Veterinary provision of analgesia for domestic cats (*Felis catus*) undergoing gonadectomy: A comparison of samples from New Zealand, Australia and the United Kingdom.

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Abstract

AIM: To compare the use and provision of analgesia to cats undergoing gonadectomy by a sample of veterinarians in New Zealand, Australia and the United Kingdom.

METHODS: Small animal veterinarians' views and practices on provision of analgesia to cats at three different time phases (pre/intra-operatively, post-operatively and post-discharge) were gathered using an electronic questionnaire. Respondents were also asked to state the pharmacological agent(s) used and the dosage rate(s). Differences in provision of analgesia were assessed relative to the respondent using binary logistic regression. The effects of sex of the patient and time of provision were explored using McNewar's Test and Cochran's Q respectively. Differences between drug types used amongst countries was tested using a cross-tabulation.

RESULTS: There were 717 responses to the survey. Of these 249 (34.7%) were from New Zealand, 269 (37.5%) were from the UK and 199 (27.8%) from Australia. The prevalence of analgesia provision declined across the three different time phases for spaying and castration (both $p<0.001$). Provision of analgesia for castration was less than for spaying at each of the pre/intra-operative ($p=0.002$), post-operative ($p<0.001$) and after discharge ($p<0.001$) phases.

Post-operative provision of analgesia following both castration ($p<0.001$) and spaying ($p<0.001$) differed amongst countries of practice. Veterinarians in Australia and New Zealand

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were more likely to provide post-operative analgesia for both castration and spaying than those from the UK ($p<0.001$). Veterinarians from the UK more commonly used non-steroidal anti-inflammatory drugs (NSAID) in the pre/intra-operative phase ($p<0.001$) than veterinarians from either New Zealand or Australia.

CONCLUSIONS AND CLINICAL RELEVANCE: Contemporary use of analgesics for cats appears focused on provision at clinic and may not address the effects of surgery beyond the first 24 hours. The UK, Australia and New Zealand clearly differ in the types of analgesia administered, possibly reflecting differing professional considerations of the risks associated with the use of NSAID. In the interests of animal welfare, pain relief should perhaps be provided or offered more frequently for owner administration.

KEY WORDS: *Analgesia, cat, castration, desexing, NSAID, opioid, pain, spay*

Abbreviations

ASAVA	Australian Small Animal Veterinary Association
BSAVA	British Small Animal Veterinary Association
BVA	British Veterinary Association
CAS	Companion Animal Society
COX	Cyclooxygenase
F	Female
M	Male
NSAID	Non-steroidal Anti-inflammatory Drug(s)
NZVA	New Zealand Veterinary Association
UK	United Kingdom

Introduction

As the most common elective surgery for cats, gonadectomy is of legitimate interest both in terms of animal welfare and effective companion animal population management. Most owners that present cats at clinic for surgeries do so for elective procedures. Therefore the expectation is that these cats are free from pain prior to provision of veterinary care (Dyson 2008). As such, pain in general and, more specifically, the pain associated with gonadectomy, require careful management. Failure to do so for such a common procedure may impose substantial welfare costs on the animals concerned.

The efficacy of pain management for cats is often elucidated through research which uses ovariohysterectomy as the surgical model (e.g. Al-Gizawy *et al.* 2004; Giordano *et al.* 2010; Cagnardi *et al.* 2011). Pain behaviours following gonadectomy have been found to persist for substantial lengths of time (Väisänen *et al.* 2007; Waran *et al.* 2007) but also diminish following provision of post-operative butorphanol (Rütgen *et al.* 2011). Despite this, analgesia for owner administration following discharge from the clinic has received little attention in the literature. It should be noted that Meloxicam is available as an oral analgesic and has been reported as commonly used "off-label" for treatment of pain in cats (Robertson, 2005). Data concerning longitudinal provision of carprofen (Steagall *et al.* 2009) indicate that prolonged post-operative pain management for cats by their owners may be possible as long as there are no complicating factors (e.g. reduced renal function) and owners do not exceed the stated dose.

In general analgesia provision is affected by the gender, time since graduation (Lascelles et al. 1999) and practice size (Raekallio et al. 2003) of the practitioner. Historically, research into provision of analgesia for cats during or following gonadectomy demonstrates it to be low, especially when compared to dogs (e.g. Williams *et al.* 2005). It is then, perhaps, unsurprising that analgesia for cats has been described as under-provisioned (Robertson, 2005). In general, analgesia provision for castration is less common compared to ovariohysterectomy (Dohoo and Dohoo, 1996; Lascelles *et al*. 1999; Wright 2002; Hugonnard *et al.* 2004; Raekallio *et al.* 2003). In part this is due to the perceived differences in pain caused by the two procedures (Williams *et al.* 2005). This sex difference is also expressed through owner reports where male cats received a significantly lower pain severity score than female cats (Väisänen *et al.* 2007). However, experimentally, this difference may become non-significant after 1.5 hours (Cagnardi *et al.* 2011).

Overall, the literature suggests that under-provision of analgesia to cats arises from their unique physiology, a lack of approved NSAID for use in cats (Lascelles *et al.* 2007) and a general wariness amongst veterinary practitioners when using certain drug types. For example, the perception that opioids induce mania in cats persists (Robertson 2005), despite the fact that this only resulted from doses of 20mg/kg (Dhasmana *et al.* 1972). Similarly it is suggested that concern around the impact of non-steroidal anti-inflammatory drugs (NSAID) on renal function and integrity is evident amongst veterinarians, despite there being suggestion that this is mitigated if they are used correctly (Robertson and Taylor, 2004). The pre-operative use of NSAID such as meloxicam and carprofen is reported as common

practice in the UK and, in healthy cats, renal side effects appear to be rare (Lascelles *et al*. 2007). However, others suggest it should only be used post-operatively and after recovery from anaesthesia (Wright, 2002).

The timing of administration of analgesia is also important as are the combinations of analgesic agents used. Similarly, it has been cited in other species that pre-emptive analgesia may attenuate the post-operative pain response. For example, Lascelles et al. (1997) identified that pre-emptive analgesia using pethidine reduced post-surgical hyperalgesia in dogs following ovariohysterectomy. In turn it is argued that this reduction in nociceptive input may function to reduce the requirements for analgesia post-operatively (Pascoe 2000; Wright 2002). Little research has been conducted that addresses pre-emptive analgesia provision and efficacy for cats specifically.

Elective surgeries also result in pain with a number of root causes (e.g. inflammation and acute tissue injury). Processing of these different insults occurs through a variety of complex mechanisms. In terms of cats, there is little explicit evidence of the value and efficacy of multimodal analgesia in the literature (Lascelles *et al*. 2007) although it is anecdotally reported as commonly used, and efficacious, in a clinical setting (Robertson, 2005). In general, post-operative NSAID provide long periods of analgesia, for example Meloxicam may provide up to 24 hours of pain relief for cats (Robertson, 2005) whereas the opioid hydromorphone may only be effective for up to 5 hours (Wegner and Robertson, 2003). Post-operative pain assessment following ovariohyseterctomy using carprofen, ketoprofen or meloxicam was found to provide appropriate analgesia for the majority of cats for up to 18 hours (Slingsby and Waterman-Pearson, 2000). As such NSAID may be able to significantly reduce pain for the patient even after discharge from the clinic. The length of post-operative cover will depend on whether they are provided as part of the pre-medication, immediately following the operation or sometime after regaining consciousness.

This paper sought to explore the current provision of analgesia to both male and female cats during and following gonadectomy. It is hypothesised that provision of analgesia will be contingent upon the sex of the patient and will be less likely as time since the operation increases. In addition, provision of analgesics is considered relative to the practitioner's gender, time since graduation and country of practice, to establish any effects. We also hypothesise that analgesia provision may be affected by the characteristics of the veterinarian. Finally descriptions of the analgesics used are provided and discussed.

Materials and methods

This study targeted companion animal veterinarians in New Zealand, Australia and the UK. A questionnaire containing 34 questions, taking approximately 10-15 minutes to complete (Supplementary Figure 1) was disseminated on-line (www.surveymonkey.com) through a direct link promoted by the New Zealand Veterinary Association's Companion Animal Society (NZVA-CAS), the British Veterinary Association (BVA) and British Small Animal Veterinary Association (BSAVA) and the Australian Small Animal Veterinary Association (ASAVA). To improve response rates the associations and people responsible for promoting the survey were prompted to remind their members on two occasions during data collection.

Only responses to 17 of the 34 questions are considered in this paper as the other questions related to practices and attitudes concerning implementation of pre-pubertal gonadectomy (Farnworth *et al.* 2013). Information gathered included, basic information about the respondent including gender, year of qualification and country of current practice. In addition respondents were asked about their provision of analgesia, including drugs and dosages used, for male and female cats during gonadectomy. Respondents were also asked about analgesia provision during three specific phases, these being: the intra/pre-operative phase, the post-operative phase and post-discharge phase.

Statistical analyses

The data were described in terms of percentage of respondents providing a given answer as well as providing mean or median values and ranges where appropriate. Statistical analyses were conducted using the Statistical Package for the Social Sciences (SPSS) version 19.0 for Windows (IBMInc, Chicago IL, USA). For the purposes of analysis graduation time was condensed into the categories 0-10, 11-20 and 21+ years. Statistical significance was established at $p < 0.05$.

McNemar's test was to explore whether there were differences in the likelihood (yes or no) that analgesics were provided to male and female cats at three different time stages during gonadectomy, namely pre/intra-operatively, post-operatively and after discharge. We then used Cochran's Q test to test for differences in the likelihood (yes or no) of pain relief provision among the three time phases for both males (castration) and females (spaying). We adjusted the significance levels, to account for the multiple tests, using a Bonferroni correction.

Binary logistic regression was used to determine the possible impact of the main effects of gender of veterinarian, country of practice and graduation time category (0-10 years, 11-20 years, and ≥20 years) on analgesia provision (yes or no) to cats undergoing gonadectomy. The possible effects of the two-way interaction between gender and graduation time and between gender and country of practice and the effect of the three-way interaction of gender, graduation time and country of practice were also examined. We investigated this relationship separately for each combination of time phase and procedure (castration or spay). This avoided issues around independence of error within a single analysis due to repeat measure caused by multiple non-independant responses from each veterinarian To accommodate the use of repeated tests on the same data set we adjusted our threshold significance level using the Bonferroni Correction. The adjusted significant level was calculated at $p = 0.008$.

Finally data concerning the drugs used were tabulated to identify the number of practitioners using multimodal therapies. For the purposes of analysis drugs reported by respondents using trademarked names (e.g. Rimadyl) were re-categorised based on their generic active ingredient (e.g. carprofen). Following cross-tabulation we examined the association between the use of NSAID only, opioid only and opioid/NSAID combination drug regimens and country of practice using chi-square analyses. Other combinations are presented but were too infrequent to allow meaningful statistical analysis. In the analysis we controlled for procedure (castration or spaying). As for the previous analyses the association was tested separately for the two time phases namely the pre-/intra-operative and immediately post-operative periods. Significance levels were also subject to a Bonferroni adjustment with the new threshold level set at 0.025.

Results

Basic demographics

There were 717 responses to the survey. Of these 249 (34.7%) were from New Zealand, 269 (37.5%) were from the UK and 199 (27.8%) from Australia. For New Zealand this response rate represents 41.6% of the total NZVA-CAS membership (249/599 ; S Blaikie,[1] pers. comm.). The UK and Australian samples groups were less easily contacted and the percentage response rates for the UK (269/4500; 6%; T Sainty [2], pers. comm.) and Australia (199/1460; 13.6%; M Cole[3], pers. comm.) are substantially lower than those for New Zealand. A greater percentage of females (F) responded (Australia 75%; New Zealand 58%; UK 66%) than males (M) when compared to the veterinary associations statistics which are as follows: ASAVA: F=49.2% M=50.8%; BVA: F=57.9% M=42.2%; NZVA-CAS F=49% M=51%.

Differences in analgesia use relative to procedure and phase

The likelihood that pain relief would be provided differed between male and female cats at each of the pre/intra-operative, post-operative and after discharge phases ($p = 0.002$; $p < 0.001$; $p < 0.001$ respectively). Similarly the likelihood of pain relief provision showed a significant decline across the pre, post- and after discharge periods for both male (Cochran's $Q = 803.55$; $df = 2$; $p < 0.001$) and female (Cochran's $Q = 730.331$; $df = 2$; $p < 0.001$) cats (see Table 1).

Differences in analgesia provision amongst respondents

Pre-operative analgesia

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A large majority of veterinarians in all combinations of categories (i.e. country, gender and graduation time) provide pain relief during the pre-operative stage of both castration and spaying respectively (Australia: 168/196 (85.7%) and 154/171 (90.1%); New Zealand 227/245 (92.7%) and 213/225 (94.7%); UK 255/265 (96.2%) and 244/249 (98%)). Accordingly the number of responses to the category of "no provision of analgesia" was small or zero. Because of this incomplete information from predictors the statistical procedures associated with the logistic regression are inappropriate. We elected not conduct the analysis at this time phase.

Post-operative analgesia for castration

A test of the full model against a constant only model was statistically significant , indicting the inclusion of the independent variables of gender, country of practice and graduation time significantly improved the chance of predicting category membership (i.e. whether or not pain provision was provided) (χ^2=84.482; df = 15; $p < 0.001$). Examination of the main effects of gender, country of practice and graduation time individually revealed that only the main effect of country of practice was significant (Wald statistic = 13.907; df = 2; p = 0.001) (see Table 2). The proportion of the variance accounted for by the regression model was relatively small at around 16 % (Nagelkerke $R^2 = 0.167$).

Expressed as an odds ratios, New Zealand veterinarians are 2.382 (95 % CI: 1.372-4.138) times more likely to provide post-operative analgesia after castration than UK veterinarians. The equivalent odds ratio for the Australia-United Kingdom comparison is 2.885 (95 % CI: 1.510-5.512)

Post-operative analgesia for spaying

A test of the full model against a constant only model was statistically significant , indicting the inclusion of the independent variables of gender, country of practice and graduation time significantly improves on chance in predicting category membership (i.e. whether or not pain provision was provided) (χ^2=113.24; df = 15; $p < 0.001$). Individual examination of the main effects of gender, country of practice and graduation time revealed that only the main effect of country of practice was significant (Wald statistic = 23.819; df = 2; $p < 0.001$) (see Table 2). The proportion of the variance accounted for by the regression model was relatively small at around 22 % (Nagelkerke $R^2 = 0.223$).

Expressed as odds ratio New Zealand veterinarians are 4.038 (95 % CI: 2.199-7.412) times more likely to provide post-operative analgesia than UK veterinarians. The equivalents odds ratio for the Australia-United Kingdom comparison is 3.193 (95 % CI: 1.604-6.357)

Provision of analgesia for owner administration

A test of the full model against a constant only model was not statistically significant, indicting the inclusion of the independent variables of gender, country of practice and graduation time did not improve on chance in predicting category membership (i.e. whether or not pain provision was provided) for castration (χ^2=12.507; df = 15; p = 0.640) or spaying (χ^2=18.139; df = 15; p = 0.244).

Analgesics used relative to country of practice

When controlling for procedure (castration or spay), we demonstrated a significant association between country of practice and the drug regime (opioids only, NSAID only, combination of opioids and NSAID) for the pre/intra-operative time phase (Castration: χ^2 = 171.521; df = 4; $p < 0.001$, Spay: χ^2 = 191.853; df = 4; $p < 0.001$). The significant difference was driven by the higher likelihood that veterinarians in the United Kingdom would use NSAID only or in combination with opioids when compared to veterinarians from New

Zealand and Australia (Table 3). The differences in drug regime were less marked for the immediate post-operative period (Table 3). However there remained a similar significant association between country of practice and drug regime for castration ($\chi^2 = 13.026$; df = 4; $p < 0.011$) but not for spaying ($\chi^2 = 8.161$; df = 4; $p = 0.086$). The significant effect of country of practice on drug regime appeared largely driven by the relatively higher use of opioids for analgesia provision in New Zealand.

Due to wide variations in the manner in which respondents reported the dosage used for each analgesic and a lack of information about how these were administered these data were excluded from further analysis.

Discussion

In this sample veterinary provision of analgesia for cats undergoing gonadectomy is substantial in the pre/intra-operative phase. It appears from comparison with earlier literature from Australia, New Zealand and the UK that routine provision of analgesia has increased in both the pre/intra-operative and post-operative phases (Watson *et al.* 1996; Lascelles *et al.* 1999; Williams *et al* 2005). Some caution should be taken in interpretation of these findings given the different survey vehicles used and populations sampled. For example, Williams *et al.* (2005) specifically asked about peri-operative use of analgesia which could include some overlap between the pre/intra- and post-operative distinction used in this research. It also surveyed a larger sample of veterinarians and not just those that specialised in companion animal practice. Watson *et al.* (1996) were also not specifically companion animal focused and the use of analgesics for ovariohysterectomy of dogs and cats was reported as a combined percentage of 6% (Watson *et al.* 1996). It should also be noted that, as with any survey, the likelihood for non-response bias is substantial as those choosing not to answer the survey may represent a specific group (e.g. veterinarians that are not interested in analgesia). Even allowing for these distinctions, the authors are confident in their assertion that veterinarians are far more likely to use analgesia for cats in contemporary practice.

In the pre/intra-operative phase the overall provision of analgesics to male and female cats is 92.2% and 95% respectively. This suggests not only a change in the number of practitioners using analgesia but also greater equity of analgesia provision between the two procedures.

Previous reporting in the literature suggests that male veterinarians and those in practice for longer were less likely to provide analgesia (Lascelles *et al*. 1999). Our analyses indicate that although the category 'time since graduation' may explain some of the likelihood that analgesia is provided, the effects are trivial, country of practice explains the majority of any effect. Likewise no evidence for differences between male and female practitioners were found. These changes suggest an overall recognition of the importance of managing pain, both in practice and likely in veterinary education. The under-provisioning of analgesia for cats (Robertson, 2005), in these three countries and for this procedure at least, appears to be waning.

Post-operative analgesia provision is also prevalent in the three countries surveyed indicating that the duration of pain management for cats undergoing gonadectomy is, for many, able to address issues of pain in the clinic. However, post-operative administration of drugs is not as common as pre/intra-operative management, particularly in the UK (Table 2). Improvements may still be able to be made. However it is important to note that those practitioners that provide pre/intra-operative NSAID should exercise caution. Post-operative overdosing of meloxicam (oral provision after previous parenteral dosing) has resulted in renal insufficiency in eight cats in the UK (Dyer *et al.* 2010).

Also of note is the inequity between male and female cats, possibly reflecting the continued perception, rightly or otherwise, that castration is less painful that ovariohysterectomy (Wright, 2002). Anecdotally some respondents to the survey indicated that they would like to provide post-operative pain relief but that clients did not expect to pay extra for the medication and veterinary practices could not be expected to carry the financial burden. This raises an interesting dilemma for veterinary practices in terms of meeting the needs of the patient and the client (owner) as well as establishing exactly how much, and what period, of analgesia is appropriate for gonadectomy. Further research should investigate owner willingness to pay for analgesia and veterinary perception of obligation to provide analgesia following surgery.

There was a general paucity of provision of post-discharge pain relief, 16.1% and 3.8% of respondents provided analgesia for clients to take home following spaying and castration respectively. Practitioners were not asked why they chose to provide, or not provide, analgesia. Possible reasons for non-provision of post-discharge analgesia may include concerns about longer term use of NSAID (Robertson, 2008; Dyer *et al.* 2010), a lack of

owner willingness to pay and a lack of awareness of practitioners as to the potential duration of pain caused by gonadectomy. A recent survey of pet owners' expectations in Great Britain suggests that 61% of owners would expect their pet to be sent home with pain relief following surgery (Demetriou *et al*. 2009). The findings in this research suggest this expectation is not being met following gonadectomy. Further research on pain management following discharge, extending beyond gonadectomy of cats into a range of surgeries and species, may be useful.

In the UK sample mean percentage report of pre/intra-operative NSAID across the two procedures (43.5%) is substantially more commonplace than in New Zealand (5.9%) and Australia (18%). Likewise, although the use of a combined NSAID and opioid pre/intra-operative therapy is relatively uncommon, it is, on average, utilised more frequently by practitioners in the UK (24.4%) than those in New Zealand (2.3%) or Australia (9.7%). In part this may be associated with the length of time that NSAID have been commonly used pre/intra-operatively, although exactly how is hard to clarify. As previously cited there is still some controversy around the use of NSAID in general. Some authors argue that risk is minimal if the dose and anaesthetic regime are appropriate (e.g. Gurney, 2012) whilst others argue more strenuously for caution based on the potential risks (e.g. Wright, 2002). A comparison of Williams *et al.* (2005) with Lascelles *et al.* (1999) indicates that in New Zealand 93% of vets indicated concern about the side-effects associated with NSAID use, compared with only 75% in the UK some 6 years prior. It is not within the scope of this paper to argue for or against pre/intra-operative NSAID use or to dispute what is 'reasonable caution'. However, as asserted by Lascelles *et al.* (2007), there is a clear need for more research which specifically addresses the value of single-mode and multi-modal NSAID therapies and multi-modal therapies in general (Robertson, 2008) in the treatment and amelioration of pain in cats. An epidemiological study of NSAID linked mortality or lasting harm in otherwise problem-free cats may also be useful.

Wider pre/intra-operative use of NSAID in the UK appears to reduce the likelihood that practitioners will provide further post-operative analgesia. Conversely practitioners in Australia and New Zealand show reduced usage of NSAID in the pre/intra-operative phase but more use of NSAID post-operatively. The use of NSAID is often promoted as, in general, it provides a far longer period of analgesia than commonly used opioids (Robertson, 2008). Therefore, later administration, or a post-operative boost, may serve to extend the period of pain relief. Many authors identify that pre-emptive pre/intra-operative use of analgesics,

362 including NSAID, could subsequently reduce the post-operative pain response, and hence the
363 need for analgesia (e.g. Kelly *et al.* 2001). Additionally pre/intra-operative NSAID may also
364 reduce post-operative inflammatory pain. It is reasonable then to pose the question: If limited
365 NSAID analgesia is to be used is it better to provide it post-operatively to extend the period
366 of analgesia (as in New Zealand and Australia), or earlier to avoid subsequent sensitisation
367 and need for increased post-operative analgesia (as in the UK)? There is some research
368 demonstrating the effect of central sensitisation in dogs (Lascelles *et al*. 1997, 1998; Welsh *et*
369 *al.*1997), however currently there is none for cats. The authors recommend more research be
370 undertaken in order to explore this question.

371 It should be noted that respondents were not asked about the mode or timing of delivery for
372 the analgesics given, or the reasons for selection or avoidance of some compounds. This
373 information would be valuable as it would allow elucidation of various aspects of analgesia
374 use in cats. This would include the potential to identify if animals would be under full or
375 partial pain management at various stages of the surgical process.

376 In conclusion, there is clear evidence of significant improvements in analgesia provision for
377 cats across the countries surveyed, although more attention to the pain management of
378 discharged patients may be warranted. The authors identify that much research is still
379 required to understand the value of pre/intra-operative and multi-modal analgesia use in cats,
380 especially as it relates to central sensitisation.

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388 **References**

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Table 1. Overall number (and percentage) of respondents from New Zealand, Australia and the UK (total n=717) reporting provision of analgesia at three different time phases (pre/intra-operative, post-operative and post-discharge) to cats undergoing gonadectomy. Variation in total number is due to missing responses.

Analgesia provided	Pre/intra-operative[a]		post-operative[a]		post-discharge "at home" [a]	
	Castration	Spay	Castration [b]	Spay	Castration [b]	Spay
Yes	650/705 (92.2%)	624/657 (95%)	327/646 (50.6%)	436/651 (67%)	24/635 (3.8%)	103/641 (16.1%)

[a] Percentage of practitioners providing analgesia amongst the three time phases is statistically significantly different for both castration ($\chi^2 = 1045.24$; df = 2; $p < 0.001$) and spaying ($\chi^2 = 853.21$; df = 2; $p < 0.001$).

[b] Percentage of practitioners providing analgesia for males is statistically significantly different as compared to females during the post-operative ($\chi^2 = 30.955$; df = 1; $p < 0.001$) and the post-discharge ($\chi^2 = 54.034$; df = 1; $p < 0.001$) phases.

Table 2: Number (percentage of valid responses) of veterinarians that provide post-operative analgesia to cats undergoing gonadectomy. Data are presented relative to the respondent's country of practice. Differences among the total number of responses and the number of responses in any category are due to missing datum points for specific questions.

Country of practice	Respondents providing post-operative analgesia for castration	Respondents providing post-operative analgesia for spaying
	Yes	Yes
New Zealand (n = 249)	137 (62.6%)	188 (84.3%)
Australia (n = 199)	115 (65.3%)	137 (76.1%)
United Kingdom (n=269)	73 (31.0%)	109 (44.3%)

Table 3. Response of veterinarians (n = 717) to a survey about pain relief for cats undergoing gonadectomy. Data include those that provide one or more analgesics, based on the reported class(es) used. Data represent the analgesic classes used either pre/intra-operatively and post-operatively by veterinarians from the UK, New Zealand or Australia. Numbers are presented as reported use/number of respondents using analgesia (percentage). Variation between numbers is due to non-report of drugs used.

Time Phase	Analgesia	New Zealand		Australia		United Kingdom	
		Spay	Castration	Spay	Castration	Spay	Castration
Pre/intra-operative[a]	Opioid[c] only	171/213 (80.3)	162/227 (71.4)	98/164 (59.8)	97/169 (57.4)	57/244 (23.4)	61/255 (23.9)
	NSAID[d] only	13/213 (6.1)	13/227 (5.7)	29/164 (17.7)	31/169 (18.3)	108/244 (44.3)	109/255 (42.7)
	Opioid/NSAID combination	5/213 (2.3)	5/227 (2.2)	19/164 (11.6)	13/169 (7.7)	66/244 (27.1)	55/255 (21.6)
	Other[e] only	5/213 (2.3)	8/227 (3.5)	5/164 (3)	7/169 (4.1)	-	-
	Opioid/opioid combination	7/213 (3.2)	8/227 (3.5)	4/164 (2.4)	-	2/244 (0.8)	3/255 (1.2)
	NSAID/NSAID combination	-	-	-	-	3/244 (1.2)	3/255 (1.2)
	Opioid/other combination	6/213 (2.8)	5/227 (2.2)	5/164 (3)	6/169 (3.6)	-	-
	NSAID/other combination	-	-	-	1/169 (0.6)	2/244 (0.8)	1/255 (0.4)
	Other combination	-	2/227 (0.9)	1/164 (0.6)	3/169 (1.8)	-	-
Post-operative[b]	Opioid only	34/188 (18.1)	27/137 (19.7)	11/137 (8)	6/115 (5.2)	12/109 (11)	8/109 (7.3)
	NSAID only	127/188 (67.6)	98/137 (71.5)	103/137 (75.1)	97/115 (70.8)	87/109 (79.8)	56/109 (51.4)
	Opioid/NSAID combination	15/188 (8)	5/137 (3.6)	9/137 (6.6)	5/115 (4.5)	7/109 (6.4)	5/109 (4.6)
	NSAID/NSAID combination	4/188 (2.1)	3/137 (2.2)	7/137 (5.1)	6/115 (5.2)	2/109 (1.8)	2/109 (1.8)

Opioid/Opioid combination	1/188 (0.5)	1/137 (0.7)	-	-	-	-

[a] Use of drug categories 'opioid only' NSAID only' and 'opioid/NSAID combination' differ significantly amongst countries for castration and spaying respectively ($\chi^2 = 171.521$; df = 4; $p < 0.001$; $\chi^2 = 191.853$; df = 4; $p < 0.001$)

[b] Use of drug categories 'opioid only' NSAID only' and 'opioid/NSAID combination' differ significantly amongst countries for castration ($\chi 2 = 13.026$; df = 4; $p < 0.011$) but not for spaying ($\chi 2 = 8.161$; df = 4; $p = 0.086$).

[c] Opioids in categories include reported use of: Morphine; buprenorphine; butorphanol; methadone; pethidine

[d] Non-steroidal anti-inflammatory drugs (NSAID) in categories include reported use of: Meloxicam; carprofen; ketoprofen; tolfenamic acid

[e]'Other' in categories includes reported use of: Medetomidine; Ketamine; acepromazine and other miscellaneous agents reported fewer than 4 times by the respondents which are neither opioid nor NSAID