Acta Scientiae Veterinariae, 2025. 53: 1985.

RESEARCH ARTICLE
Pub. 1985

ISSN 1679-9216

Maropitant in Cats Undergoing Ovariohysterectomy: Evaluation of Clinical and Analgesic Effects

Luana Marcia Rocha[1], Gilberto Serighelli Júnior[2], Ronise Tochetto[3], Luara da Rosa[4], Felipe Comassetto[4] & Nilson Oleskovicz[4]

ABSTRACT

***Background*:** Emesis is a frequent adverse effect associated with the use of α2-adrenergic agonists and opioids in veterinary medicine, particularly in cats, where it's incidence can reach up to 80%. Maropitant, a neurokinin-1 (NK1) receptor antagonist, has demonstrated potent antiemetic properties and potential analgesic effects, making it a promising candidate for perioperative management. However, its efficacy in modulating intraoperative and postoperative analgesia in cats undergoing ovariohysterectomy (OH) remains underexplored.

***Materials, Methods & Results*:** A double-blinded, randomized clinical trial was conducted with 16 healthy female cats divided into 2 groups. The maropitant group (MG) received 1 mg/kg subcutaneously 1 h prior to preanesthetic medication with dexmedetomidine (5 µg/kg) and morphine (0.3 mg/kg), while the control group (CG) received an equivalent volume of saline. Anesthesia was induced with propofol and maintained with isoflurane. Intraoperative parameters, including heart rate (HR), systolic arterial pressure (SAP), and fentanyl rescue requirements, were monitored. Postoperative analgesia was assessed using the UNESP/Botucatu multidimensional feline acute pain scale, with rescue analgesia administered as needed. Maropitant effectively prevented vomiting, with no instances of emesis observed in the MG, compared to a 62.5% incidence in the CG ($P = 0.0256$). HR and SAP increased during periods of heightened surgical stimulation in both groups, reflecting physiological responses to nociception; however, these increases were less pronounced in the MG, suggesting partial modulation of visceral pain. Intraoperative fentanyl rescues were significantly fewer in the MG (median: 9) compared to the CG (median: 13), particularly at moments of intense nociception ($P = 0.0486$). Postoperative pain scores showed no significant differences between groups, with both requiring similar numbers of rescue analgesia interventions during the evaluation period. Signs of nausea, such as sialorrhea and lip-licking, were observed in both groups, with no statistical differences, indicating that maropitant's antinausea efficacy may be limited.

***Discussion*:** The findings highlight the dual role of maropitant as an antiemetic and adjunctive intraoperative analgesic. It's complete inhibition of vomiting underscores it's efficacy in blocking emetic signaling pathways via NK1 receptor antagonism in the brainstem vomiting center, particularly against stimuli from α2-adrenergic agonists and opioids. This antiemetic effect is clinically significant, improving the welfare of cats undergoing OSH by eliminating a common and distressing adverse effect. Furthermore, the reduction in intraoperative fentanyl rescues suggests that maropitant's modulation of visceral nociception is effective, potentially linked to its ability to inhibit substance P-mediated nociceptive transmission in visceral afferents. However, the lack of significant differences in postoperative pain scores and analgesic rescues between groups suggests that maropitant's analgesic efficacy may be dose-dependent or limited to the intraoperative period. In conclusion, Maropitant at a dose of 1 mg/kg administered subcutaneously is a valuable addition to perioperative protocols in cats undergoing OSH, effectively preventing vomiting and reducing intraoperative analgesic requirements. Further research is warranted to optimize dosing strategies and explore its integration within multimodal analgesic protocols to enhance its clinical applications.

Keywords: maropitant, cats, emesis, pain.

DOI: 10.22456/1679-9216.145240

Received: 15 January 2025 Accepted: 30 March 2025 Published: 29 April 2025

[1]Private Veterinary Practitioner, Miami, FL, USA. [2]Department of Veterinary Medicine, Agricultural Sciences Sector, Federal University of Paraná (UFPR), Curitiba, PR, Brazil. [3]Private Veterinary Practitioner, Lages, SC, Brazil. [4]Department of Veterinary Medicine, Santa Catarina State University (UDESC), Center for Agro-Veterinary Sciences (CAV), Lages, SC. CORRESPONDENCE: G. Serighelli Jr. [gilberto.serighelli@ufpr.br]. Rua dos Funcionários n. 1540. Juvevê. CEP 80035-050 Curitiba, PR, Brazil.

INTRODUCTION

Emesis is a frequent adverse effect linked to the use of α2-adrenergic agonists and opioids in veterinary practice [5,15]. In felines, the occurrence rate is high, reaching approximately 80% after the administration of agents such as dexmedetomidine, buprenorphine, hydromorphone, or xylazine [9,19]. While antiemetic medications can reduce the likelihood of vomiting, they often fail to eliminate it entirely [9,19].

Maropitant, a neurokinin-1 receptor antagonist, is recognized as a potent antiemetic with demonstrated efficacy in mitigating emesis induced by opioids [2,4,7,10] and α2-adrenergic agonists in veterinary medicine [2,15,16]. Maropitant is a selective NK1 antagonist that blocks the binding of Substance P, a neurotransmitter found in high concentrations in the chemoreceptor trigger zone and the vomiting center, both key areas involved in the vomiting reflex [7,11].

Maropitant's potential utility as a preanesthetic agent is notable, given the frequent use of opioids and α2-adrenergic agonists for sedation and preanesthetic preparation in cats, where emesis is a common adverse effect [4,10,15,16]. Subcutaneous (SC) administration of maropitant at a dose of 1 mg/kg has been shown to effectively prevent emesis triggered by the combined intramuscular administration of morphine and dexmedetomidine in cats [15,16].

This study aimed to evaluate the clinical and analgesic effects of maropitant in felines undergoing ovariohysterectomy. The objectives included assessing intraoperative fentanyl rescue, postoperative analgesic efficacy using a multidimensional acute pain scale for cats, and the antiemetic effects of maropitant administered prior to morphine and dexmedetomidine.

MATERIALS AND METHODS

Animals

This double-blinded, randomized, parallel-group clinical trial with balanced randomization (1:1) was conducted at Santa Catarina State University (UDESC) and approved by the Ethics Committee for the Use of Animals under protocol 3630220817. Only animals classified as American Society of Anesthesiologists (ASA) physical status I were included. The sample size was calculated using statistical software[1], with an alpha level of 5% (two-sided) and a beta of 20% (80% power).

Study design

A total of 16 healthy female mixed-breed cats, with a mean body weight of 2.9 ± 0.5 kg ($P = 0.841$), were included in the study. All animals were classified as American Society of Anesthesiologists (ASA) physical status I and were selected from the routine surgical schedule of the Veterinary Clinical Hospital at UDESC. Prior to enrollment, each cat underwent physical examination and clinical laboratory tests (complete blood count, urea, creatinine, ALT, ALP, GGT, and albumin) to confirm health status. Animals were hospitalized 48 h before the procedure for acclimatization in a quiet room with adequate space for interaction with the observer. They received a diet of commercial dry food and water *ad libitum*. Animals were randomly assigned to experimental groups using block randomization to ensure equal distribution (www.randomization.com). Postoperative pain evaluators were blinded to the group allocations. The day before surgery, all cats underwent assessment using the UNESP/Botucatu multidimensional feline acute pain scale and were fasted for 12 h.

Anesthesia and instrumentation

On the day of the procedure, cats were allocated into 2 groups: the Maropitant Group (MG), which received 1 mg/kg of maropitant[2] [Cerenia - 10 mg/mL] subcutaneously 1 h before preanesthetic medication, and the Saline Solution Group (CG), which received an equivalent volume of saline subcutaneously 1 h before preanesthetic medication. After 1 h, dexmedetomidine[3] [Dexdomitor - 500 ug/mL, 5 µg/kg] and morphine[3] [Dimorf - 10 mg/mL, 0.3 mg/kg] were administered intramuscularly. Animals were observed for 15 min before and 30 min after dexmedetomidine and morphine administration by 2 blinded evaluators who recorded sialorrhea, lip-licking, retching, and signs of nausea. Sialorrhea (presence of foam-like liquid around the lips, with or without dripping) and lip-licking were documented as individual signs. Nausea was defined as rhythmic contraction of the diaphragm and abdominal muscles without content expulsion, regardless of whether retching followed. The time to the first nausea or vomiting episode and the total number of emetic events were recorded for each animal.

Peripheral venous access was established via the cephalic vein, and anesthesia was induced with intravenous (IV) propofol[3] [Propovan 10 mg/mL - initial dose of 1 mg/kg], administered in 30 s intervals until

the loss of the swallowing reflex, eyeball rotation, and lateral and medial palpebral reflexes was confirmed. Subsequently, lidocaine[3] [Xylestesin 2% - 0.1 mL of 2%, without a vasoconstrictor] was applied periglottically to facilitate orotracheal intubation using a Murphy tube. The tube was then connected to an anesthetic machine[4] [Datex Ohmeda 9100c] via a Mapleson D non-rebreathing anesthetic circuit, with 100% oxygen supplied at a flow rate of 200 mL/kg/min. Anesthesia was maintained with isoflurane[3] [Isoforine - 1 mL/mL], starting at an initial concentration of 1.63% (V%) and adjusted as needed to achieve an appropriate anesthetic depth. Isoflurane concentration was continuously monitored using a gas analyzer and adjusted by the same anesthetist based on the clinical response of each animal. Anesthetic monitoring included the following parameters: heart rate (HR, in beats per minute, bpm) recorded via electrocardiography, peripheral oxygen saturation (SpO_2, in %) measured by pulse oximetry, respiratory rate (RR, in breaths per minute, bpm) and end-tidal carbon dioxide ($EtCO_2$, in mmHg) monitored via capnography with a side-stream sensor, and body temperature (T, in °C) measured using a transesophageal thermometer. Systolic arterial pressure (SAP, in mmHg) was measured using a vascular Doppler[5] (Parks Medical®, model 811-B for veterinary use) combined with an aneroid sphygmomanometer and a cuff sized at 40% of the animal's thoracic limb circumference. End-tidal isoflurane concentration (EtIso) was also monitored continuously using a gas analyzer.

After achieving a stable anesthetic plane for 10 min, baseline data (zero timepoint, T0) were collected. Analgesic rescue interventions were standardized as follows: fentanyl[3] [Fentanest - 0.05 mg/mL; 2.5 µg/kg IV] was administered if a 20% increase occurred in 2 out of 3 parameters - heart rate (HR), respiratory rate (RR), or systolic arterial pressure (SAP) -compared to T0. Atropine (0.044 mg/kg IV) was administered for HR below 90 bpm, while ephedrine (0.1 mg/kg IV) was given for SAP below 90 mmHg. For end-tidal carbon dioxide ($EtCO_2$) values exceeding 45 mmHg, assisted ventilation at 10 breaths per minute was provided until normalization. Intraoperative analgesic rescue requirements were recorded according to these predefined criteria.

Prophylactic antibiotic therapy with ampicillin[6] [Ampicilina Sódica 1g - 20 mg/kg, IV] was administered prior to anesthesia induction. Elective ovariohysterectomy was performed on all animals by the same surgeon using a standardized 3-clamp technique. Intraoperative evaluation time points were as follows: 10 min after anesthesia induction (T0), after skin incision (T1), after clamping of the right ovarian pedicle (T2), after clamping of the left ovarian pedicle (T3), after clamping of the cervix (T4), and after dermorrhaphy (T5). Following the surgical procedure, meloxicam[7] [Maxicam 0,2% - 0,1 mg/kg, SC, SID, 3 days] was administered as a postoperative analgesic.

After extubation, the cats were returned to the acclimatization room. Postoperative pain assessments were conducted at predefined time points (2, 4, 6, 8, 12, and 24 h post-surgery) using the UNESP/Botucatu multidimensional feline acute pain scale. All evaluations were performed by the same trained evaluator to ensure consistency and reduce inter-observer variability. Rescue analgesia was administered when the pain score reached or exceeded 8 points, consisting of morphine [0.2 mg/kg], delivered intramuscularly.

Statistical analysis

Data were analyzed using SigmaPlot software. The D'Agostino & Pearson test was applied to assess the normality of the data distribution. For comparisons between groups, the Student's *t*-test was used for normally distributed data, while repeated measures analysis of variance (ANOVA-RM), followed by Dunnett's *post hoc* test, was applied for comparisons across time points within groups. A significance level of $P < 0.05$ was considered statistically significant.

RESULTS

All animals enrolled in the study (n = 16 cats) successfully completed the study. The population was homogeneous regarding age (2.8 ± 1.6 years; $P = 0.435$) and body mass (2.34 ± 1.83 kg; $P = 0.421$) across the treatment groups.

Regarding cardiorespiratory parameters (Table 1), heart rate (HR) was significantly higher in both groups during time points of increased surgical stimulation (T2, T3, and T4) compared to baseline (T0), with an average increase of 21.01% in the maropitant group and 22.30% in the control group, with no significant difference between treatments ($P = 0.874$). Systolic arterial pressure (SAP) followed a similar trend to HR, showing elevations during periods of greater stimulation (T2, T3, and T4), with increases of 13.79% in the maropitant group and 17.42% in the

control group. However, SAP significantly increased at T2 in the control group ($P = 0.0030$) and at T4 in the maropitant group ($P = 0.0474$). End-tidal carbon dioxide ($EtCO_2$) was significantly higher in the maropitant group at T2, whereas body temperature (T°) progressively decreased in both groups throughout the procedure.

Regarding intraoperative rescue analgesia with fentanyl (Table 1), the median number of intraoperative analgesic rescues (Table 1) was significantly higher in the control group (CG) at M2 ($P = 0.0486$). No significant differences were observed between groups at other time points, nor in the total number of rescues: 13 in the control group and 9 in the maropitant group ($P = 0.783$).

Table 1. Mean Values and Standard Deviations of cardiorespiratory parameters of **cats** (n=16) and Intraoperative Analgesic Rescue at Perioperative Moments (M0–M5) in Cats Undergoing Elective Ovariohysterectomy Treated with Maropitant (GM) or Saline Solution (GC).

Parameters		M0	M1	M2	M3	M4	M5
HR (beat/min)	GM	109 ± 14	95 ± 36	132 ± 25A	139 ± 24A	141 ± 27A	122 ± 24
	GC	101 ± 19	104 ± 18	133 ± 32A	133 ± 29A	123 ± 24A	106 ± 20
f (mov/min)	GM	23 ± 5	20 ± 4	22 ± 6	22 ± 5	21 ± 4	21 ± 6
	GC	22 ± 7	20 ± 5	23 ± 9	20 ± 8	18 ± 7	20 ± 8
SpO_2 (%)	GM	95 ± 5	95 ± 5	97 ± 4	97 ± 4	97 ± 2	95 ± 5
	GC	96 ± 2	96±2	97±3	97±2	97±2	96 ± 3
$EtCO_2$ (mmHg)	GM	31 ± 3	31 ± 3	34 ± 3a	34 ± 4	32 ± 3	31 ± 3
	GC	29 ± 4	29 ± 6	29 ± 5b	31±4	31±6	27±4
FeIso (%)	GM	0.99 ± 0.14	0.99 ± 0.16	1 ± 0.14	0.99 ± 16	0.98 ± 0.18	0.99 ± 0.23
	GC	1 ± 0.24	1 ± 0.26	1 ± 0.25	1 ± 0.29	0.96± 0.26	0.88± 0.37
SAP (mmHg)	GM	100 ± 25	96 ± 20	110 ± 19a	117 ± 22	122 ± 16A	103 ± 24
	GC	109 ± 12	111 ± 11	144 ± 15 Ab	141 ± 30	123 ± 12	110 ± 15
T (°C)	GM	37.6 ± 0.3	37.4 ± 0.4A	37.1 ± 0.4A	37 ± 0.4A	36.8 ± 0.5A	36.6 ± 0.6A
	GC	37,1±0,5	37 ± 0.5A	36.7 ± 0.6A	36.6 ± 0.6A	36.6 ±0.7A	36.2 ± 0.7A
Intraoperative Rescue	GM	0 [0 - 0]	0 [0 - 0]	0a [0 – 1]	0 [0 – 2]	0 [0 – 1]	0 [0 - 1]
	GC	0 [0 - 0]	0 [0 - 0]	1b [0 – 1]	0.5 [0- 2]	0 [0 – 1]	0 [0 - 0]

Heart Rate (HR), Respiratory Rate (RR), Peripheral Oxygen Saturation (SpO_2), End-Tidal Carbon Dioxide (EtCO2), Expired Fraction of Isoflurane (FeISO), Systolic Arterial Blood Pressure (SAP), Body Temperature (T°C). Uppercase letters in the same row indicate a significant difference compared to M0 (ANOVA-RM), followed by Dunnett's test for parametric data. For Intraoperative Rescue, differences between groups were determined using Student's *t*-test ($P \leq 0.05$).

Postoperative pain scores (Table 2), assessed using the multidimensional acute pain scale for felines (UNESP-Botucatu), were similar between groups throughout the evaluation period, with no significant differences between treatments. Both groups required three rescue analgesia interventions, with no additional rescues needed after 8 h postoperatively. Pain scores decreased over time, with median values approaching zero from 8 h postoperatively onward.

Regarding sialorrhea, lip-licking, retching, and signs of nausea, clinical evaluation (Table 3) revealed that vomiting was significantly more frequent in the control group (CG) compared to the maropitant group (MG). Specifically, 5 out of 8 animals in the CG experienced vomiting (62.5%), while none in the MG exhibited this behavior ($P = 0.0256$). Despite the absence of vomiting, sialorrhea was observed in 25% of the animals in the MG and in 37.5% of those in the CG ($P = 0.2821$). Lip-licking occurred in 50% of the MG and 87.5% of the CG ($P = 0.2821$). Similarly, no signs of nausea were observed in the MG, whereas 25% of the animals in the CG exhibited this symptom ($P = 0.6799$). No significant differences were found between groups for sialorrhea, lip-licking, or retching.

Table 2. Postoperative pain scores (median, minimum, and maximum) assessed using the Multidimensional Acute Pain Scale for Felines (UNESP-Botucatu), at 2, 4, 6, 8, 12, and 24 h after elective ovariohysterectomy in cats.

GROUPS	2	4	6	8	12	24
Maropitant	6 [1 - 10]	4.5 [1 - 11]	3.5 [0 – 6]	1 [0 - 6]	0 [0 - 1]	0 [0 - 0]
Control	3.5 [1 - 13]	3,5 [0 - 7]	1 [0 - 11]	1 [0 - 7]	0 [0 - 5]	0 [0 - 3]

Cats after Elective Ovariohysterectomy were treated with Maropitant (GM) or Saline Solution (GC) and Pre-medicated with Dexmedetomidine (5 µg/kg) and Morphine (0.2 mg/kg). Different lowercase letters in the same column indicate significant differences between groups [t-test followed by Mann-Whitney Test for Rank Comparison] ($P \leq 0.05$).

Table 3. Descriptive data for various outcomes in healthy cats undergoing elective ovariohysterectomy:

Outcome	Maropitant group	Control group	*P* value
Sialorrhea	2 (8)	3 (8)	0.4667
Lip-licking	4 (8)	7 (8)	0.2821
Retching	0 (8) a	5 (8) b	0.0256
Signs of nausea	0 (8)	2 (8)	0.6799

Values Represent the Number of Cats Affected Relative to the Total Number of Animals, Based on the Martins-Flores Scale [15]. Cats Were Treated with Maropitant (GM) or Saline Solution (GC) and Pre-medicated with Dexmedetomidine (5 µg/kg) and Morphine (0.2 mg/kg). Different Lowercase Letters in the Same Column Indicate Significant Differences Between Groups (Student's *t*-test) [$P \leq 0.05$].

DISCUSSION

The findings of this study align with previously published evidence supporting the dual role of maropitant as both an analgesic and an antiemetic in veterinary anesthesia. During the intraoperative period, maropitant resulted in a lower number of rescue interventions, particularly during moments of heightened nociceptive stimulation. This outcome can be attributed to the ability of NK-1 receptor antagonism to attenuate visceral nociceptive transmission without compromising cardiovascular stability, even under intense surgical stimulation [3,11]. While clinical trials in humans, particularly those evaluating its efficacy in managing somatic pain, have yielded inconsistent results, numerous animal models have demonstrated the efficacy of NK-1 receptor antagonists for visceral analgesia. These antagonists have shown effectiveness in addressing visceral pain in various laboratory models, including noxious bladder and colonic stimulation in mice and guinea pigs, as well as colorectal stimulation in rabbits [3,11].

Substance P (SP) is a critical neuropeptide involved in pain modulation, acting through the activation of NK-1 receptors located along pain pathways, including sensory afferents, the dorsal root ganglia, and the dorsal horn of the spinal cord [3,11]. These receptors are significantly more prevalent in visceral afferents than in somatic afferents, suggesting a prominent role in visceral antinociception [17]. Maropitant's ability to block NK-1 receptors and inhibit SP-mediated nociception explains its efficacy in reducing visceral pain [1,3,11]. Experimental studies in dogs and cats have shown that maropitant reduces the minimum alveolar concentration (MAC) of sevoflurane during visceral stimulation, demonstrating its MAC-sparing effects in visceral analgesia [3,17]. Notably, while maropitant reduces MAC by approximately 15-24% depending on the dose, higher doses do not lead to further significant reductions, suggesting a plateau effect in its analgesic properties [1].

In this study, heart rate (HR) and systolic arterial pressure (SAP) increased significantly during periods of surgical stimulation in both groups, reflecting physiological responses to noxious stimuli. This can be explained by the fact that, although maropitant exerts an analgesic effect, it is not always sufficient to fully mitigate nociceptive stimuli, leading to elevations in HR and SAP. However, these increases were less pronounced in the maropitant group, particularly regarding arterial pressure. A previously blinded clinical trial compared the effects of maropitant (1.0 mg/

kg) and morphine (0.5 mg/kg), both administered subcutaneously, in healthy bitches undergoing elective ovariohysterectomy [13]. The treatments were given 30 min prior to induction with propofol, which was followed by maintenance with inhalant anesthesia. Monitoring parameters included heart rate, systolic blood pressure, and inhalant anesthetic requirements. The maropitant-treated group demonstrated significantly reduced heart rate, systolic blood pressure, and inhalant anesthetic consumption compared to the morphine-treated group [13].

From an antiemetic perspective, maropitant demonstrated significant efficacy in preventing vomiting. None of the animals in the maropitant group exhibited emesis, compared to 62.5% in the control group. This finding aligns with previous studies highlighting the high efficacy of maropitant in preventing emesis induced by opioids and α2-adrenergic agonists in cats and dogs [9,16,19]. The underlying mechanism involves the blockade of substance P (SP) at NK-1 receptors located in the brainstem vomiting center, effectively disrupting emetic signaling pathways. Additionally, maropitant's prolonged duration of action, with a half-life of approximately 16.8 h in cats, further underscores its suitability for perioperative use, where sustained antiemetic effects are advantageous [8,16]. This pharmacokinetic profile enables administration well in advance of emetogenic stimuli without compromising its efficacy.

Despite its success in preventing vomiting, maropitant's efficacy in controlling nausea appeared to be less pronounced. Signs of nausea, such as sialorrhea and lip licking, were observed in both groups. These findings are consistent with previous studies reporting the limited ability of maropitant to mitigate nausea when compared to its strong antiemetic efficacy [4,18,19]. Nausea is a multifactorial and subjective phenomenon influenced by diverse central and peripheral mechanisms, which may not be fully addressed by NK-1 receptor antagonism alone. Residual autonomic responses or incomplete blockade of nausea-related pathways might account for behaviors such as sialorrhea and lip licking [14,18]. This phenomenon has been previously reported in both cats and dogs [10,12]. While sialorrhea and lip licking are commonly regarded as indicators of nausea, their assessment remains subjective [18]. Findings from this study, alongside prior reports, suggest that if these behaviors indeed reflect nausea, the antinausea efficacy of maropitant may be inferior to its antiemetic effect [14]. Emesis represents a complex physiological response to various stimuli and can be divided into 3 distinct phases: nausea (the sensation or inclination to vomit), retching (involuntary attempts to vomit), and vomiting (the ejection of gastric contents) [5,6,14]. The reasons behind maropitant's ability to reduce emesis without a comparable reduction in nausea in cats and dogs remain unclear [14].

Postoperative pain scores, assessed using the multidimensional acute pain scale for felines (Unesp-Botucatu), with no significant differences throughout the evaluation period. This finding suggests that, although maropitant combined with morphine may have an additive effect during the intraoperative period, this synergy was not evident postoperatively. The lack of differentiation in postoperative scores could be attributed to the single bolus administration of maropitant. Previous studies, demonstrated that a bolus dose of maropitant (5 mg/kg IV) followed by continuous infusion (150 mcg/kg/h) reduced the minimum alveolar concentration (MAC) of sevoflurane by 30% during visceral stimulation in dogs [3]. These findings suggest that higher or repeated doses of maropitant might be necessary to achieve a more pronounced postoperative analgesic effect [3].

The role of maropitant in intraoperative analgesia and antiemesis underscores its importance as a multimodal agent. By targeting central pathways of pain and emesis, maropitant provides a unique therapeutic profile that complements traditional analgesics and antiemetics. However, the absence of significant differences in the total number of analgesic rescues and the persistence of nausea-related behaviors highlight areas where additional research is needed. Future studies could investigate the combined use of maropitant with other agents, such as nonsteroidal anti-inflammatory drugs or α2-adrenergic agonists, to enhance its efficacy and broaden its clinical applications.

Finally, it is important to note that maropitant's utility extends beyond its analgesic and antiemetic effects. Clinical studies have reported smoother anesthetic recoveries, earlier return to feeding, and reduced stress-related behaviors in animals treated with maropitant [11,13]. These additional benefits further establish maropitant as a valuable adjunct in perioperative management. However, clinicians should remain mindful of potential adverse effects, such as

discomfort associated with subcutaneous administration, and consider alternative routes of administration when necessary to improve patient welfare [16].

CONCLUSION

In conclusion, maropitant at a dose of 1 mg/kg administered subcutaneously was effective in preventing vomiting in cats when given 1 h prior to dexmedetomidine (5 µg/kg) and morphine (0.2 mg/kg). It also reduced the need for intraoperative analgesic rescues during ovariohysterectomy, highlighting its potential role in managing visceral nociception. However, at the administered dose, maropitant did not provide significant analgesic effects in the postoperative period, suggesting that its efficacy may be limited to intraoperative nociceptive modulation.

MANUFACTURERS

[1]Open Source Epidemiologic Statistics for Public Health. Atlanta, GE, USA.

[2]Pfizer Animal Health. Madison, NJ, USA.

[3]Cristália Produtos Químicos Farmacêuticos. São Paulo, SP, Brazil.

[4]GE Healthcare. Cambridge, MA, USA.

[5]Parks Medical. Aloha, OR, USA.

[6]Aurobindo Pharma Indústria Farmacêutica. Anápolis, GO, Brazil.

[7]Zoetis Indústria de Produtos Veterinários Ltda. Campinas, SP, Brazil.

Ethical approval. All animal procedures were conducted in strict compliance with the guidelines approved by the Ethics Committee for the Use of Animals (CEUA/UDESC) under protocol number 3630220817.

Declaration of interest. The authors report no conflicts of interest. The authors alone are responsible for the content and writing of paper.

REFERENCES

1 **Alvillar B.M., Boscan P., Mama K.R., Ferreira T.H., Congdon J. & Twedt D.C. 2012.** Effect of epidural and intravenous use of the neurokinin1 (NK-1) receptor antagonist maropitant on the sevoflurane minimum alveolar concentration (MAC) in dogs. *Veterinary Anaesthesia and Analgesia*. 39(2): 201-205. DOI: 10.1111/j.1467-2995.2011.00670.x.

2 **Benchaoui H.A., Cox S.R., Schneider R.P., Boucher J.F. & Clemence R.G. 2007.** The pharmacokinetics of maropitant, a novel neurokinin-1 antagonist, in dogs. *Journal of Veterinary Pharmacology and Therapeutics*. 30(4): 336-344. DOI: 10.1111/j.1365-2885.2007.00877.x

3 **Boscan P., Monnet E., Mama K., Twedt D.C., Congdon J. & Steffey E.P. 2011.** Effect of maropitant, a neurokinin 1 receptor antagonist, on anesthetic requirements during noxious visceral stimulation of the ovary in dogs. *American Journal of Veterinary Research*. 72(12): 1576-1579. DOI: 10.2460/ajvr.72.12.1576. PMID: 22126683.

4 **Claude A.K., Dedeaux A., Chiavaccini L. & Hinz S. 2014.** Effects of maropitant citrate or acepromazine on the incidence of adverse events associated with hydromorphone premedication in dogs. *Journal of Veterinary Internal Medicine*. 28(5): 1414-1417. DOI: 10.1111/jvim.12414

5 **Elwood C., Devauchelle P., Elliott J., Freiche V., German A.J., Gualtieri M., Hall E., den Hertog E., Neiger R., Peeters D., Roura X. & Savary-Bataille K. 2010.** Emesis in dogs: a review. *Journal of Small Animal Practice*. 51(1): 4-22. DOI: 10.1111/j.1748-5827.2009.00820.x

6 **Gan T.J. 2007.** Mechanisms underlying postoperative nausea and vomiting and neurotransmitter receptor antagonist-based pharmacotherapy. *CNS Drugs*. 21(10): 813-833. DOI: 10.2165/00023210-200721100-00003

7 **Garcia-Recio S. & Gascon P. 2015.** Biological and pharmacological aspects of the NK1-Receptor. *BioMed Research International*. 2015: 495704. DOI: 10.1155/2015/495704.

8 **Hickman M.A., Cox S.R., Mahabir S., Miskell C., Lin J., Bunger A., & McCall R.B. 2008.** Safety, pharmacokinetics, and use of the novel NK-1 receptor antagonist maropitant (Cerenia) for the prevention of emesis and motion sickness in cats. *Journal of Veterinary Pharmacology and Therapeutics*. 31(3): 220-229. DOI: 10.1111/j.1365-2885.2008.00952.x

9 **Kolahian S. & Jarolmasjed S. 2010.** Effects of metoclopramide on emesis in cats sedated with xylazine hydrochloride. *Journal of Feline Medicine and Surgery.* 12(12): 899-903. DOI: 10.1016/j.jfms.2010.06.008

10 **Kraus B.L.H. 2013.** Efficacy of maropitant in preventing vomiting in dogs premedicated with hydromorphone. *Veterinary Anaesthesia and Analgesia*. 40(1): 28-34. DOI: 10.1111/j.1467-2995.2012.00788.x.

11 **Kraus B.L.H. 2017.** Spotlight on the perioperative use of maropitant citrate. *Veterinary Medicine: Research and Reports*. 8: 41-51. DOI: 10.2147/VMRR.S126469.

12 **Lorenzutti A.M., Martín-Flores M., Litterio N.J., Himelfarb M.A. & Zarazaga M.P. 2016.** Evaluation of the antiemetic efficacy of maropitant in dogs medicated with morphine and acepromazine. *Veterinary Anaesthesia and Analgesia*. 43(2): 195-198. DOI: 10.1111/vaa.12286

13 **Marquez M., Boscan P., Weir H., Vogel P. & Twedt D.C. 2015.** Comparison of NK1 receptor antagonist (maropitant) to morphine as a pre-anaesthetic agent for canine ovariohysterectomy. *Plos One*. 10(10): 1-10. DOI: 10.1371/journal.pone.0140734.

14 **Martin-Flores M., Mastrocco A., Lorenzutti A.M., Campoy L., Kirch P., Stone M., Learn M.M. & Boesch J.M. 2017.** Maropitant administered orally 2–2.5 h prior to morphine and dexmedetomidine reduces the incidence of emesis in cats. *Journal of Feline Medicine and Surgery*. 19(8): 876-879. DOI: 10.1177/1098612X16663595

15 **Martin-Flores M., Sakai D.M., Learn M.M., Mastrocco A., Campoy L., Boesch J.M. & Gleed R.D. 2016.** Effects of maropitant in cats receiving dexmedetomidine and morphine. *Journal of the American Veterinary Medical Association*. 248(11): 1257-1261. DOI: 10.2460/javma.248.11.1257

16 **Martin-Flores M., Sakai D.M., Mastrocco A., Learn M.M., Campoy L., Kirch P.J., Boesch J.M. & Gleed R.D. 2016.** Evaluation of oral maropitant as an antiemetic in cats receiving morphine and dexmedetomidine. *Journal of Feline Medicine and Surgery*. 18(11): 921-924. DOI: 10.1177/1098612X15613389

17 **Niyom S., Boscan P., Twedt D.C., Monnet E. & Eickhoff J.C. 2013.** Effect of maropitant, a neurokinin-1 receptor antagonist, on the minimum alveolar concentration of sevoflurane during stimulation of the ovarian ligament in cats. *Veterinary Anaesthesia and Analgesia*. 40(4): 425-431. DOI: 10.1111/vaa.12017

18 **Ramsey D., Fleck T., Berg T., Nederveld S., DeLong D., Tena J.K., Aleo M., & McCall R. 2014.** Cerenia prevents perioperative nausea and vomiting and improves recovery in dogs undergoing routine surgery. *International Journal of Applied Research in Veterinary Medicine*. 12(3): 228-237.

19 **Santos L.C., Ludders J.W., Erb H.N., Martin-Flores M., Basher K.L. & Kirch P. 2011.** A randomized, blinded, controlled trial of the antiemetic effect of ondansetron on dexmedetomidine-induced emesis in cats. *Veterinary Anaesthesia and Analgesia*. 38(4): 320-327. DOI: 10.1111/j.1467-2995.2011.00619.x.