals. Common analgesic such as opioids and anti-inflammatory drugs vastly used to control postoperative pain in cats, while they can cause serious side effects in this species. On the other hand, acupuncture can play important role in replacing this kind of drugs.

Objectives: This study aims to evaluate the analgesic effects of acupuncture in comparison with tramadol and meloxicam on postoperative pain of cats after ovariohysterectomy.

Methods: Forty-five adult stray cats were randomly distributed into three groups of fifteen animals each: TR: tramadol (2 mg/kg IV) administered before anesthesia induction; ML: meloxicam (0.2 mg/kg SC) administered after placement the last skin suture; AC: bilateral acupoints from Kidney 11 (KI-11) to Kidney 17 (KI-17) were stimulated. Postoperative pain was evaluated using the revised Glasgow Composite Pain Scale-Feline and UNESP-Botucatu Multidimensional Composite Pain Scale up to 24 h after surgery. Rescue analgesia was provided

with tramadol (2 mg/kg IM). Data were analyzed using Kruskal-Wallis, the Fisher exact probability test and Friedman test. $P<0.05$ considered significant.

Results: Mean pain scores did not significantly differ among groups at any time point ($P>0.05$). The pain score and prevalence of rescue analgesia was not different among treatment groups through 24 hours.

Conclusions: Based on this study, analgesic effects of acupuncture were like tramadol and meloxicam during the first 24 h after ovariohysterectomy in cats.

Keywords: acute pain, analgesia, complementary medicine, feline, surgery

1. Introduction

It has been shown that ovariohysterectomy causes postoperative pain in cats (Lascelles BD, 1999). Common analgesic drugs such as opioids and NSAIDS have some adverse effects on dogs (Akhtardanesh, Sharifi, Rasooli, & Aghazamani, 2014) and can be hepatotoxic in cats or cause bradycardia, respiratory depression, gastrointestinal (GI) toxicity, dysphoria, vomiting and nausea (Bortolami & Love, 2015; Epstein *et al*., 2015).

Considering the complications of using analgesic drugs in cats, nonpharmacologic modalities such as acupuncture offer a compelling pain management method for feline patients. Acupuncture is a safe and low-cost technique. It has been used successfully in companion animals to decrease pain and is now an accepted treatment modality for painful animals (Epstein *et al*., 2015; Lindley & Cummings, 2006).

The underlying scientific mechanisms of acupuncture and its place in modern medicine has progressed tremendously. Over centuries, acupuncture has evolved in both Eastern and Western cultures to become a scientifically driven, medically appropriate therapy for both human and veterinary patients (Kendell, 2002). Stimulation of acupuncture points (acupoints) produces analgesia and can be achieved by various techniques: dry needle, electroacupuncture, aqua-acupuncture, Laser acupuncture. Dry needle is the most used technique in veterinary acupuncture, and involves the insertion of fine, sterile needles into acupoints (Frank, & Fowler, 2018). After insertion of the needle into the skin and underlying tissues the action of acupuncture starts. Acupoints are usually associated with major nerves, blood vessels or lymphatic vessels. The acupuncture needle interacts with these structures to have effects on tissues near the insertion site and commence its interaction with the nervous system and more distant sites (Fry *et al.*, 2014).

According to Western acupuncture theories, stimulation of acupoints activate the larger diameter fibers in nervous system, modifies pain perception at the spinal cord and decreases the perception of pain in the brain (Kotani *et al*., 2001).

Pain recognition, assessment and quantification in animals can only be measured indirectly (Khodabakhshi Rad, Kazemi Mehrjerdi, Pedram, Azizzadeh, & Amanollahi, 2022), because pain is a subjective experience, while animals are nonverbal and cannot self-report the presence of pain. It is now accepted that the most accurate method for evaluating pain in dogs and cats is not by physiological parameters but by observations of behavioral changes (Epstein *et al*., 2015; Reid *et al*., 2018). An animal in pain will try to withdraw from the source of the insult, protect the affected area through immobilization and active defensive aggression and may communicate the pain to others through changes in facial expression, body postures and vocalization. By contrast, healthy and happy animals are identifiable by an open and relaxed posture, facial expressions of contentment and production of chemicals that are associated with pleasure, such as endorphins (Reid *et al*., 2018; McGowen & Goff, 2016).

The pivotal part of effective pain management is using a reliable, valid (being able to measure what it was designed to measure), responsive (enough sensitivity to detect health status

differences that are clinically important) and sensible (cut-off point and responsiveness identification) pain assessment tool (Reid *et al*., 2007). There are a few pain scales which have been exclusively designed for the cats. In 2011, UNESP-Botucatu multidimensional composite pain scale (MCPS) validated for assessing acute postoperative pain in cats by Brondani *et al* (Brondani *et al*., 2011; Buisman *et al*., 2017; (Belli *et al*., 2021). A systematic review showed that the MCPS is the only pain scale that has been investigated for validity, reliability and sensibility in cats (Merola & Mills, 2016). The other available scale for cats is Glasgow composite measure pain scale (CMPS), which was the first tool in veterinary medicine designed using psychometric principles and first used to assess acute pain in the dog (Reid *et al*., 2007) (Saberi Afshar, et al., 2017). The latest feline version of Glasgow feline composite measure pain scale, rCMPS-f, embedded a three-point facial scale within the cat tool and provided a new validated scale for the measurement of acute pain in cats (Corletto, 2017; Holden *et al*., 2014).

To date, few studies have investigated the postoperative analgesic effects of electroacupuncture, laser acupuncture and scalp acupuncture in cats (Nascimento *et al*., 2019; Ribeiro *et al*., 2017). But no published study has yet assessed the effect of acupuncture on preoperative pain management in cats.

The objective of this study was to evaluate the analgesic effects of acupuncture, and to compare these effects with those of meloxicam and tramadol in stray cats undergoing ovariohysterectomy, using two validated feline pain scales. We hypothesized that: prevalence of rescue analgesia and pain scores would have no significant difference in acupuncture group (AC) when compared with the meloxicam (ML) or tramadol group (TR).

Material and methods

Study Design and Animals

Fifty-two mixed breed stray cats were selected to participate in this study. The exact age of most cats was unknown, although all were suspected to be between 1-3 years of age. All cats were between 3-4.5 kg of weight. The health status of all cats was evaluated by physical examination, measurement of complete blood counts (CBC) and total protein (TP). All cats were evaluated preoperatively by abdominal ultrasonography for confirmation of the absence of pregnancy. The exclusion criteria were presence of systemic diseases, pregnancy and lactation.

All cats housed in comfortable individual cages in a calm and quiet exclusive feline ward with food and water provided ad libitum for 4 days before surgery. This period used as an acclimatization to the new environment.

Study design

Cats were randomly assigned to three treatment groups:

- Tramadol (Tr, n=15, 2 mg kg^{-1} Tramadol, slow IV, immediately before induction)

- Meloxicam (Me, n=15, 0.2 mg kg^{-1} Meloxicam, SQ, after placement of the last skin suture)

- Acupuncture (Ac, n=15, needles inserted from onset of induction and remained in place for 25 minutes).

Anesthesia and surgery

Baseline (preoperative) rCMPS-F and MCPS scores were recorded 2 hours before sedation. Cats were premedicated with ketamine hydrochloride [Ketamine 10%; Alfasan woerden-Holland, 3 mg/kg IM)]. Approximately 20 10 mins after sedation, ketamine hydrochloride (5 mg/kg, IV) and diazepam (Zepadic; Caspian Tamin, 0.05 mg/kg, IV) were administered to allow

endotracheal intubation. Isoflurane (Forane; Abbott Laboratories) was administered using a non-rebreathing circuit for maintenance of anesthesia. Ovariohysterectomy was performed by the same surgeon using a 3 cm ventral midline approach and 3 clamp technique through median laparotomy access (MacPhail & Fossum, 2018).

The anesthesia time (time from induction of anesthesia to discontinuation of isoflurane), surgery time (time from the first incision until placement of the last skin suture) and time to extubation (time from termination of isoflurane until extubation) were recorded for each cat (Table 1).

Acupuncture treatment

The acupuncture needles were administered after induction of anesthesia and remained in place for 25 minutes. The local acupoints on stomach meridian from KI-11 to KI-17 was stimulated bilaterally. The exact location of each acupuncture points was determined in accordance with the traditional Chinese principles, using the "cun" measurements (1 cun=width of the last rib): (Marten, 2012)

- KI-11: on the cranial edge of the pelvic symphysis, about 0.5 cun lateral to CV-2

- KI-12: 1 cun each cranial to KI-11 and lateral to CV-3

- KI-13: 1 cun lateral to CV-4, 1 cun lateral to the midline halfway between the navel and pelvic symphysis.

- KI-14: 2 cun caudal to the navel, 1 cun lateral to the CV-5.

- KI-15: 1 cun lateral to CV-7 and 1 cun from the midline.

- KI-16: 1 cun lateral to CV-8 and 1 cun lateral to the midline next to the navel.

- KI-17: 1 cun lateral to CV-10.

Sterile stainless-steel needles (Dong Bang Acupuncture, Seoul, South Korea, size 0.18 × 13 mm) were inserted tangentially to a depth of 0.2-0.3 cun and kept for 25 minutes.

Postoperative assessments

Cats were returned to their cages and the pain scores were evaluated by a same single observer, unaware of the treatment group 2, 4, 7, 13, and 24 hr after tracheal tube extubation.

Cats were scored for signs of pain using the Glasgow composite measure pain scale (rCMPS-f, from 0=no pain to 20=maximum pain) (Reid *et al.,* 2007) and UNESP-Botucatu

Multidimensional Composite Pain Scale (MCPS, from 0 =no pain to 30 =maximum pain) (Buisman *et al*., 2017).

For scoring, each cat's behavior was initially evaluated for 1 min without opening the cage. Following this, the cage was opened, and the cat was touched and stimulated to move around, for observation of reactions, interactions and behavior. Finally, the incision and surrounding area of the abdomen was palpated using 2–3 digits.

In addition, to minimize variability between different observers and improve the level of objectivity, all measurements in this study were performed by the same observer, blinded to group allocation, who was caring for the cats during the study and was familiar with their individual behavior.

Cats scoring greater than 33% of the either rCMPS-F or MCPS maximum score, received tramadol (2 mg/kg, IM) as rescue analgesia. The pain score evaluated 30 minutes after rescue analgesia (Holden *et al*., 2014).

The number of cats requiring rescue analgesia were recorded. Data collected after rescue analgesic administration were not included in the statistical analysis.

Statistical analysis

Values for pain scores were analyzed using the Kruskal-Wallis test to compare differences between treatment groups at each time point and the Friedman test was used to compare differences over time for each treatment group.

A Friedman test was also used to compare differences in pain scores over time within each group. Corresponding areas under the curves (AUCs) of rCMPS-F and MCPS were calculated from baseline until 24 hours using the trapezoidal method and compared among groups using a Kruskal–Wallis test. Data from pain scores obtained after the first dose of rescue analgesia were removed from the analyses.

The number of cats that required rescue analgesia were compared using the Fisher exact probability test.

Statistical analyses were done by SAS software version 9.4 (Proc Univariate & Proc ANOVA, SAS version 9.0; SAS institute Inc., Cary, NC, USA).

3. Results

Fifty-two cats were screened for enrollment in the study. Seven of these, did not meet the inclusion criteria (three had signs of systemic disease and four were in early stages of pregnancy).

Table 1 shows duration of anesthesia and surgery, time to extubating and body weight. These variables were not significantly different among treatment groups ($P>0.05$). None of the cats showed postoperative complications or any adverse effects.

Table 1. Body weight, anesthesia and surgery times, and time to extubation in treated cats.

	TR	ML	AC
N	15	15	15
Weight	3.5(±0.45)	3.43(±0.49)	3.28(±0.55)
Anaesthesia	58.3(±13.8)	56.8(±12)	55.5(±13.8)
Surgery	45.2(±11.4)	46.5(±10.8)	42(±7.9)
Time to extubation	14.5(±9.1)	14(±5.2)	15.8(±4.4)

Values are expressed as mean ± SD

TR=tramadol; ML=meloxicam; AC=acupuncture

Mean MCPS and rCMPS-F pain scores did not significantly differ among groups at any time point (P>0.05)(Figure 1 and 2).

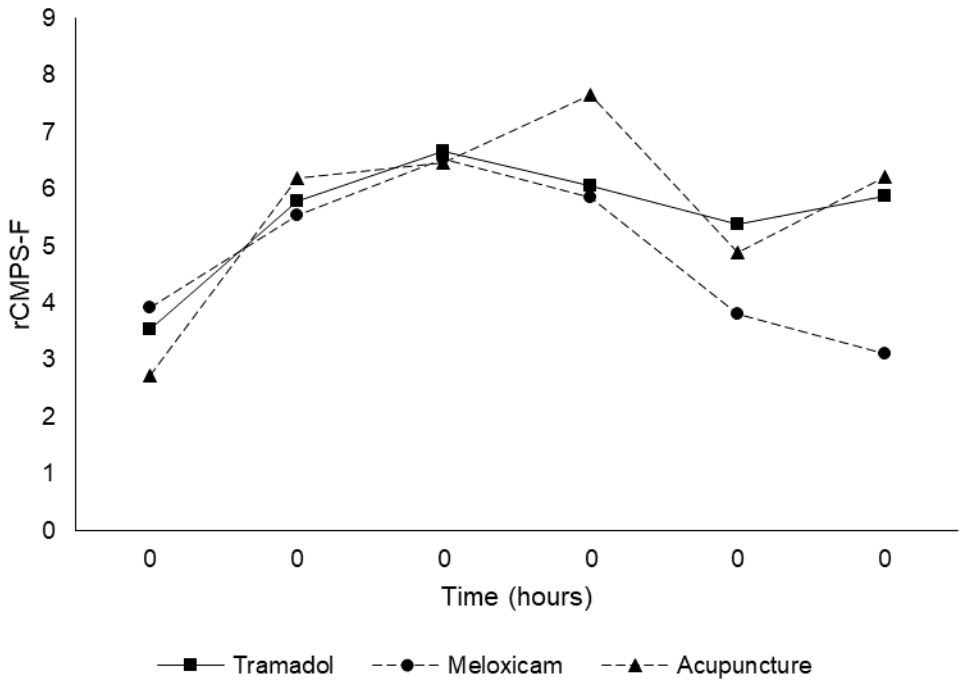

Figure 1. Mean±SD pain score based on rMCPS-F, 2 hours before surgery (BL) and 2-24 hours after surgery

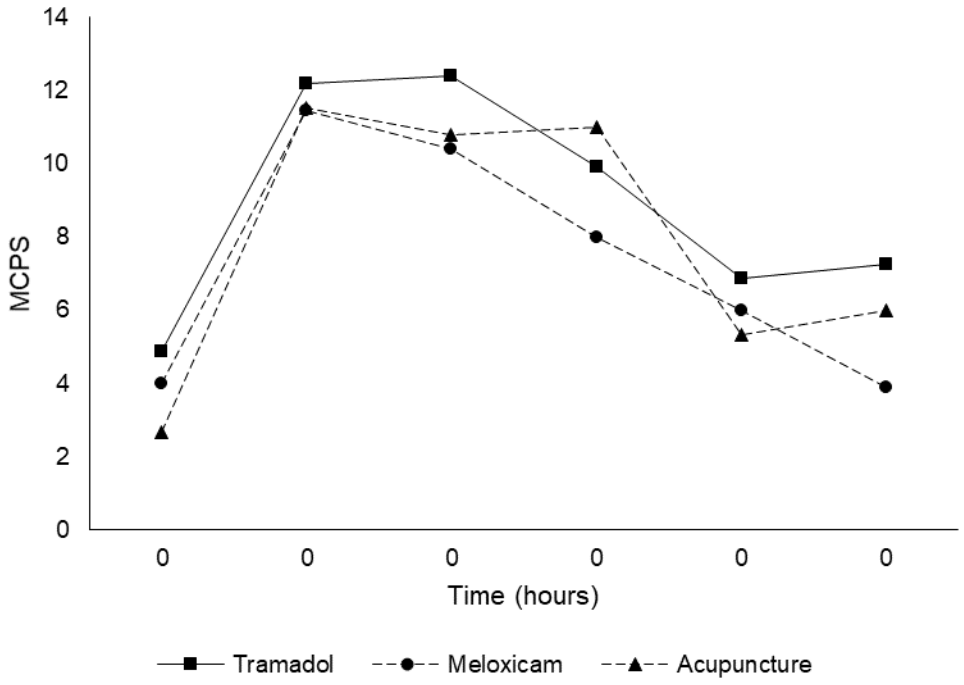

Figure 2. Mean±SD pain scores based on MCPS, 2 hours before surgery (BL) and 2-24 hours after surgery

When compared with baseline values, MCPS pain scores were significantly higher in the first 7 hours after extubation in all treatment groups (Table 2). rMCPS-F pain scores were significantly higher than baseline 4 and 7 hours after surgery in all treatment groups (Table 2).

Table 2. Pain scores (median and lower-upper range) measured prior to surgery (BL) and at 2, 4, 7, 13 and 24 hr post-extubation in cats undergoing ovariohysterectomy treated with Tramadol (TR, n=15), Meloxicam (ML, n=15) and acupuncture treatment (AC, n=15).

Treatment	Scale	Time (hours)					
		BL	2	4	7	13	24
TR	rCMPS-F	1.5(0-11)	5(3-11)†	6(4-11)*†	6(2-10)*	5(2-10)	3(1-12)
	MCPS	1(0-16)	12(9-16)*	12(7-20)*	9.5(0-18)*	6(0-14)	8(0-16)
ML	rCMPS-F	5(0-10)	5(3-7)†	6(3-11)*	5.5(2-11)*	3(1-9)	3(1-10)
	MCPS	3.5(0-13)	11(9-15)*	10.5(5-15)*	8.5(0-15)*	6(1-13)	2(0-13)
AC	rCMPS-F	2.5(0-7)	6(5-8)*†	6(4-12)*	8(3-11)*	7(0-7)	7(1-9)*
	MCPS	1(0-10)	12(9-14)*	11(9-13)*	10.5(8-19)*	4(1-11)	6(1-9)*†

* Significantly different from baseline (P<0.05)

† Significant difference between to scales (p<0.05)

Repeated measure analysis results showed that the two pain measurement scales difference is not significant through 24 hours, however, rCMPS-F had significantly lower scores compared to MCPS at 2 and 4 hours after extubation and the difference decreased in 7, 13 and 24 hours after extubation. Hence, the two methods were the same in measuring the pain in a 24-hour basis (Figure 3).

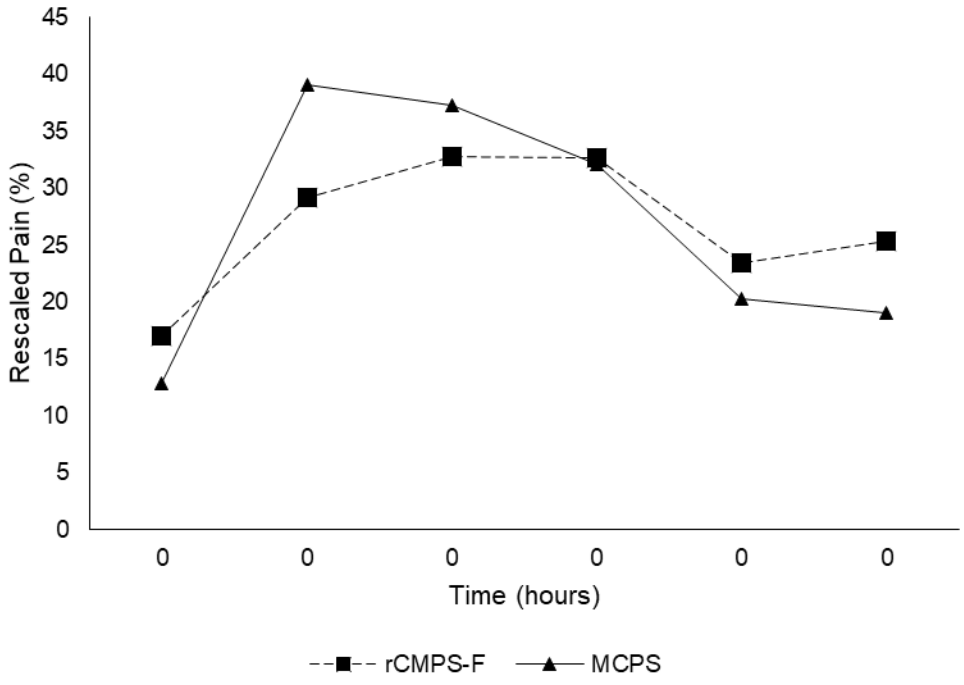

Fig 3. Mean ±SD of pain scores for three treatment groups based on homogenized MCPS and rCMPS-F 2 hours before surgery (BL) and 2-24 hours after surgery. Asterisks shows significant difference at 0.05 alpha level.

On the other hand, comparing the two scales in each treatment group using Friedman test showed that in tramadol group, MCPS evaluated the pain significantly higher than rCMPS-F in 2 and 4 hours after extubation.

In meloxicam group, MCPS method evaluated the pain significantly higher only in 2 hours after extubation. The same is also true about the acupuncture group, where MCPS method evaluated the pain significantly higher 2 hours after extubation, however, in this group, MCPS evaluated the pain significantly lower than rCMPS-F in 24 hours after extubating.

Twenty cats required rescue analgesia. The number of cats which required rescue analgesia did not differ statistically between groups (Table 3). Time to first rescue analgesia was not different among treatments ($P>0.05$). No cat required a second dose of rescue analgesia.

Table 3. Number of cats that received rescue analgesia based on rCMPS-F and MCPS (scores ⩾ 33% of maximum score) following ovariohysterectomy.

Method	Time (hours)						
	BL	2	4	7	13	24	Total
Tramadol	0	0	0	7	0	0	7
Meloxicam	0	0	0	4	2	0	6
Acupuncture	0	0	0	6	0	1	7

Briefly, the results of this study showed that postoperative pain scores and prevalence of rescue analgesia were not significantly different among treatments using the MCPS and rCMPS-F pain scores.

4. Discussion

In this study, the analgesic effect of acupuncture was evaluated and compared with those of meloxicam and tramadol. The latter two treatments are often used in the management of postoperative pain in cats and there are currently concerns about the use of them in feline practice considering they can cause mild to serious adverse effects including bradycardia, respiratory depression, gastrointestinal (GI) toxicity and nephrotoxicity (Epstein *et al*., 2015).

In recent years, evidence-based data and empirical experience justify the use of acupuncture in small animal practice (Epstein *et al*., 2015; Roynard *et al*., 2018; Cassu *et al*., 2012). Acupuncture is a safe method in veterinary patients and can provide analgesia comparable to that achieved with injectable opioids or nonsteroidal anti-inflammatory drugs (Fry *et al*., 2014).

The results of this study demonstrated that postoperative pain scores and prevalence of rescue analgesia were not significantly different among treatments using both rCMPS-F and MCPS, confirming the hypothesis of this study. These results are supported by clinical reports, where perioperative acupuncture caused an effective analgesia compared to conventional analgesic drugs and reduced the need for supplemental analgesics in small animals (Nascimento *et al*., 2019; Ribeiro *et al*., 2017; Gakiya *et al*., 2011).

To obtain a more reliable impression of pain, two scoring systems (rCMPS-f and MCPS) were used in this study. Both pain scales have been used to measure pain following ovariohysterectomy in cats (Merola & Mills, 2016; Nascimento *et al*., 2019; Steagall *et al*., 2018). Other studies also failed to show significant differences in pain scores between groups when the rCMPS-f or the MCPS scale was used in cats (Teixeira *et al*., 2020; Steagall *et al*., 2018; Marques *et al*., 2015). This can be explained by several limitations:

1- Cats which received rescue analgesia removed from statistical analysis, to avoid analysis bias while at the same time introducing selection bias. This approach limited the ability to detect significant differences among treatments using pain scores. However, the scores were increased in all treatment groups at 2 h, 4h and 7h using the MCPS, and at 7h using the rCMPS-F when compared with baseline values. This reflects that pain scores are commonly higher after surgery when compared with baseline values.

2- Given the subjectivity of pain and scoring systems, the observer training and being familiar with the cats' normal behavior is pivotal to the identification of pain (Reid *et al*., 2018; Benito *et al*., 2017). In current study, pain was assessed by a veterinary student, who received video-based training on feline pain assessment. While the observer spent a

week with the cats to get familiar with their individual behavior and responses, it is possible that the lack of experience played a role in the results.

3- Small sample size and absence of negative control group. Having a control negative group makes it easier to detect a subtle treatment effect; however, a negative control group was not included for ethical reasons. Also, the study did not include a placebo acupuncture group. It has been shown that placebo acupuncture (non-acupuncture points stimulated by needles) may also produce an analgesic response, although more potent effects are achieved by real point stimulation (Chen *et al*., 2016). The stimulation of sham points reduced the pain threshold in dogs, rats, and rabbits; however, the stimulation of real points provides a more intense response (Kotani *et al*., 2001; Cassu *et al*., 2008) Due to the low analgesic effects reported with sham point stimulation, the decision made not to include a placebo acupuncture group in the study.

4- Both MCPS and rCMPS-f recorded the pain statistically similar over the 24-hour period. However, rCMPS-F had significantly lower scores compared to MCPS at 2 and 4 hours after extubation. Many of the items in the rCMPS-F are similar to UNESP-Botucatu MCPS including behavioural categories – vocalisation, posture, attention to wound, response to people, response to touch and demeanor (Merola & Mills, 2016). Other

similarities between rCMPS-F and the UNESP-Botucatu scale include the ranking of the items within each category according to the pain intensity and the provision of a protocol which ensures consistency of the assessment procedure (Brondani *et al*., 2011; Buisman *et al*., 2017). Thus, the rCMPS-F has good overlap and commonality with MCPS in general use. However, different from the rCMPS for cats which considered a variety of procedures, the UNESP-Botucatu only considered ovariohysterectomy as a pain mode for its validation, Thus MCPS is a more reliable tool for measuring acute pain after OHE.

In recent study, Buisman *et al.* showed that the use of anesthetic protocols which affect behavior can present a confounding factor in the assessment of pain by MCPS in the early postoperative period (Buisman *et al*., 2015). Previous studies reported that ketamine may induce behavioral changes during recovery from general anesthesia, including ataxia, hyperreflexia, hypersensitivity to touch and noise and increased motor activity (Gieseg *et al*., 2014) One study showed that the mean time for cats to recover normal behavior following ketamine (3 mg/kg) in combination with midazolam (0.5 mg/kg) was 4.28 ± 3.12 hours (Ilkiw *et al*., 2002). A recent study demonstrated that the administration of ketamine (5 mg/kg) prior to general anesthesia with isoflurane in cats produced psychomotor changes, resulting in an increase in scores evaluated by MCPS until the third hour of assessment (Buisman *et al*., 2015).

Also, pretreatment with ketamine and diazepam could interfere in the analgesic response of acupuncture (Xu *et al*., 1989). Studies appear to support a similar clinical effect in dogs, although ketamine's analgesic effect has not yet been studied in a feline surgical model (Slingsby & Waterman-Pearson, 2000; Wagner *et al*., 2002). In addition, benzodiazepines potentiate the GABAergic activity, which could interfere in the acupuncture effects, since the GABAergic system is also involved in the analgesic pathways of acupuncture (Qiao *et al*., 2017). Currently there are no published data on the analgesic effects of acupuncture in cats pretreated with ketamine and ~~D~~diazepam. Some studies have investigated the interference of ketamine and benzodiazepines on acupuncture-induced analgesia. Results of studies on laboratory animals indicated that ketamine may induce an antagonistic effect on acupuncture analgesia (Xu *et al*., 1989).

Tramadol can produce adverse behavior responses in cats, including excitation, euphoria, and panting. None of these adverse effects were observed in the current study. In addition, no local adverse effects related to acupuncture were identified, suggesting that acupuncture is a safe alternative to provide analgesia in cats. These findings are supported by previous studies that reported the safety of acupuncture therapy in dogs and cats (Cassu *et al*., 2012; Gakiya *et al*., 2011; Nascimento *et al*., 2019).

The significant limitation of this study was that all acupuncture treatments performed by a surgical resident with a year of experience in animal acupuncture. It has been shown that there is a significant difference in the accuracy of acupuncture needle placement among veterinary acupuncturists with different clinical experiences. Accurate needle placement needed for appropriate stimulation of neural, fascial, vascular, and other structures that may be small to microscopic. Therefore, variability in needle placement could profoundly influence clinical effects (Yang *et al*., 2007).

In conclusion, in this study postoperative analgesia was not significantly different among treatment groups using both MCPS and rCMPS-f–. These findings suggest that acupuncture might be an important alternative in the treatment of perioperative pain in cats and can be an alternative to conventional analgesics such as NSAIDS and opioids. Larger and sham-controlled studies are needed to support these results.

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مقایسه اثرات ضد دردی طب سوزنی با ترامادول و ملوکسیکام پس از جراحی برداشت رحم و تخمدان در گربه

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چکیده

زمینه مطالعه: نشان داده شده که طب سوزنی دارای اثر بی-دردی در حیوانات است. در گربه-ها، داروهای مسکنی مثل ضدالتهاب ها و اپیوییدها به صورت گسترده برای کنترل دردهای پس از جراحی استفاده می-شود در حالی که این داروها می-توانند عوارض جانبی جدی در این گونه ایجاد کنند. طب سوزنی می-تواند به عنوان جایگزینی برای این داروها در کنترل درد حاد در گربه-ها استفاده شود.

هدف: هدف از این مطالعه ارزیابی اثرات بی-دردی طب سوزنی و مقایسه آن با ترامادول و ملوکسیکام در کنترل درد بعد از جراحی برداشت رحم و تخمدان در گربه-هاست.

روش کار: 45 گربه خیابانی در این مطالعه آینده-نگر، اتفاقی و کور وارد شدند. پروتوکل بیهوشی شامل کتامین، دیازپام و ایزوفلوران بود. حیوانات به صورت اتفاقی در سه گروه درمانی دسته بندی شدند: TR: که در آن-ها داروی ترامادول با دوز 2 میلی-گرم\کیلوگرم عضلانی، پیش از القای بیهوشی تزریق می-شد؛ ML: که در آن ها داروی ملوکسیکام با دوز 0/2 میلی‌گرم\کیلوگرم زیرپوستی، پس از آخرین بخیه تزریق می-شد؛ و AC: که در آن-ها نقاط طب سوزنی کلیوی 11 تا کلیوی 17 به صورت دو طرفه

تحریک می-شد. درد پس از جراحی تا 24 ساعت بعد از جراحی با استفاده از دو روش revised Glasgow Composite Pain Scale-Feline و UNESP-Botucatu Multidimensional Composite Pain Scale ارزیابی شد. بی-دردی اورژانس هم با استفاده از ترامادول در صورت نیاز انجام شد. داده‌های به دست آمده با استفاده از روش-های کروسکال والیس، آزمون دقیق فیشر و آزمون فریدمن آنالیز شدند. عدد P کوچک تر از 0/05 معنادار در نظر گرفته شد.

نتایج: میانگین عدد درد در هیچ یک از زمان-ها بین گروه-ها تفاوت معناداری نداشت ($P>0.05$). عدد درد و فراوانی بی-دردی اورژانس در 24 ساعت تفاوتی بین گروه های مورد مطالعه نداشت.

نتیجه گیری نهایی: بر اساس این مطالعه، اثر بی-دردی طب سوزنی در 24 ساعت اول پس از جراحی برداشت رحم و تخمدان در گربه-ها، مشابه ترامادول و ملوکسیکام بود.

کلمات کلیدی: جراحی، گربه، درد حاد، طب سوزنی، بی-دردی