

## Current attitudes towards the use of perioperative analgesics in small animals by Uruguayan veterinarians

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**ABSTRACT.** In recent decades, several articles have reported significant progress regarding pain treatment in veterinary medicine. This study aims to analyse the attitudes of veterinarians working in small animal practices in Uruguay towards the use of analgesics during the perioperative period. Veterinarians in charge of clinics performing surgeries were interviewed, including clinics located in the capital city, Montevideo (n=59) and the rest of the country (n=81), based on data obtained from the National Veterinary Census in 2010. Most interviews were conducted in person, and if not possible, they were carried out through video calls. According to gender, 54% of interviewees were women and 46% were men, with 95% of them practising in urban areas. The most used drugs were nonsteroidal anti-inflammatory drugs (NSAIDs), with dipyron (89%) being the most popular. Amongst opioids, pure agonists presented minimal inclusion in analgesic treatment (13%), with tramadol (93%) being the most used opioid. Drugs belonging to other groups were less mentioned. Thirty-eight per cent of the respondents considered that their training in pain management was inadequate. Veterinarians categorised the intensity of pain caused by several surgical procedures as “severe”, however, they used weak opioids such as tramadol or NSAIDs as a single therapy to treat most cases. The scarce use of analgesic drugs and techniques that provide profound analgesia (such as mu-opioid receptor agonists) by Uruguayan veterinarians reveals the need for open discussion, adjustment of attitudes and continuing education on pain management.

**Keywords:** Analgesics, surgery, animal welfare, pain management.

### INTRODUCTION

Over the last few years, there has been a growing interest in evaluating and treating pain in animals which has been reflected in an increased number of publications on the topic. Although the scenario regarding the use of analgesics in the perioperative period seems to be improving, research shows that it is still suboptimal (Capner *et al.*, 1999; Hansen, 1993; Hugonnard *et al.*, 2004; Lorena *et al.*, 2014; Raekallio *et al.*, 2003; Williams *et al.*, 2005).

The first study that looked into the use of analgesics in veterinary medicine was carried out in the United States, and it reported that in a teaching hospital only 6% of the cats (*Felis catus*) received analgesia in the postoperative period, compared to 40% of the dogs (*Canis familiaris*) (Hansen and Hardie, 1993). In 1999, cats in the United Kingdom received less analgesia than dogs, and treatment of pain in veterinary medicine was suboptimal (Lascelles *et al.*, 1999). Oligoanalgesia in veterinary medicine has also been reported in South Africa, Finland, France, New Zealand, Canada, and more recently in Brazil (Dohoo & Dohoo, 1996; Hewson *et al.*, 2006; Joubert, 2001; Lorena *et al.*, 2014; Raekallio *et al.*, 2003; Williams *et al.*, 2005).

In France, the difficulty to recognise pain, lack of knowledge about the use of analgesics and fear of their side effects were the main reasons for providing insufficient analgesia (Hugonnard *et al.*, 2004). Sociodemographic factors such as gender, years of professional experience, accessibility to drugs and urbanisation of the region studied, influence veterinarians' attitudes toward pain and analgesia. Variants such as religion, environment, gender, age, income, career orientation, and whether they lived with companion or farm animals were considered. Those who showed more interest in animal welfare were students who had companion animals of their own, who lived in urban areas, the youngest ones or the ones who were at the beginning of their professional careers. Moreover, women proved to be more sensitive to animal welfare than men (Ostovic *et al.*, 2017).

This study aimed to determine the current attitudes of Uruguayan veterinarians regarding the use of analgesics in cats and dogs during the perioperative period.

### MATERIAL AND METHODS

In this study, 142 veterinarians in charge of small animal clinics were interviewed in person or through video call. A random selection of veterinarians was used, applying stratification by state/department to avoid geographical bias. The stratification was based on the National Census of Veterinarians of Uruguay, conducted in 2010 by the University of the Republic (Universidad de la República, Udelar), Ministry of Livestock, Agriculture and Fisheries (Ministerio de Ganadería, Agricultura y Pesca, MGAP) and the Society of Veterinary Medicine of Uruguay (Sociedad de Medicina Veterinaria del Uruguay, SMVU), which shows

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that 59% of the veterinarians practise veterinary medicine in the capital city and the remaining 41% are distributed across the country (Gil & Piaggio, 2010).

Those clinics registered in the MGAP as authorised businesses under decree 160/997 were contacted since the census did not present data on how these professionals were distributed throughout the different states (commonly referred to as “departments” in Uruguay). In addition, veterinary clinics that met the other established criteria, including being registered with the National Zoonosis Commission and distributor “Laboratorios Sur”, but were not involved with the MGAP, were also added in order to increase the sample.

The distribution of questionnaires was planned based on the geographic location of 303 small animal clinics that perform surgery according to the MGAP, pursuing a minimum of 61 questionnaires from Montevideo and 81 questionnaires from the remaining departments. The stratification in Montevideo was carried out through the zonal community centres.

The questionnaire used was based on previously published questionnaires (Capner *et al.*, 1999; Hunt *et al.*, 2015; Lascelles *et al.*, 1999; Lorena *et al.*, 2014; Williams *et al.*, 2005) and it collected the following information:

Part I: Demographic data including gender, year of graduation, geographic location, highest academic degree obtained, number of veterinarians and technicians working in the practice.

Part II: Drugs and procedures used regularly to provide pre and/or post-operative analgesia; the expected duration of analgesia after a single preoperative dose of opioid, nonsteroidal anti-inflammatory drug (NSAID), local anaesthetic, dissociative anaesthetic and gabapentinoids, techniques employed including the use of local anaesthetic blockade of peripheral nerves, epidural analgesia, homoeopathy or acupuncture. In this part, the veterinarian indicated the drug or the technique employed but the specification of the technique was not mandatory.

Part III: Perioperative drugs used and the factors affecting the veterinarian’s decision (side effects, cost, information about toxicity and dose, requirement to keep records of use and analgesic efficacy). This part was composed of three tables: opioids, NSAIDs and corticosteroids. Open-ended questions were used to ask respondents about the potential side effects of the different drugs.

Part IV: Different attitudes towards the treatment of pain in different situations. The veterinarians answered eleven statements based on a scale from 1 (completely agree) to 10 (completely disagree).

Part V: Different procedures were listed in a table (laparotomy, fractures, mastectomy, ovariohysterectomy,

dental procedures and orchiectomy) and the interviewees answered in which cases they administered analgesics and when (pre, intra and/or postoperatively, including prescriptions for continued treatment at home), indicating in those cases which drug(s), dose, frequency and route of administration were preferred.

Part VI: Severity of pain in the first 12 hours after specific surgical procedures in cats and dogs. The numerical choices ranged from 1 (painless) to 10 (worst pain possible).

Part VII: Information related to continuing education, if respondents thought that their knowledge in the area was appropriate, forms of updating their knowledge, and whether the veterinarian was the main responsible for monitoring the patients postoperatively.

#### STATISTICAL ANALYSIS

The statistical significance of the association between variables that were recorded as dichotomous (presence or absence of a postgraduate degree, residence in the capital city or other departments, prescription or nonprescription of a certain drug), was verified by Fisher’s exact test, while the association of other categorical variables was contrasted using the Chi-squared test of independence. The significance of the difference between the number of veterinarians in Montevideo and the rest of the country was tested using a difference of proportions test based on a normal approximation. The association of location of professional practice, gender, specialisation, or species treated with degrees of importance or agreement/disagreement with a statement, was verified by classifying the range of scores into three categories: 1 to 3 (agreement), 4 to 6 (indifferent) and 7 to 10 (disagreement), and posteriorly applying Chi-squared tests of independence. A Fleiss’ Kappa test was used to analyse the concordance between pain perceptions. Logistic regression was used to study the tendency to administer analgesics to cats and dogs given several input variables (gender, postgraduate studies, years since graduation, Montevideo vs. other departments, working with colleagues and pain perception). A *P*-value of <0.05 was considered to indicate statistical significance in all cases. All statistical analyses were performed in R 3.6.3.

#### RESULTS

A total of 142 veterinarians were surveyed throughout the country, 43% were female and 57% were male respondents (table 1). Most veterinarians worked exclusively in small animal practice (78.9%) and had graduated recently (58.5% after 2000). Amongst the respondents, 66.9% worked together with other colleagues as part of a team. Only 19% had a specialisation (short-term courses), residency or postgraduate degree (master’s or PhD).

**Table 1.** Demographic data obtained from 142 Uruguayan veterinarians, interviewed about the use of analgesics in small animals.

	Montevideo	Other departments	Total
Location of practice	43%	57%	100%
Female	49%	60.7%	54%
Male	51%	39.3%	46%
Exclusive small animal practice	91.8%	69.1%	78.9%
Mixed small and large animal practice	8.2%	30.9%	21.1%
Graduated 1979-1990	47.6%	52.4%	15.6%
Graduated 1991-2000	45.7%	54.3%	25.9%
Graduated after 2000	57.0%	43.0%	58.5%
Has a postgraduate degree*	29.5% <sup>a</sup>	11.1% <sup>b</sup>	19%
Work alone	40.4%	59.6%	33.1%
Work with colleagues	60.0%	40.0%	66.9%

\*( $P=0.06$ ).

In the second part of the interview, the veterinarians were asked about the use of opioids, NSAIDs and other drugs or techniques employed for pain management. A list of all the opioids and NSAIDs available in the country was provided, and it included an open option referred to as “others/specify”. Concerning the use of opioids, tramadol (93%) was the most used in acute pain by Uruguayan veterinarians, while other opioids such as morphine and fentanyl were used less frequently (12.7% and 11.9% respectively) (table 2). Forty per cent of the veterinarians with a postgraduate degree used morphine and fentanyl, while veterinarians without any type of preparation (hereinafter non specialised) veterinarians rarely used them ( $P<0.01$ ). In addition, 77.7% of the veterinarians who used these drugs worked in the metropolitan area ( $P<0.01$ ). Opioids such as methadone, butorphanol, buprenorphine and meperidine were barely mentioned. There was no difference between genders regarding the use of opioids.

The most commonly used NSAIDs were dipyrone (88.7%) and carprofen (71.1%). Other NSAIDs used were meloxicam (57.7%), firocoxib (52.1%), ketoprofen (46.5%), flunixin meglumine (31.7%) and tolfenamic acid (10.5%) (table 2). All the respondents mentioned at least one NSAID. No difference between genders was observed in the use of NSAIDs.

The use of dissociative agents for pain management was given little consideration by veterinarians in their daily routine (8.5%). The most frequently mentioned local anaesthetic was lidocaine (87.1%), followed by bupivacaine (10.5%). Local anaesthetics were used in procedures such as peripheral infiltrative blocks (72%), perineural blocks (30.3%), intra-articular blocks (9.2%) and finally epidural anaesthesia (7.7%). The use of opioids through epidural administration was rarely mentioned. Only a few veterinarians (12%) mentioned considering gabapentinoids for the treatment of acute pain.

**Table 2.** Percentage of opioids and non-steroidal anti-inflammatory drugs (NSAIDs) used in the perioperative period by 142 Uruguayan veterinarians interviewed about the use of analgesics in small animals.

Drug Type	Drug	n	%
NSAIDs	Dipyrone	126	89
	Carprofen	101	71
	Meloxicam	82	58
	Firocoxib	74	52
	Ketoprofen	67	47
	Flunixin meglumine	45	32
	Tolfenamic acid	16	11
	Tramadol	132	93
	Morphine	19	13
Opioids	Fentanyl	17	12
	Butorphanol	7	5
	Methadone	1	1
	Buprenorphine	1	1
	Meperidine	0	

Among other therapies available for the participants to choose from, acupuncture was the most popular one (8.5%), while homoeopathy, fentanyl patches and physiotherapy were barely mentioned.

In the third part of the interview, the veterinarians were asked to classify as very important, important, not so important, not important or not applicable, different determining factors for the use of opioids and NSAIDs in the perioperative period (including side effects, cost, sedation, available information about the drug and its analgesic/anti-inflammatory effect).

Analgesic effect (96.2%) and information about efficacy, toxicity and dosage (90.9%) were the factors considered by most veterinarians when using opioids in dogs as well

as cats (95.4% and 89.9% respectively). Less than 10% of the veterinarians mentioned considering the side effects to be related to the use of opioids, associating them to central nervous system (sedation) and gastrointestinal effects, such as vomiting. When classifying the data by department, Montevideo considered the analgesic effect to be “very important”, while in the rest of the country less relevance was given to this point ( $P<0.05$ ). Analgesia was considered of “extreme importance” by veterinarians who used more potent opioids, while it was considered “very important” and “important” by those who did not use these drugs ( $P<0.05$ ).

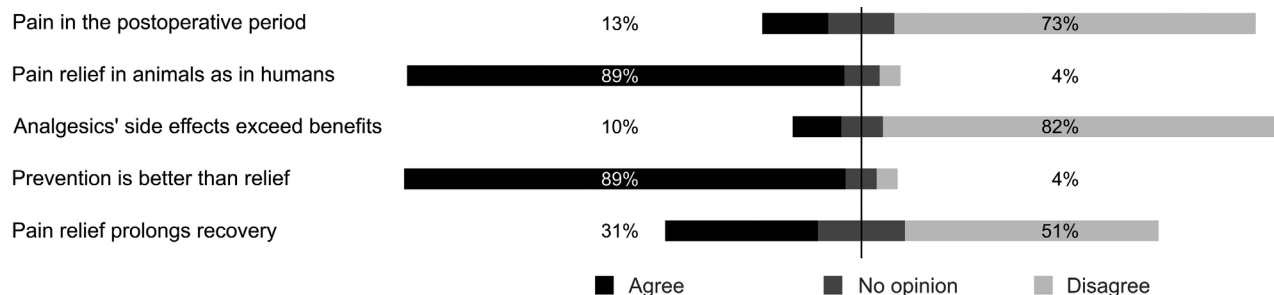
Anti-inflammatory (96.4%) and analgesic effects (95%) were considered important factors for the use of NSAIDs. Gastrointestinal effects such as gastritis, ulcers and vomiting were taken into consideration by most veterinarians when using NSAIDs.

The fourth part of the interview contained a list of statements regarding the recognition and treatment of pain on a scale from 0 to 10, being 0 completely agree, 5 indifferent, and 10 completely disagree. Only 13% of the respondents agreed with the statement “a certain degree of pain in the postoperative period is good because it keeps the animal inactive”. Most veterinarians who disagreed with the previous statement worked in Montevideo (60%), whereas 40% worked in the rest of the country ( $P=0.045$ ). For the statement “animals should receive the same consideration for pain relief as humans”, a high number of professionals in the area agreed (89%), as well as with the phrase “preventing pain is better than relieving it” (89%). The majority of the respondents (82%) disagreed with the statement “analgesics’ side effects exceed their benefits”, in this case, those veterinarians with a postgraduate degree showed more emphasis in their disagreement (96%) than those without one (78%). Roughly half of the respondents (51%) disagreed with the phrase “recovery from anaesthesia can be prolonged by relieving pain”, and those who agreed were more distributed throughout the country (64%) rather than located in the capital city (36%) ( $P=0.022$ , table 1).

The fifth part of the questionnaire consisted of a list of the surgical procedures above mentioned, and the interviewees had to answer in which cases they administered analgesics and when. Dipyrene and tramadol were the most used drugs

in dogs while meloxicam and tramadol were the most used in cats. Tramadol (35%), dipyrene (25%) and meloxicam (9%) were the most used in dogs that underwent laparotomy, while in cats the most used drugs for this procedure were tramadol (35%), meloxicam (21%), dipyrene (17%) and tolfenamic acid (8%). Veterinarians provided analgesia in most cases for both dogs (94%) and cats (88%) ( $P>0.05$ ). During the postoperative period, a low proportion of dogs (23%) and cats (22%) received additional doses of analgesics ( $P>0.05$ ). During orthopaedic postoperative care, analgesics were more frequently prescribed to dogs (92%) than cats (76%) ( $P<0.05$ ). When compared in which moment they used analgesia (pre, intra and/or postoperatively), there were no differences between the variables considered in the logistic regression (gender, postgraduate studies, years since graduation, Montevideo vs. other departments, working with colleagues and pain perception) (table 3). The variable year of graduation was not statistically significant but it presented borderline values, which suggests that it could be influencing the use of analgesia in the postoperative period: veterinarians who had graduated recently were more likely to prescribe analgesics ( $0.1>P>0.05$ ). Veterinarians with postgraduate studies prescribed more analgesia in cats. This tendency was seen with cats only. Veterinarians working in metropolitan areas expressed higher use of analgesics in the postoperative period following ovariohysterectomies in dogs. Veterinarians working with other colleagues provided more analgesia in the postoperative period following fracture repairs in cats. The perception of pain was especially important at the time of prescribing analgesics, mainly in cats. The greater the perception of pain the respondent had, the more likely he/she was to administer analgesia.

Regarding pain intensity associated with each procedure (part VI), scores greater than 5 on the simple descriptive scale were considered as severe pain (Gerbershagen *et al.*, 2011). The procedures that veterinarians perceived as the most painful in dogs were fracture repairs (94%) and ear canal ablation (82%), followed by cruciate ligament repair (79%) and mastectomy (75%) (table 4). In cats, fracture repair (91%) and diaphragmatic hernia (81%) presented the highest pain scores, followed by ovariohysterectomy (63%) and dental procedures with several extractions (60%)



**Figure 1.** Attitudes towards statements related to the treatment of pain in small animals by 142 Uruguayan veterinarians interviewed.

**Table 3.** Results of the logistic regression for postoperative or prescription doses of analgesics in three procedures for cats and dogs by 142 Uruguayan veterinarians interviewed about the use of analgesics in small animals.

Species	DOGS						CATS						
	Fracture repair	Orchiectomy	Ovariectomy	Fracture repair	Orchiectomy	Ovariectomy	Fracture repair	Orchiectomy	Ovariectomy	Fracture repair	Orchiectomy	Ovariectomy	
Timeframe	Postoperative <sup>a</sup>	Postoperative	Prescription	Postoperative	Prescription	Prescription	Postoperative	Postoperative	Prescription	Postoperative	Prescription	Postoperative	Prescription
Gender													
Female (ref.)													
Male	0.97 (0.21, 4.53)	0.65 (0.27, 1.51)	0.98 (0.40, 2.41)	1.09 (0.45, 2.73)	0.70 (0.22, 2.22)	0.97 (0.23, 4.12)	0.57 (0.12, 2.52)	1.16 (0.47, 2.92)	1.22 (0.51, 2.95)	1.28 (0.52, 3.21)	0.85 (0.35, 2.09)		
Graduation year	0.08 (0.002, 0.17)*	0.01 (-0.03, 0.06)	0.04 (-0.001, 0.09) <sup>^</sup>	0.04 (-0.006, 0.09) <sup>^</sup>	0.05 (-0.01, 0.11)	0.001 (-0.07, 0.07)	0.05 (-0.03, 0.13)	-0.01 (-0.06, 0.05) <sup>^</sup>	0.03 (-1.74, 0.08)	0.005 (-0.04, 0.05)	0.045 (-0.001, 0.09) <sup>^</sup>		
Postgraduate degree													
No (ref.)													
Yes	3.35 (0.41, 73.02)	1.52 (0.53, 4.68)	1.93 (0.64, 6.68)	1.54 (0.46, 6.13)	3.39 (0.55, 66.0)	0.77 (0.14, 4.59)	2.31 (0.29, 48.3)	2.57 (0.80, 9.48)	3.30 (1.11, 10.9)*	3.48 (0.98, 16.8)	3.26 (0.93, 15.46) <sup>^</sup>		
Location of practice													
Rest of the country (ref.)													
Montevideo	2.60 (0.49, 17.04)	2.19 (0.94, 5.24) <sup>^</sup>	1.31 (0.54, 3.23)	2.82 (1.16, 7.23)*	2.16 (0.68, 7.80)	0.76 (0.17, 3.24)	5.45 (1.08, 42.3)*	2.19 (0.90, 5.55) <sup>^</sup>	0.82 (0.34, 1.96)	2.11 (0.87, 5.30)	0.97 (0.39, 2.38)		
Practice with colleagues													
No (ref.)													
Yes	1.51 (0.29, 7.34)	2.03 (0.85, 4.89)	1.14 (0.44, 2.84)	1.69 (0.69, 4.09)	1.15 (0.35, 3.59)	5.47 (1.28, 27.3)*	1.09 (0.21, 5.07)	1.77 (0.70, 4.52)	0.98 (0.39, 2.42)	1.18 (0.46, 2.98)	0.83 (0.31, 2.08)		
Pain perception	0.03 (-7.04, 0.68)	0.13 (-0.1, 0.36)	0.23 (-0.001, 0.47) <sup>^</sup>	0.14 (-0.09, 0.38)	0.23 (-0.06, 0.53)	0.33 (-0.19, 0.89)	-0.07 (-0.93, 0.58)	0.24 (0.04, 0.45)*	0.19 (0.005, 0.41)*	0.30 (0.07, 0.54)*	0.14 (-0.09, 0.36)		

Point estimates of odds ratios are presented with the 95% confidence interval (lower and upper limits) in parentheses.

Point estimates of the slopes are presented for graduation year (quantitative) and pain perception (treated as quantitative for this analysis), with the 95% confidence interval (lower and upper limits) in parentheses.

<sup>a</sup> Results for prescription were not reported as the vast majority of practitioners applied prescription rendering the regression useles.

<sup>^</sup> Effect marginally significant (0.1 > P > 0.05); \*effect significant (0.05 > P > 0.01).

**Table 4.** Distribution (percentage) of professionals according to pain perception for eight different procedures in dogs and six procedures in cats.

Procedures in dogs	Total responses	Pain severity										Median (range)
		1	2	3	4	5	6	7	8	9	10	
Fracture repair	140	0.0%	0.0%	0.0%	0.0%	1.4%	1.4%	3.6%	11.4%	12.1%	70.0%	10 (5-10)
Cruciate ligament repair	142	0.0%	0.7%	0.0%	0.0%	5.6%	6.3%	13.3%	26.6%	8.4%	39.2%	8 (2-10)
Exploratory laparotomy	141	0.0%	0.7%	1.4%	2.1%	13.5%	7.8%	14.9%	21.3%	9.2%	29.1%	8 (2-10)
Ovariohysterectomy	142	0.0%	0.0%	2.1%	0.7%	10.6%	4.9%	15.5%	25.4%	8.5%	32.4%	8 (3-10)
Castration	142	0.7%	0.0%	2.7%	2.1%	15.8%	8.9%	20.5%	22.6%	6.2%	20.5%	7 (1-10)
Dental procedure	141	0.0%	1.4%	2.1%	0.7%	15.6%	7.1%	11.3%	23.4%	8.5%	29.8%	8 (2-10)
Ear canal ablation	126	0.0%	0.0%	1.6%	0.8%	4.8%	1.6%	9.5%	12.7%	13.5%	55.6%	10 (3-10)
Mastectomy	140	0.0%	0.0%	0.0%	1.4%	4.3%	7.1%	12.1%	22.9%	13.6%	38.6%	9 (4-10)
Procedure in cats												
Fracture repair	140	0.0%	0.0%	0.0%	0.0%	2.9%	1.4%	4.3%	12.9%	10.7%	67.9%	10 (4-10)
Diaphragmatic hernia	130	0.0%	0.0%	0.0%	0.0%	6.2%	2.3%	10.8%	17.7%	10.8%	52.3%	10 (4-10)
Exploratory laparotomy	141	0.0%	0.7%	2.1%	2.1%	15.6%	5.7%	12.8%	24.8%	10.6%	25.5%	8 (2-10)
Ovariohysterectomy	141	0.0%	0.0%	2.1%	3.5%	9.2%	8.5%	13.5%	22.0%	9.2%	31.9%	8 (3-10)
Castration	141	1.4%	1.4%	4.3%	6.4%	13.5%	7.8%	21.3%	21.3%	2.8%	19.9%	7 (1-10)
Dental procedure	140	0.0%	1.4%	2.9%	1.4%	12.1%	6.4%	15.7%	17.1%	10.0%	32.9%	8 (2-10)

**Table 5.** Detailed Fleiss' kappa coefficients for the pain perception ratings attributed to the procedures listed in table 4.

Rating	Kappa	z	P
2	-0.004	-1.133	0.257
3	0.002	0.701	0.483
4	0.013	3.857	<0.001
5	0.018	5.443	<0.001
6	0.008	2.509	0.012
7	0.013	3.969	<0.001
8	0.006	1.952	0.051
9	0.002	0.636	0.525
10	0.090	27.850	<0.001

(table 5). Exploratory laparotomies in dogs were considered more painful by veterinarians working in metropolitan areas (65%) than veterinarians working in other regions of the country (53%) ( $U=1921.5$ ,  $P<0.05$ ), something similar occurred with cats (68% and 58% respectively) ( $U=2001$ ,  $P<0.05$ ). There was a low concordance (kappa=0.0347, 95% confidence interval 0.0315-0.0379) between veterinarians regarding the degree of pain attributed to different procedures and it was found to be significant ( $P<0.001$ ) only due to the high number of interviews. When analysing by pain

rating (table 5), it is evident that the greatest discrepancies are found near both ends of the pain scale, meaning that while there was agreement on certain procedures that were extremely painful, there was less agreement on the scores for procedures that are found to cause pain less than extreme.

Veterinarians considered that their training for recognition and treatment of pain was provided by clinical experience (89%) and conferences (68%), and a smaller proportion mentioned university education (38%). Moreover, national (69%) and regional events (70%) were considered the best ways of updating their knowledge on the topic.

Many veterinarians (62%) indicated that their knowledge to recognise and treating pain in small animals was adequate. The majority of the veterinarians (91%) reported being responsible for perioperative monitoring of the patients and pain assessment.

## DISCUSSION

This study was based on a total of 142 interviews, all of which were completed satisfactorily and mostly in person. The sampling method used was stratified random sampling and was adopted to avoid bias, allowing to work with a representative sample of the population of small animal veterinarians in the whole country.

No significant differences were found among the professionals interviewed, in concordance with previous studies (Lorena *et al.*, 2014). It was observed that before 2004 most veterinarian graduates were men and from 2005 onwards the majority were women. In Uruguay, since 1990, men and women have entered veterinary school in equal proportion, which explains the results observed in this study (Gil & Piaggio, 2010). A similar event was reported in Canada, where the change occurred in 1994 (Dohoo & Dohoo, 1996; Hewson *et al.*, 2006). Similar to other studies, the majority of the respondents had graduated more than 10 years ago (66%).

Few Uruguayan veterinarians had a postgraduate degree or had specialised in a certain area (19%), similar to what was reported in New Zealand (Williams *et al.*, 2005). In Brazil and Italy, half of the respondents had postgraduate education (Catanzaro *et al.*, 2016; Lorena *et al.*, 2014). In the Uruguayan national veterinary census carried out in 2010, only 17% had a postgraduate degree (Gil & Piaggio, 2010). The reason could be that in Uruguay, to date, there is no specific anaesthesiology discipline in undergraduate or postgraduate programs. Brazil has implemented residency programs since 1983, including a College of Veterinary Anaesthesiology that awards the title of specialist in the area.

Tramadol was used by most of the respondents (93%) and to lesser extent morphine (12.7%) and fentanyl (11.9%). Research has proved that the use of tramadol in dogs is questionable (Donati *et al.*, 2021), recommending more effective opioids for the treatment of acute pain in this species. This is explained by the fact that dogs produce lower concentrations of the metabolite (O-desmetiltramadol) responsible for the analgesic effect than other species (Budberg *et al.*, 2018; KuKanich, 2013; Ruel & Steagall, 2019). It has been described that morphine is more effective than tramadol for dogs undergoing soft tissue procedures such as ovariohysterectomy, ovariectomy and mastectomy (Kongara *et al.*, 2012, 2013; Teixeira *et al.*, 2013). Tramadol was also preferred by most Brazilian and Colombian veterinarians, although more effective opioids such as morphine were used more frequently (51% of the Brazilians and more than 45% of the Colombians) (Lorena *et al.*, 2014; Morales-Vallecilla *et al.*, 2019). Different results were obtained in other countries, for example in Canada the most popular opioids were butorphanol and meperidine (Hewson *et al.*, 2006), while in the United Kingdom buprenorphine was also used, apart from butorphanol (Capner *et al.*, 1999) and in South Africa meperidine was the most popular opioid (Joubert, 2001).

Veterinarians with postgraduate education proved to use opioids with greater analgesic efficacy (mainly in cats), such as morphine and fentanyl, this has also been proved in previous studies (Hunt *et al.*, 2015; Lorena *et al.*, 2014) and could explain why these opioids are not frequently chosen in Uruguay. The availability of opioid drugs in

different countries could explain these differences as well (Lorena *et al.*, 2014).

We can conclude that more than 80% of the veterinarians in Uruguay do not use opioids effectively enough to manage surgical pain. This means that the majority of the surgeries that cause moderate to severe pain, such as fracture repairs, are performed without the use of an effective opioid, analgesic infusions with other drugs or peripheral nerve blocks. Guidelines for anaesthesia and pain management in small animals recommend including full mu-opioid receptor agonists in the analgesic plan for patients that will undergo surgery (Grubb *et al.*, 2020; K. Mathews *et al.*, 2015; Steagall MV *et al.*, 2022). The fact that in Uruguay only 13% of the veterinarians are using fentanyl or morphine has implications on animal welfare, considering that many animals go through procedures such as orchietomy or ovariohysterectomy experiencing pain.

In Uruguay, the acquisition of opioids conducted by the Ministry of Public Health does not consider their use in veterinary medicine, therefore, there is restrictive access to this group of drugs in human pharmacy. There are no full mu-opioid receptor agonists approved for use in veterinary medicine, a factor that could also contribute to the infrequent prescription of these drugs by Uruguayan veterinarians.

In the United States there are regulations in place allowing the patients better access and care by approving these drugs beyond state borders and outside their own clinics (American Veterinary Medical Association [AVMA], n.d.). Similarly, in Brazil the rules dictating the access to opioids were reviewed and adjusted to changes in society and the market (National Agency Health Surveillance [ANVISA], 2017). A report about opioid distribution in Uruguay concluded that the risk of deviation of these drugs in facilities regulated by the Ministry of Public Health is low (Ministry of Public Health [MSP], 2019). This indicates that Uruguay has an effective regulation system of the market, to which veterinarians have almost no access.

Analgesic effect was the most notorious factor influencing veterinarians when choosing treatment with opioids. In contrast, in Brazil, the most common factors were adverse effects and costs. Brazilian and Canadian veterinarians showed more concern towards the excitatory effect in cats and respiratory depression in both cats and dogs (Dohoo & Dohoo, 1996; Lorena *et al.*, 2014), while Uruguayan veterinarians were more concerned about emesis and sedation.

In this study, all the respondents used NSAIDs, dipyrone was the most popular being used by 88.7% of the veterinarians, followed by carprofen (71.1%) and meloxicam (57.7%). Dipyrone was also chosen among most respondents in New Zealand (Williams *et al.*, 2005). Despite its weak anti-inflammatory effect (Monteiro and Steagall, 2019), its analgesic effect and low incidence of adverse effects have been reported and it is recommended to use it as a single medication or in multimodal therapies in dogs

(Silva *et al.*, 2021). In the United Kingdom, veterinarians used meloxicam and carprofen more frequently (Hunt *et al.*, 2015), while in France and Brazil, ketoprofen and meloxicam were the most commonly used drugs of this group (Hugonnard *et al.*, 2004; Lorena *et al.*, 2014). The frequent use of meloxicam in cats seen in this research could be due to several publications reporting its analgesic efficacy in patients undergoing abdominal surgery, and its safety in cats and dogs (Mathews *et al.*, 2001; Slingsby and Waterman-Pearson, 2002). Additionally, in countries such as Brazil and Uruguay, meloxicam for veterinary use can be found in the market in different pharmaceutical presentations including different routes of administration.

Nonsteroidal anti-inflammatories are well tolerated by most animals, with a small number of patients (less than 10%) having to discontinue the treatment due to adverse effects. Some of the side effects known to be caused by NSAIDs include emesis, diarrhoea, gastrointestinal ulcers, nephropathy and hepatopathy. In addition, there are pre-existing conditions and other factors that make the use of NSAIDs contraindicated for certain patients. Therefore, it is important to investigate and consider alternative therapies and promote their use in companion animals (KuKanich, 2013).

According to most respondents, the analgesic effect was one of the main factors considered for the use of anti-inflammatories, both in cats and dogs, similar to the results obtained in the United Kingdom (Hunt *et al.*, 2015). The potential adverse effects and the information available were the most influential factors for Brazilian veterinarians when choosing the treatment (Lorena *et al.*, 2014).

Lidocaine was used by most veterinarians (87.3%), to perform peripheral nerve blocks by infiltration, followed by perineural blocks, these results were similar to the results obtained in New Zealand (Williams *et al.*, 2005).

Analgesic and anaesthetic drugs are commonly used through the epidural route because it provides efficient analgesia and/or anaesthesia (Jones, 2001; Sarotti *et al.*, 2015; Valverde, 2008). However, in Uruguay, epidural drug administration was notoriously low (7.7%) according to this study. It should be noted that the use of epidural drug administration was more frequent in New Zealand based on a study carried on in 2003 (Williams *et al.*, 2005) than in Uruguay in 2019. In Brazil, 30.4% of the respondents employed epidural anaesthesia/analgesia with local anaesthetics and 22.2% with opioids, exceeding the numbers obtained in our territory (Lorena, *et al.*, 2014).

A minority of veterinarians (8.5%) considered dissociative anaesthetics as a component of pain management for acute pain, which contrasts with Brazil where 52% of the veterinarians used these and they were even more popular in the United Kingdom (97%) (Hunt *et al.*, 2015; Lorena *et al.*, 2014). Administered at subanaesthetic doses, ketamine provides an antihyperalgesic effect due to its antagonism of NMDA receptors. After evaluating its analgesic efficacy, several studies reported its benefits, including a decrease

in minimum alveolar concentration (MAC), decreased requirement for rescue analgesia, decrease in pain scores based on acute pain scales, decrease in hyperalgesia associated with surgical sites (Muir *et al.*, 2003; Pascoe *et al.*, 2007; Sarrau *et al.*, 2007; Slingsby and Waterman-Pearson, 2000; Solano *et al.*, 2006; Wagner *et al.*, 2002).

Gabapentinoids were not commonly used by Uruguayan veterinarians to treat acute pain (12%), unlike British veterinarians (68.8%) (Hunt *et al.*, 2015). The Global Pain Council of the World Small Animal Veterinarian Association (WSAVA) recommends the use of gabapentin for preventing or treating postoperative pain or when there is low availability of analgesic drugs (Mathews *et al.*, 2014). The analgesic efficacy of gabapentin has been described when used as an adjuvant for the treatment of perioperative pain in cats and dogs (Crocioni *et al.*, 2015; Schmierer *et al.*, 2020; Steagall *et al.*, 2018; Vettorato & Corletto, 2011). However, some studies question its efficacy in patients with acute pain (Wagner *et al.*, 2010).

Acupuncture was the most popular alternative therapy amongst the respondents (8.5%) while homoeopathy, fentanyl patches and physiotherapy were barely mentioned. In Brazil the most common ones were acupuncture (17%) and homoeopathy (13.8%) (Lorena *et al.*, 2014); Finnish veterinarians incorporated physiotherapy (37%), acupuncture (16%) and homoeopathy (3%) (Raekallio *et al.*, 2003). This difference between Uruguay and other countries could be due to the unavailability of undergraduate and postgraduate courses in such areas, therefore, there is a significant lack of knowledge about alternative therapies offered nowadays in veterinary medicine. Although there is a lack of evidence regarding the efficacy of acupuncture, pharmacopuncture, homoeopathy and physiotherapy which makes the subject quite controversial, these therapies may be effective techniques when associated with conventional drugs such as NSAIDs and opioids (Cassu *et al.*, 2011, 2012; Marques *et al.*, 2015; Nascimento *et al.*, 2019; Pacca *et al.*, 2015; Tomacheuski *et al.*, 2020; Zidan *et al.*, 2018).

Most respondents disagreed with the idea that a certain degree of pain in the postoperative period is good because it keeps the animal inactive, and veterinarians from Montevideo put the most emphasis on this idea (72%). Also, veterinarians of the metropolitan area use more full agonist opioids and considered exploratory laparotomies more painful in dogs and cats. It is significantly worrying that 41% of the respondents still think that pain can be beneficial for recovery. It has been stated that urban areas in greater contact with companion animals show more concern for animal welfare (Ostovic *et al.*, 2017), which could explain the findings in this study. Similar to the results obtained in Brazil, in Uruguay 86% of the veterinarians agreed that animals should receive the same consideration for pain relief as humans. Only 46% of the respondents understood that treating pain does not prolong postoperative recovery, which differs from the results obtained in the neighbouring country (Lorena,



2010). As seen in Brasil, in Uruguay the gender factor did not influence the prescription of analgesics, however, the year of graduation did (the more years that had passed since graduation, the lower the prescription of analgesics) (Lorena *et al.*, 2014).

The greater the perception of pain generated by a procedure, the more likely the administration of analgesia is, except in orthopaedic surgeries where this relationship is not so clear. Based on other studies, orthopaedic procedures have been considered to be the most painful surgeries (Gómez de Segura *et al.*, 2003; Hewson *et al.*, 2006; Lorena *et al.*, 2014). Regarding procedures that veterinarians considered equally painful for cats and dogs, the latter ones received more analgesia. This pattern was repeated in several studies, in which veterinarians provided more analgesia to dogs than cats, even though they perceived certain procedures as equally painful for both species (Capner *et al.*, 1999; Hunt *et al.*, 2015; Joubert, 2001; Lascelles *et al.*, 1999; Reimann *et al.*, 2017; Williams *et al.*, 2005).

The experience gained with practice was considered the best source to acquire knowledge about pain recognition and treatment by most professionals in Uruguay, Brazil, Canada, New Zealand and the United Kingdom (Hewson *et al.*, 2006; Lascelles *et al.*, 1999; Lorena *et al.*, 2014; Williams *et al.*, 2005). Seventy per cent of the respondents thought that the most appropriate way of acquiring new knowledge was through national and regional academic events. Most Uruguayan veterinarians believed that their knowledge of the subject is adequate, similarly to the results obtained in Canada and New Zealand (Hewson *et al.*, 2006; Williams *et al.*, 2005). In contrast, most Brazilian and British respondents classified their knowledge as “insufficient” (Lascelles *et al.*, 1999).

The undergraduate training in the area was considered to be inadequate by most respondents, something similar occurred in New Zealand (Williams *et al.*, 2005). In Canada, undergraduate education was also reported not to be a useful source of information (Dohoo & Dohoo, 1996). In Uruguay, the lack of undergraduate and postgraduate education on pain management could explain the results obtained.

Postoperative monitoring was the responsibility of most Uruguayan veterinarians (91%), differing from lower values obtained in the United Kingdom, and New Zealand (Capner *et al.*, 1999; Lascelles *et al.*, 1999; Williams *et al.*, 2005). In Uruguay, there are no anaesthesia courses for technicians and perhaps this explains the results obtained.

A possible limitation of this study may be related to the availability of veterinarians to answer the questionnaire since many of them were at their workplace at the time of the interview and this factor could have influenced the quality of the answers obtained.

The results obtained in this study reveal that Uruguayan veterinary professionals acknowledge that animals experience severe pain when undergoing diverse surgical

procedures, however, they use weak opioids or NSAIDs alone to treat such pain. The high cost of the drugs, the low number of opioids approved for veterinary use and the lack of postgraduate education in the area seem to explain the differences obtained in this study compared to other countries.

Based on these concerning results, an important debate about animal welfare arises aiming at improving professional training at the University of the Republic. Also, a serious discussion with ministerial authorities about facilitating veterinary access to more potent opioids with affordable costs is needed. In conclusion, the low use of analgesic drugs and complementary techniques which provide profound analgesia by Uruguayan veterinarians reveals the need for open discussion, adjustment of attitudes and continuing education on pain relief in animals.

## COMPETING INTERESTS STATEMENT

The authors declare no conflict of interest.

## AUTHOR CONTRIBUTIONS

All authors have read and approved the current manuscript. JGB was involved in the execution of the study, the statistical analysis and the elaboration of the manuscript. GF contributed to the study design, sampling and data analysis. LR was involved in the execution of the study and elaboration of the manuscript. VM and ER participated in the execution of the project. SPL participated in the critical analysis of the project. NCO was responsible for the study design, execution and critical analysis of the project.

## ETHICS STATEMENT

This study was approved by the Ethical Committee of the Faculty of Humanities at Universidad de la República (protocol approval number 121900-500704-21).

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