Comparison of different tools for pain assessment following ovariohysterectomy in bitches

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Abstract:

BACKGROUND: Accurate identifying and assessment of the degree of pain that the animal is suffering can be a challenge, and control of painful condition is becoming an increasingly important part of veterinary medicine. **OBJECTIVES:** This study was carried out to compare different tools for postoperative pain assessment in bitches. **METHODS:** Ten adult mixed breed bitches were selected and randomly divided into two equal treatment and control groups. Anaesthesia was premedicated with acepromazine (0.03 mg/kg, IM) and induced with Sodium thiopental (6-10 mg/kg, IV). Halothane was used for maintenance of the anesthesia. Ovariohysterectomy was performed in the two groups. Treatment group received 3 mg/kg of tramadol intramuscularly (i.m.) and control group received normal saline (equal volume with tramadol, i.m.) before the anesthetic induction. After operation the injections of tramadol and normal saline were repeated every 6 hours over a period of 7 days. The animals were monitored at hour 2, 3 and 4 after each injection and they were scored for signs of pain by two trained assessors who were blinded to the groups. The measured variables were pain assessment with different methods including Simple Descriptive Scale (SDS), Visual Analogue Scale (VAS), and University Melbourne Pain Scale (UMPS). Duration of anesthesia and duration of surgery, were also recorded. **RESULTS:** There were no significant differences between the two groups with regard to analgesia that were measured based on VAS and SDS methods, but in UMPS method, analgesia was significantly better in treatment group. Among simple clinical criteria body temperature and respiratory rate did not show any significant alterations, but heart rate had significant changes between the groups. **CONCLUSIONS:** The ability to quantify the degree of pain experienced by animals is an important aspect in the assessment of animal welfare; in addition, we concluded, that the great challenge for the veterinarians is the evaluation of postoperative pain in dogs.

Introduction

Definition of pain in human is an unpleasant sensory and emotional experience associated with actual or potential tissue damage (Wright and Aydede, 2017) and the definition of animal pain is an aversive, sensory experience representing awareness by the animal of damage or threat to the integrity of its tissues; (note that there might not be any damage) (Heuberger et al, 2016; Molony, 1997).

Postoperative pain is classified as acute and associated with actual or potential tissue damage (Duthie, 1998; Stessel et al., 2017; Yazbek and Fantoni, 2005;). Although accurate identification and assessment of the degree of pain being suffered by an animal can be a challenge (Landa, 2012; Sharkey, 2013), control of painful condition is becoming an increasingly important part of veterinary medicine (Jirkof, 2017; McMillan et al., 2008). Because of the lack of verbal communication, the level of postoperative pain in dogs is difficult to assess. Therefore, the assessment of pain in veterinary medicine relies on temperament, vocalization, posture, activity level, locomotion, reaction to palpation, and other behavioral changes and it should be considered that threshold and response to pain varies according to species, breed, healthy status and age (McMillan, 2016; Vedpathak et al., 2009). All those criteria are subjective and prone to numerous external factors. The objective indicators of pain are physiological and biochemical responses and pain threshold. The purpose of multimodal assessment of pain is to achieve objectiveness and credibility of results (Matičić et al., 2010). An important issue regarding pain management is familiarity with the personality of the animal subject to evaluation. In this instance the pet owner may be the best person to evaluate, for example, the level of anxiety or pain that the patient may be experiencing (Bufalari et al., 2007; Mathews, 2000). Pain assessment in animals is the mandatory step in the successful management of pain. For successful assessment, a number of scales have been used such as Simple Descriptive Scale (SDS), Visual Analogue Scale (VAS), and University of Melbourne Pain Scale (UMPS) (Bufalari et al., 2007; Hielm-Björkman et al 2011).

The SDS as the simplest of the three scales usually consists of four or five expressions used to describe various values of pain intensity, e.g. no pain, mild, moderate, or severe pain. Each expression is assigned a number, which becomes the pain score for that animal (Leonardi et al., 2006).

VAS is a measurement that tries to measure a characteristic or attitude that is believed to range across a continuum of values and cannot be directly measured. For example, the amount of pain that a patient feels ranges across a continuum from none to an extreme amount of pain (Elfving et al, 2016). VAS has been used by human patients to evaluate their own severity of pain, it includes the use of a line in which the left end of the line represents no pain and the right end of the line represents the most pain possible. Patients then indicate the intensity of the pain by placing a mark on the line (Elfving et al 2016; Lawrence et al., 1993). When a VAS is used for estimating pain in animals, the animals are observed, and the location at which the mark is placed is determined by an observer (Hielm-Björkman et al., 2011).

The University of Melbourne Pain Scale (UMPS) is one of the multiparametric scales used to assess postoperative pain in

dogs which also considers interaction between the animal and the evaluator. UMPS is a scale based on specific behavioral and physiological responses and includes multiple descriptors in six categories of parameters or behaviors related to pain (Matičić et al., 2010).

Various agents can be used for pain relief, including centrally acting analgesics and non-steroidal anti-inflammatory agents (Yazbek and Fantoni, 2005). Some researchers showed that preoperatively administration of carprofen could alleviate pain in dogs (Welsh et al., 1997) and the same results were obtained with morphine and buprenorphine by the others (Brodbelt et al., 1997; Snyder et al, 2016). The analgesic properties of tramadol result from mixed opioid and nonopioid mechanisms (Manne and. Gondi, 2017; Monteiro et al., 2009). The nonopioid mechanism was shown to inhibit the reuptake of noreepinephrine and serotonine (Beakley et al 2015; Duthie, 1998) and possibly displacement of stored 5 hydroxytryptamine from nerve endings in spinal and supraspinal pathways (Driessen and Reimann,1992; Raffa et al., 1992), therefore preventing impulses reaching the brain (Beakley et al 2015; Duthie, 1998). Tramadol has low affinity for μ receptors and an analgesic potency of one-tenth that of morphine (Monteiro et al., 2009), however, tramadol produced similar analgesia to morphine in the early postoperative period following ovariohysterectomy in dogs (Mastrocinque and Fantoni, 2003). In human beings it has been reported that the incidence of nausea and vomiting of tramadol was lower than that of other opioids (Duthie, 1998). Human field investigations showed tramadol in comparison with morphine produces less respiratory depression, does not release histamine and when used in therapeutic dosages does not have any effect on heart rate, ventricular function and blood pressure (Houmes et al., 1992). On the other hand, some side effects such as the decrease in prostacycline and prostaglandins synthesis which have been seen by non-steroidal anti-inflammatory drugs, do not occur with tramadol (Allegaert, 2016; Raffa et al., 1992).

The aim of this study was to compare different tools that would facilitate clinical evaluation of postoperative pain in dogs and to seek a simple and practical way to assess pain in this species.

Materials and Methods

This experimental study was carried out in ten adult mixed breed bitches weighing between 15 and 25 kg and aged between 1.5 and 3 years. Physical examination and complete blood count and biochemical serum analysis were performed in all dogs. Dogs were randomly divided into two equal treatment and control groups. Food and water was withheld from all dogs for 12 and two hours, respectively.

Ovariohysterectomy was performed under general anesthesia. Dogs were premedicated with intramuscular acepromazine 0.03mg/kg (Acepromazine 2%, Kela laboratoria NV., Belgium), administered 20 minutes before anaesthetic induction. Anesthesia was induced with Sodium thiopental (Biochemic GmbH, Vienna- Austria), 6-10 mg/kg intravenously. After endotracheal intubation, anesthesia was maintained using halothane (Pacegrove LTD., England)) at a concentration of 1 to 1.5% delivered in oxygen by using a closed circuit. Anesthetic was kept constant by the use of classi-

Table 1. Simple Descriptive Scale (SDS) for scoring of abdominal pain in dogs (according to Mastrocinque and Fantoni, 2003).

score	Criteria
0	Complete analgesia, with no overt signs of discomfort and no reaction to firm pressure applied to the injured region
1	Good analgesia, with no overt signs of discomfort but reaction to firm pressure
2	Moderate analgesia, with some overt signs of discomfort which were made worse by firm pressure
3	No analgesia, with obvious signs of persistent discomfort made worst by firm pressure

Table 2. Visual analogue scale, for assessment of abdominal pain in dogs.

score	Criteria
0	No pain: Dog is running, eating, jumping, and bouncy. Sitting or walking normally. Sleeping comfortably with dreaming. Normal affectionate response to caregiver. Appetite is normal
1	Probably no pain: Dog seems to be normal, but condition is not as clear-cut as previous category. Heart rate is normal or slightly increased because of excitement.
2	Mild discomfort: Dog will eat or sleep but may not dream. Dog may resist palpation of the surgical wound, but otherwise shows no sign of discomfort. Not depressed. There may be a slight increased in respiratory rate; heart rate may or may not be increased.
3	Mild pain or discomfort: Dog will guard incision, or the abdomen may be slightly tucked up. Dog looks a little depressed cannot get comfortable, may tremble or shake, seems to be interested in food and may still eat a little but somewhat picky. Respiratory rate may be increased and a little shallow. Heart rate may be increased or normal depending on weather on opioid was given previously
4	Mild to moderate pain: Dog resists touching of the operative site. Guarding or splinting of the abdomen or stretching all four legs. May look, lick, or chew at the painful area. The dog may sit or lie in an abnormal position and is not curled up or relaxed. May tremble or shake. May or may not seem interested in food. May start to eat and then stop after one or two bites. Respiratory rate may be increased or shallow. Heart rate may be increased or normal. Pupils may be dilated. May whimper occasionally, be slow to rise, and hang the tail down, and appear somewhat depressed
5	Moderate pain: Dog may be reluctant to move, depressed, or inappetent and may bite or attempt to bite when the caregiver approaches the painful area. Trembling or shaking with head down may be a feature, depressed. Dog may vocalize when caregiver attempts to move it or when it is approached. There is definite splinting of the abdomen and the dog may remain recumbent without moving for several hours. The ears may be pulled back. The heart and respiratory rates may be increased. Pupils may be dilated. The patient lies down but does not really sleep and may stand in the praying position
6	Increased moderate pain: Similar to previous category, but dog may vocalize or whine frequently without provocation and when attempting to move. Heart rate may be increased or within normal limits if an opioid was administered previously. Respiratory rate may be increased with an abdominal lift. Pupils may be dilated.
7	Moderate to severe pain: Similar to previous category, but in addition, the dog is quite depressed and is not concerned with its surroundings. The dog may urinate or defecate without attempting to move, cries out when moved, and will spontaneously or continually whimper. Occasionally, an animal does not vocalize. Heart and respiratory rates may be increased. Hypertension may also be present. Pupils may be dilated.
8	Severe pain: Signs same as previous category. Vocalizing may be more of a feature, or animal is so consumed with pain that it does not notice the caretaker's presence. The patient may thrash around in the cage intermittently. Tachycardia and tachypnea, with increased abdominal effort and hypertension are usually present, even if an opioid was given previously. These can be unreliable parameters if not present.
9	Severe to excruciating pain: Signs same as previous category, but the dog is hyperesthetic. The dog trembles involuntary when any part of the body in close proximity to wound or injury touched.
10	Excruciating pain: Signs same as previous category, but the dog is emitting piercing screams or almost comatose. The patient is hyperesthetic or hyperalgesic. The whole body is trembling, and pain is elicited wherever you touch the patient.

cal signs of anesthetic depth. All ovariohysterectomies were performed by a single trained surgeon. Duration of anesthesia and duration of surgery were recorded.

Table 3. University Melbourne Pain Scale (UMPS) for scoring of abdominal pain in dogs (according to Firth and Haldane, 1999). * Includes turning head toward affected area; biting, licking, or scratching at the wound; snapping at the handler; or tense muscles and a protective (guarding) posture. ** Does not include alert barking. Minimum total score=0, maximum total score=27.

Category	Descriptor	Score
Physiologic data	Physiologic data within reference range	0
a	Dilated pupils	2
b	Percentage increase in heart rate relative to preprocedural rate	
c Choose only one	>20%	1
	>50%	2
	>100%	3
d Choose only one	Percentage increase in respiratory rate relative to preprocedural rate	1
	>20%	2
	>50%	3
	>100%	
e	Rectal temperature exceeds reference range	1
f	Salivation	2
Response to palpation	No change from preprocedural behavior	0
Chose one only	Guards/reacts* when touched	2
	Guards/reacts* before touched	3
Activity	At rest, sleeping	0
Choose only one	Semiconscious	0
	Awake	1
	Eating	0
	Restless (pacing continuously, getting up and down)	2
	Rolling, thrashing	3
Mental status	Submissive	0
Choose only one	Overtly friendly	1
	Wary	2
	Aggressive	3
Posture	Guarding or protecting affected area (including fetal position)	2
a	Lateral recumbency	0
b. Choose only one	Sternal recumbency	1
	Sitting or standing, head up	1
	Standing, head hanging down	2
	Moving	1
	Abnormal posture (e.g., prayer position, hunched back)	2
Vocalization**	Not vocalizing	0
Choose only one	Vocalizing when touched	2
	Intermittent vocalization	2
	Continues vocalization	3

Table 4. Body weight, age, duration of anesthesia and duration of surgery in dogs undergoing ovariohysterectomy. (Mean ± SD)*. *No significant differences were seen between these criteria in two groups.

Group	Body weight (kg)	Age (year)	Duration of anesthesia (min)	Duration of surgery (min)
treatment	19.8±3.96	1.8±0.83	36.7±2.9	29.2±3.1
control	19.6±2.60	1.9±0.65	37.2±3.8	28.7±3.4

Table 5. Visual Analogue Scale (VAS) in both groups after ovariohysterectomy (Mean ± SD)*. *No statistically significant changes were seen between groups (p>0.05).

Time / Group	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
Treatment	4.4±1.81	4.4±.89	3.8±1.09	3.6±.89	2.72±0.7	2.26±1.17	1.72±0.97
Control	3.52±1.56	3.18±1.64	2.4±1.34	1.6±1.51	1.4±1.34	0.86±0.86	0.8±0.83

Table 6. Simple Descriptive Scale (SDS) in both groups after ovariohysterectomy (Mean ± SD)*.*No statistically significant changes were seen between groups (p>0.05).

Time / Group	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
Treatment	2.20±0.44	1.80±0.83	1.60±0.54	1.40±0.54	1.12±0.26	0.46±0.50	0.40±0.54
Control	1.86±0.77	1.40±0.54	0.92±0.91	0.92±0.91	0.80±0.83	0.60±0.54	0.40±0.54

Table 7. Heart rate (beat/minute) in both groups after ovariohysterectomy (Mean ± SD) (Mean±SD). *The changes were significant in compare with before surgery in each group (p<0.05).

Time / Group	Before surgery	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
Treatment	130±16.20	117.6±13.64*	108.2±23.17	103.6±16.75*	93.2±25.22*	95.6±34.41*	98.2±32.47*	98.8±32.17*
Control	89±13.41	143.8±42.00*	90.4±18.88	100.2±46.90	106.8±49.08	108.6±50.00	115.2±45.00	110.2±41.69

Treatment group received 3 mg/kg of tramadol (MS Pharma, USA) intramuscularly and control group received normal saline (equal volume with tramadol, i.m.) before the anesthetic induction. The injections of tramadol or normal saline were repeated four times a day with 6 hour intervals in 7 days. The animals were monitored at hour 2, 3 and 4 after each injection. Dogs were scored for signs of pain by two trained assessors who were blinded to the groups. The assessors were a general veterinary practitioner with minimum 5 years' experience in the field of small animal practice. If a dog appeared uncomfortable at any time during the postoperative period, or if the total score of UMPS scale was higher than 8, tramadol was administered at 3mg/kg, i.m. as a rescue analgesic.

The variables measured were pain assessment with different methods including Simple Descriptive Scale (SDS) (Table 1), Visual Analogue Scale (VAS) (Table 2), and University Melbourne Pain Scale (UMPS) (Table 3). Statistical analysis of collected data was done using the SPSS 16 program. Parametric variables were analyzed using Student's t-test or repeated measures ANOVA as appropriate. Non-parametric variables were analyzed by chi-square test ($\chi 2$ test). The minimum level of significance was defined as $p<0.05$

Results

There were no significant differences among groups for body weight, age, duration of anesthesia and duration of surgery (p>0.05) (Table 4).

With regard to analgesia that was measured with VAS, SDS and UMPS methods, only UMPS showed highly significant an-

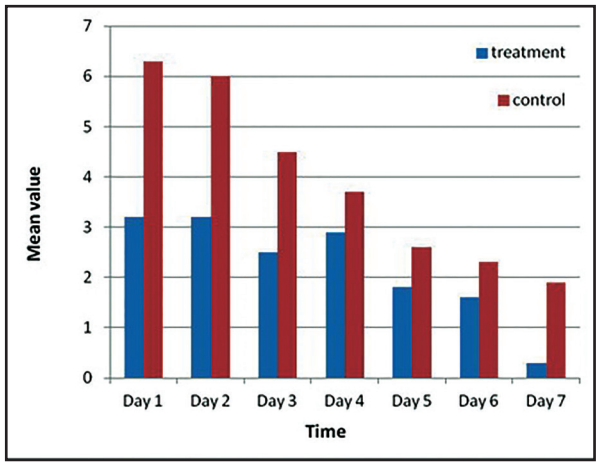

Figure 1. Comparative results of recorded UMPS scores between two groups.

algesia in treatment group ($p<0.01$) (Fig. 1) and VAS and SDS did not reveal any significant changes between groups ($p>0.05$) (Table 5 and 6). One dog in the control group was treated with supplemental tramadol.

In comparison with before surgery, heart rate decreased in treatment group significantly at day 1, 3, 4, 5, 6 and 7, and in control group significant increase of heart rate was seen on the first day after surgery ($p<0.05$) (Table 7).

Rectal temperature and respiratory rate did not show any significant changes in both groups.

Discussion

Pain is an individual experience and there is no objective method of measuring it today. In order to increase sensitivity and decrease bias while measuring the pain parameters, multiple objective and subjective pain assessment methods have been used (Matičić et al., 2010; Sharkey, 2013).

In the present study ovariohysterectomy was used as a model of surgical trauma for evaluation of three methods used for assessment of pain in dogs. Much of the animal pain research has focused on acute pain, and the most common model used for this purpose is ovariohysterectomy of dogs. Ovariohysterectomy is a relatively standardized source of soft tissue pain which makes it suitable for clinical studies of analgesia (Hansen, 2003; Tsai et al., 2013). It is generally accepted that this surgical procedure causes some degree of moderate pain (Caulkett et al., 2003; Fox et al., 1994; Mastrocinque and Fantoni, 2003) while in the present study two subjective pain scales (VAS and SDS) did not show any significant changes between control and treatment groups.

Simple descriptive scales have initially been used for humans since 1975, but the application of these methods in animals is a relatively complex task to perform. This scale is easy to apply but its sensibility is weak (Holton et al., 2001). SDS is a scale based on observation of the animal and not the nature of the procedure performed. The main disadvantages of the SDS are that it is not a sensitive scale for assessment of pain because it consists of only four or five categories and observer bias may play a key role in determining the pain scale. On the one hand, some researchers believe that SDS in not adaptable to animals since it is not precise and specific (Bufalari etal., 2007). On the other hand, VAS like SDS is a scoring system that is used extensively for people and is generally completed by the patient experiencing the pain. The scale avoids the use of imprecise descriptive terms and provides many points from which to choose.

In veterinary medicine, VAS is used for the evaluation of acute (Holton et al., 1998), postoperative pain in dogs (Firth and Haldane, 1999) and cats (Cambridge et al, 2000). To avoid possible mistakes, it is necessary that the observer be well trained to

recognize animal behavior during pain status and to discriminate species differences. Key disadvantages of the VAS in veterinary medicine occur primarily because the scale relies on an observer to identify and interpret pain behaviors. Observer bias may play a key role in assessment of pain, leading to the possibly of overdiagnosing or underdiagnosing pain. The most obvious limitation of VAS scale is that it simply places a numerical value on a subjective judgment, and indeed significant variability exists among observers with this device (Hansen, 2003; Holton et al., 1998).

There is no universal or self-sufficient pain assessment system. The comparison of clinical findings and behavioural parameters increase the objectivity of the results and help to explain their relationships, thus making the overall pain response clearer for the observer (Matičić et al., 2010). Some studies showed that UMPS is a reliable method of clinical pain assessment in dogs (Firth and Haldane, 1999; Matičić et al., 2010). The UMPS is regarded as more sensitive and more accurate than many descriptive and numerical rating scales (Firth and Haldane, 1999; Grant, 2006; Mich and Hellyer, 2008). The UMPS recognizes the importance of specific behavioural patterns, thereby eliminating the observers' bias. The behavioural and physiological parameters are taken into account and divided into six categories: physiologic data, response to palpation, activity, mental status, posture, and vocalization. The application of multiple parameters results in better accuracy and sensibility. The limitations of the system are the incapability of detecting subtle behavioural changes, the exclusive use for postoperative patients and the requirement of broad knowledge of manifestations of pain in animals (Matičić et al., 2010; Mich and Hellyer, 2008).

Clinical parameters used for the assessment of acute pain are heart rate, respiratory rate, temperature, arterial pressure and mydriasis (Matičić et al., 2010). The first reaction to painful stimulus is the increase of these parameters, but it seems after stabilization of the circulatory system these criteria lose their significance (Mich and Hellyer, 2008). Clinical parameters by themselves are not specific enough to differentiate pain from anxiety or fear, but these conditions can influence the circulation. The analgesic agents, like opioids, can decrease the clinical response, even in the case of insufficient analgesia (Hansen, 2000).

In our study significant increase in heart rate in control group was only seen on the first day after operation and surgical trauma and probably pain might be a logical reason for this change, although some researchers showed low correlation between clinical and behavioral parameters of pain in animals (Conzemius et al., 1997). Opioid-like effect of tramadol can explain the decrease inheart rate in most of the days after surgery in treatment group and this phenomenon may happen even in the case of insufficient analgesia (Hansen, 2000).

Comparison of the clinical and behavioral indices increases the objectivity of the results and helps to explain their relationships, thus making the overall pain response clearer for the assessors. Although our study did not demonstrate concordance of the dynamics of pain measured by the SDS, VAS and UMPS, indicate the greater reliability of UMPS method of pain assessment in dogs.

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مقایسه ابزارهای مختلف برای ارزیابی درد متعاقب جراحی برداشت رحم و تخمدان در سگ‌های ماده

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چکیده

زمینه مطالعه: تعیین دقیق و ارزیابی میزان دردی که یک حیوان از آن رنج می‌برد می‌تواند یک چالش به حساب آید و کنترل درد به طور فزاینده‌ای قسمت مهمی از طب دامپزشکی شده است. **هدف:** این مطالعه برای مقایسه ابزارهای مختلف برای ارزیابی درد پس از جراحی در سگ‌های ماده انجام شده است. **روش کار:** ده قلاده سگ نژاد مخلوط ماده انتخاب شدند. حیوانات به طور تصادفی به دو گروه مساوی درمان و کنترل تقسیم شدند. بیهوشی با آرام بخشی آسپرومازین (۰/۰۳ mg/kg IM) شروع و القای آن با تیوپنتال سدیم (۶-۱۰ mg/kg IV) صورت گرفت. هالوتان برای ادامه بیهوشی استفاده شد. عمل برداشت تخمدان و رحم در دو گروه انجام شد. در گروه درمان ترامادول به میزان سه میلی گرم بر کیلوگرم به شکل داخل عضلانی و در گروه کنترل سالین نرمال (هم حجم ترامادول به شکل داخل عضله) قبل از القای بیهوشی تجویز گردید. پس از جراحی تزریق‌های ترامادول و سالین نرمال چهار بار در روز با فواصل هر شش ساعت به مدت هفت روز تکرار گردید. حیوانات در ساعت‌های دو، سه و چهار پس از هر تزریق ارزیابی شدند. سگ‌ها برای علائم درد توسط دو ارزیاب آموزش دیده که نسبت به گروه ها ناآگاه بودند امتیاز دهی شدند. متغیرهای اندازه‌گیری شده، ارزیابی درد با روش های مختلف، شامل روش توصیفی ساده (SDS)، روش مشاهده‌ای (VAS) و روش ارزیابی درد ملبون (UMPS) بودند. طول مدت بیهوشی و جراحی نیز ثبت گردید. **نتایج:** اختلاف معنی داری بین دو گروه در ارتباط با بی دردی اندازه‌گیری شده با روش های VAS و SDS وجود نداشت ولی در روش UMPS بی دردی به شکل معنی‌داری در گروه درمان بهتر بود. **نتیجه‌گیری نهایی:** اگرچه اندازه‌گیری کمّی میزان درد حس شده در حیوانات برای ارزیابی میزان آسایش و راحتی موجود دارای اهمیت است، ولی مهم است بدانیم که ارزیابی درد پس از عمل در سگ‌ها یک چالش بزرگ برای دامپزشکان می‌باشد.

واژه های کلیدی: سگ های ماده، عمل برداشت رحم و تخمدان، درد، ترامادول، ارزیابی مشاهده ای درد

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