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ORIGINAL RESEARCH

Robenacoxib versus meloxicam following ovariohysterectomy in cats: A randomised, prospective clinical trial involving owner-based assessment of pain

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Abstract

Background: Injectable non-steroidal anti-inflammatory drugs (NSAIDs) are commonly prescribed to queens undergoing ovariohysterectomy (OVH), but the requirement for postoperative administration is unclear and practices vary. Existing studies assessing efficacy rely on pain scoring by experienced clinicians. However, following OVH, most cats are discharged within hours of recovery.

Methods: Cats undergoing OVH were randomly assigned to two treatment groups: MEL and ROB. Cats in the MEL group (n = 76) received meloxicam (0.2 mg/kg) and those in the ROB group (n = 65) received robenacoxib (2 mg/kg). Owners were contacted by a blinded assessor 3 days postoperatively and asked to identify physical or behavioural changes and to assign pain scores using a numerical rating scale.

Results: More cats in the ROB group displayed abnormal behaviours than cats in the MEL group ($p = 0.03$). Most owners assigned a pain score of 0 (72%) (n = 101), but pain scores were significantly higher in the ROB group than in the MEL group ($p = 0.005$).

Limitation: Methods of owner assessment of pain in cats have not been validated.

Conclusions: Both meloxicam and robenacoxib are effective in controlling postoperative pain. Meloxicam may have improved efficacy in certain patient populations. Applying a blanket approach to prescribing NSAIDs to cats undergoing OVH postoperatively may not be necessary. This has safety, environmental and cost implications.

INTRODUCTION

Most cats undergoing ovariohysterectomy (OVH) in the UK receive a non-steroidal anti-inflammatory drug (NSAID) perioperatively.[1] NSAIDs limit the production of prostaglandins by inhibiting cyclooxygenase (COX) enzymatic activity, preventing the sensitisation of peripheral nociceptors to locally produced mediators.[2] Central reduction of prostaglandin synthesis prevents hyperalgesic 'wind-up',[2] possibly through reduced stimulation of N-methyl-D-aspartate receptors.[3] Synergism with opioid analgesics facilitates dose sparing[4,5] and potentially a reduction in opioid dose-dependent side effects.

Meloxicam and robenacoxib preferentially inhibit the COX-2 enzyme. Robenacoxib, a coxib-type NSAID, demonstrates improved selectivity.[6] Reduced COX-1 enzyme interaction theoretically reduces the potential for adverse events.[7] Although the terminal plasma half-life of meloxicam (more than 24 hours)[8] is longer than that of robenacoxib (less than 2 hours), a similar duration of clinical efficacy is achieved.[9,10] The disparity between the plasma half-life of robenacoxib and the apparent length of its clinical effect may be due to

the duration of its persistence in inflamed tissues.[11] Both meloxicam and robenacoxib are licenced for use in cats and clinical studies have demonstrated effective postoperative analgesia in patients undergoing surgical neutering.[12–15]

These studies are largely reliant on pain scoring by experienced clinicians within a hospital environment. However, behavioural changes for reasons other than pain, medication and postoperative dysphoria, such as the presence of unfamiliar personnel, being caged and visual, auditory and olfactory cues, limit these approaches.[16] Cats undergoing short-term hospitalisation also demonstrate stress-related behaviours and may take up to 2 days to adapt to the environment,[17] meaning unnecessary confinement postoperatively has welfare implications.[18] Pain scales should ideally be able to reflect postoperative dysphoria and stress associated with a short-term stay in a novel environment.

In the authors' experience, most cats undergoing OVH are discharged within a few hours of recovery from anaesthesia. In the UK, 67% are discharged without an oral NSAID.[1] Although there are few studies exploring owner assessment of their pets' behaviour postoperatively, there is evidence to suggest that they can recognise behavioural changes associated with chronic[19,20] and post-surgical pain.[21]

Objectives

The study aimed to evaluate the efficacy of meloxicam and robenacoxib in providing postoperative analgesia for cats undergoing OVH following premedication with methadone and medetomidine and anaesthetised with isoflurane. The secondary aims of the study were to determine whether surgical time, surgeon experience, pregnancy, pyometra or uterine anomalies influenced postoperative pain in cats.

A novel approach to pain assessment was used whereby owners were recruited to pain score the cats in their home environment. This was a deliberate refinement designed to assess postoperative pain over a 72-hour period, as perceived by those familiar with the cat's normal behaviours, and in a familiar environment.

MATERIALS AND METHODS

The study was a prospective, randomised, blinded, single centre, controlled clinical study that took place at the RSPCA Branch Clinic, Bolton, UK, in the winter of 2022. The study was carried out under Animal Test Certificate Type S (03057/0001). Ethical approval was granted by the University of Nottingham Ethics Committee (no. 3695 221019).

Animals

One hundred and forty-four entire female cats were recruited. Written informed consent was obtained from the owner or foster carer prior to acceptance. Female cats assigned an American Society of Anaesthesiologists (ASA) category I or II were enrolled in the study, including pregnant and lactating queens and kittens weighing more than 700 g. Criteria for exclusion included previous neutering surgery, ASA grade more than III and a positive SNAP ELISA test result for feline leukaemia virus (FeLV) and/or feline immunodeficiency virus (FIV) (FASTest FeLV-FIV, Diagnostik Megacor). Cats were randomly assigned to one of two treatment groups, MEL or ROB, using an online sample randomiser (www.randomizer.org).

Anaesthesia and surgery

Cats were admitted on the day of surgery and owners were advised to fast the animals for 12 hours prior to surgery. The animals were weighed, and body surface area (BSA) was calculated using the formula BSA = bodyweight$^{2/3}$ × 0.1. Cats were weighed before premedication with 6 mg/m^2 methadone (0.36–0.69 mg/kg) (Comfortan, Dechra) and 0.6 mg/m^2 medetomidine (0.04–0.07 mg/kg) (Sedator, Dechra) by intramuscular (IM) injection into the quadriceps muscles. Ten minutes after premedication, anaesthesia was induced with isoflurane (IsoFlo, Zoetis) in 100% oxygen via a tight-fitting face mask. The vaporiser was set at 2% for 1 minute, after which the fresh gas flow was switched off and the end of the breathing system was capped to prevent environmental contamination with isoflurane. The larynx was desensitised with lidocaine hydrochloride (Intubeaze, Dechra). Cats received isoflurane for a further minute prior to intubation of the trachea with an appropriately sized non-cuffed endotracheal tube.

Cats assigned to the MEL group received 0.2 mg/kg meloxicam (Metacam, Boehringer Ingelheim) and those assigned to the ROB group received 2 mg/kg robenacoxib (Onsior, Elanco) by subcutaneous (SC) injection. All cats received 15 mg/kg amoxicillin (Betamox, Norbrook).

Anaesthesia was maintained with isoflurane delivered in oxygen via an Ayres T-piece with Jackson Rees modification. Heart rate, respiratory rate, capillary refill time, mucous membrane colour, palpebral reflexes and eye position were assessed at 5-minute intervals.

OVH was performed using a ventral midline approach by veterinary surgeons and supervised veterinary students blinded to the treatment group. The times of the first incision and placement of the last suture were recorded. Pregnancy, lactation, pathology or anatomical anomalies were recorded.

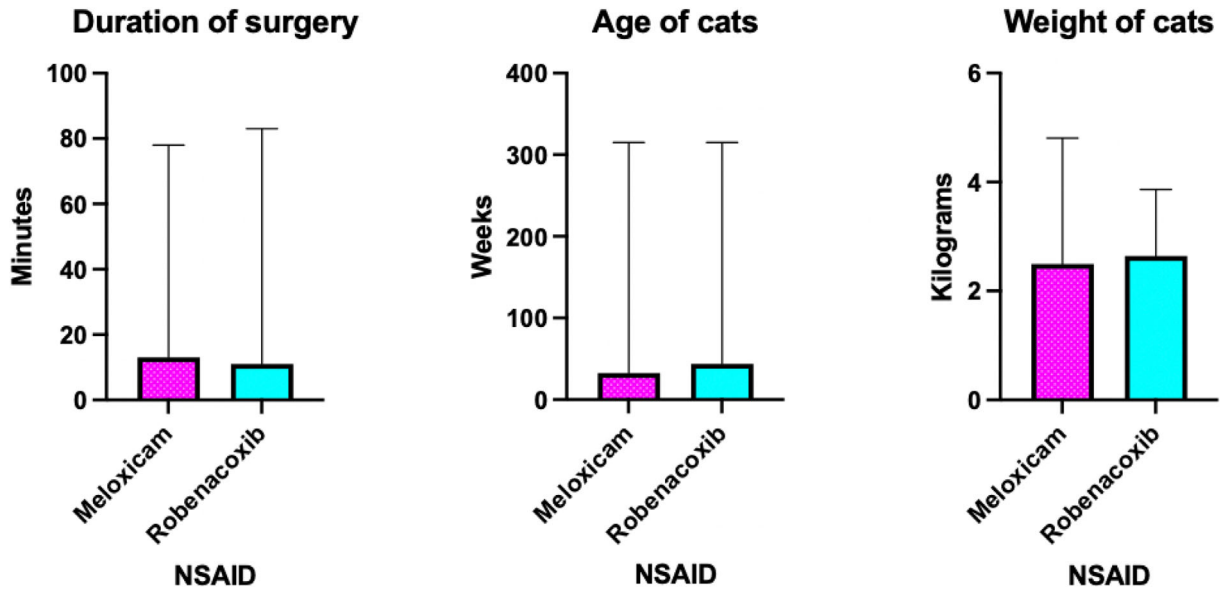

FIGURE 1 Baseline and demographic data (duration of surgery, age of cats and weight of cats). NSAID, non-steroidal anti-inflammatory drug

At the end of surgery, the cats were extubated, and 0.1 mg atipamezole (Atipam, Dechra) was administered by IM injection into the quadriceps muscles. Following extubation, patients were placed in a heated kennel to recover.

Postoperative assessment

Cats were discharged from the clinic 4–6 hours postrecovery and owners were advised on how to identify signs of pain in their cats and told to monitor them closely for 3 days. Owners were given a leaflet based on the short form of the Glasgow Composite Pain Scale, which listed signs of pain and included images of both a painful and a non-painful cat. The leaflet was designed to be accessible to clients with a range of educational needs by including non-verbal instruction. Closed-loop communication was used during the appointment to ensure that owners had understood the directions. They were advised to contact the clinic or the out-of-hours service if they had concerns, including the need for analgesia. Appointments were offered free of charge to prevent any cost-associated disincentive to seek veterinary assistance.

Owners and foster carers were telephoned 3 days after surgery by a blinded assessor and asked a series of questions to determine whether they had perceived postoperative pain in their cat in the initial 72 hours following discharge from the clinic. All telephone questionnaires were undertaken by the same assessor. Verbal responses were transposed into Google Forms.

Statistical analysis

In cats undergoing OVH, the prevalence of rescue analgesia was 25% when using medetomidine and methadone without NSAIDs[22] and 0% in cats receiving medetomidine, methadone and NSAIDs.[23] The perceived need for rescue analgesia was considered the primary outcome since it provides important information about the owner's decision-making process. A sample size calculation indicated that 67 cats per group would be required to show a statistically significant difference (more than 4 points) in pain score, as determined by the owners using a numerical rating scale (NRS) 1–10, with an effect size of 0.4, alpha 0.5 and power 80% (G Power 3.1). The sample size was increased to 70 cats per group to account for exclusions and cats being lost to follow-up and to minimise type II error.

Statistical analysis was carried out using SPSS (version 28.0.1.1) and GraphPad Prism (version 9.4.1). The normality of the data was assessed using the Kolmogorov–Smirnov test. Baseline and demographic data were compared between the two groups using the Mann–Whitney *U*-test for continuous or ordinal data and Pearson's chi-squared or Fischer's exact tests for categorical data as appropriate. Tests were two-sided and the *p*-value was set at 0.05.

Cohen's kappa coefficients were calculated for all pairwise behaviours. The results were interpreted as a κ-value of 0.75 or more indicating strong agreement and a κ-value of 0.4 or less indicating poor agreement.

Spearman's coefficient was used to test the correlation between baseline and demographic data and owner-assigned NRS pain score. The interpretation of the association was as follows: 0.00–0.19 = very weak, 0.20–0.39 = weak, 0.40–0.59 = moderate, 0.60–0.79 = strong and 0.80–1.00 = very strong.

RESULTS

Demographic and baseline data

One hundred and forty-four cats were enrolled and 141 completed the study. Three cats were excluded because the assessor was unable to contact the owner.

TABLE 1 Baseline and demographic data (breed)

Variable: breed	MEL group ($n = 76$)	ROB group ($n = 65$)
Domestic short-haired cat	71	58
Domestic long-haired cat	4	6
Ragdoll	1	1

Abbreviations: MEL, meloxicam; ROB, robenacoxib.

TABLE 2 Baseline and demographic data (surgeon)

Variable: surgeon	MEL group ($n = 76$)	ROB group ($n = 65$)
A	38	41
B	1	1
C	18	11
D	9	8
E	10	4

Note: A—qualified veterinary surgeon with >30 years of experience in clinical practice. B—qualified veterinary surgeon with <1 year of experience in clinical practice. C—qualified veterinary surgeon with <3 years of experience in clinical practice. D—qualified veterinary surgeon with >20 years of experience in clinical practice. E—final year veterinary students.
Abbreviations: MEL, meloxicam; ROB, robenacoxib.

Surgeries were carried out by four qualified veterinary surgeons or by veterinary students under supervision. There was no significant difference between the two groups in terms of age ($p = 0.4$, 95% confidence interval [CI] −3.7 to 15.4), bodyweight ($p = 0.8$, 95% CI −0.3 to 0.26) or surgical time ($p = 0.5$, 95% CI −3 to 1). Demographic and baseline data are presented in Figure 1 and Tables 1 and 2.

Ninety-eight percent of respondents were female ($n = 138$), with few male owners ($n = 3$) participating. No significant difference was found in the age of respondents across the groups ($p = 0.64$).

Of the 141 cats that completed the study, 8.5% ($n = 12$) were pregnant (seven from the MEL group [9.2%] and five from the ROB group [7.7%]). In 20 cats (14%), pathology or an anatomical anomaly was identified (nine from the MEL group [6.4%] and 11 from the ROB group [17%]) (Table 3). There was no significant difference in the distribution of pregnant animals ($p = 0.5$) and those with pathology or unusual anatomy ($p = 0.47$) between the groups.

All cats were discharged from the hospital the same day and none required rescue analgesia prior to this.

Owner responses

There was no significant difference in the number of owners who reported being concerned about their cat between the groups ($p = 0.06$). In the ROB group, 22% ($n = 14$) of owners were concerned about their cat during the 72-hour postoperative period, compared with 7.9% ($n = 6$) in the MEL group. One owner from the ROB group reported being extremely worried, and this cat was admitted to the out-of-hours service with vomiting and diarrhoea. However, more cats in the ROB group ($n = 21$, 32%) displayed abnormal behaviours during the initial postoperative period than in the MEL group ($n = 12$, 16%) ($p = 0.03$), and those doing so in the ROB group took longer to return to normal ($p = 0.02$).

TABLE 3 Summary of pathological findings and anatomical anomalies

Pathology/anatomical anomaly	MEL group ($n = 9$)	ROB group ($n = 11$)
Ovarian cyst	2	1
Tight ovarian suspensory ligament	0	1
Abnormal uterine tone	4	1
Uterine hyperplasia	1	0
Vascular uterus	0	1
Pyometra	0	1
Renal agenesis and uni-cornuate uterus	0	1
Mammary hyperplasia	1	4
Mammary trauma	0	1
Previous pelvic fracture	1	0

Abbreviations: MEL, meloxicam; ROB, robenacoxib.

TABLE 4 Owner-assigned response scores for the change in behaviours of cats administered meloxicam (MEL) or robenacoxib (ROB) prior to elective ovariohysterectomy in their home environment in the 72-hour postoperative period

	MEL group ($n = 76$)			ROB group ($n = 65$)		
	−1	0	+1	−1	0	+1
Activity level	5	67	0	11	50	1[a]
Sleeping	1	68	7	0	49	16
Interaction with owner	5	64	7	15	115	11
Vocalising	0	74	2	0	65	0
Hiding	0	74	2	0	60	5
Crouching	0	76	0	0	64	1
Playing	6	69	0	5	52	0
Appetite	0	75	0	6	59	0
Drinking	0	76	0	0	64	0
Urinating	0	76	0	0	64	1
Defecating	0	76	0	2[b]	61	2[c]

Note: Owners were asked to indicate whether there were any changes in their cat's behaviour compared with normal. Scores were defined as −1 = decreased expression of behaviour, 0 = no change in behaviour, +1 = increased expression of behaviour.
[a]Pyometra.
[b]Had not passed faeces at 72 hours.
[c]Postoperative diarrhoea.

More cats in the ROB group (19%, $n = 12$) demonstrated a change in activity level ($p = 0.04$) than cats in the MEL group (6.9%, $n = 5$). Compared with cats in the MEL group, more cats in the ROB group were also sleeping more than usual (25%, $n = 16$ cf. 9.2%, $n = 7$, $p = 0.04$) and exhibiting increased hiding behaviours (7.7%, $n = 5$ cf. 2.6%, $n = 2$, $p = 0.03$). However, there were no significant differences in reduced play (7.7%, $n = 5$ cf. 7.9%, $n = 6$, $p = 0.56$), crouching (1.5%, $n = 1$ cf. 0%, $n = 0$, $p = 0.25$) or vocalising ($n = 0$, 0% cf. $n = 2$, 2.6%, $p = 0.05$) between the two groups (Table 4).

Levels of interaction did not differ significantly between the groups ($p = 0.2$) and there was no significant difference in the time taken for cats to start to interact with the owner ($p = 0.425$) (Table 4).

Cats in the ROB group were significantly more likely to have a reduced appetite than those in the MEL group ($n = 6$, 9.2% cf. $n = 0$, 0%, $p = 0.008$). One cat refused food altogether. Cats in the ROB group were also significantly less likely to defecate normally ($n = 4$, 6.2%) than than those in the MEL group ($n = 0$, 0%) ($p = 0.041$). All owners who responded to the question reported that their cats were drinking normally. However, one owner noted that their cat was urinating more than normal. This cat belonged to the ROB group (Table 4).

Two cats from the ROB group were reluctant to jump and one cat from the MEL group refused to climb the stairs. The owner of one cat from the MEL group described the cat as 'spaced out' and another as 'grumpy'.

Kappa coefficients suggested poor or no agreement between all but one set of paired behaviours ($\kappa \leq 0.04$). There was a moderate correlation between eating and defecation behaviours ($\kappa = 0.59$, CI −0.56 to 1.7, $p \leq 0.001$).

Owner-reported postoperative wound assessment

Most owners (95%) were able to observe their cat's wound and considered the incision site normal. One owner (1.3%) from the MEL group reported the wound to appear different from normal skin, compared with six (9.2%) owners from the ROB group ($p = 0.046$). This owner described the wound as lumpy, while wounds of cats in the ROB group were described as red ($n = 2$, 3%), red and swollen ($n = 2$, 3%), red and swollen with a lump ($n = 1$, 1.5%) and crusty looking ($n = 1$, 1.5%). Two owners (3.0%) from the ROB group did not look at the wound, one because the cat was uncooperative and the other because they were concerned about causing distress.

Twenty-seven percent of cats ($n = 38$) were licking or nibbling the wound but there was no significant difference between groups ($n = 18$, 28% cf. $n = 20$, 26%, $p = 1.0$).

One cat from the ROB group (1.5%) vocalised in response to the owner touching the wound and one cat from the MEL group (1.3%) slightly flinched. One owner did not respond to this question. The remaining cats ($n = 138$, 98%) did not react to palpation.

Outdoor access

Twenty-one percent of cats ($n = 31$) had access to the outdoors preoperatively. Of these cats, 90% ($n = 28$) had been allowed outdoor access within 24 hours of discharge from the hospital, despite advice to the contrary.

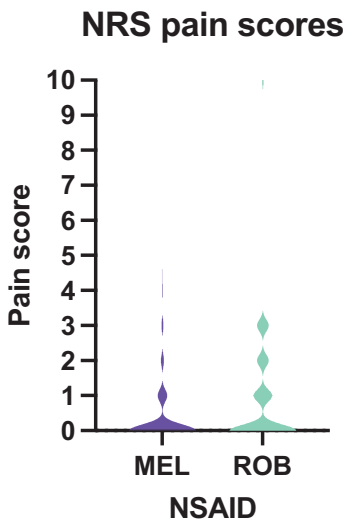

FIGURE 2 Violin plot of owner-assigned pain scores using a numerical rating scale (NRS) for cats receiving meloxicam or robenacoxib. MEL, meloxicam; NSAID, non-steroidal anti-inflammatory drug; ROB, robenacoxib

Owner-assigned NRS pain scores

Pain scores were assigned by owners using an NRS (Figure 2). Scores for the ROB group were significantly higher than those for the MEL group ($p = 0.005$). Scores for all except one cat ranged between 0 and 4. The median pain score for the MEL group was 0 (range 0–4) and the median pain score for the ROB group was 0 (range 0–10). The cat from the ROB group assigned a score of 10 was the same animal admitted to the out-of-hours service. When this cat was excluded from the analysis a significant difference was still observed ($p = 0.009$). One owner identified facial signs of pain, holding its ears out and to the side. The cat belonged to the ROB group and the owner assessed it to be mildly painful.

Forty-one owners (29%) assigned a score greater than 0, including 19.7% of owners from the MEL group ($n = 15$) and 40% ($n = 26$) from the ROB group. Of these, 75.6% ($n = 31$) identified behavioural changes in the cat. A total of 61.2% ($n = 19$) of these were from the ROB group and 38.7% ($n = 12$) of these were from the MEL group, and these owners cited behavioural change as the reason for their NRS score. Twenty-two percent ($n = 9$, three from the MEL group and six from the ROB group) did not recognise any behavioural change but assumed their pet must be painful following surgery. Of the 70.9% ($n = 100$) owners who assigned a score of 0, 93% ($n = 93$) did not note any change in their pet, while 7% ($n = 7$) identified some behavioural change but attributed this to tiredness or feeling unwell rather than pain. Of those who identified a behavioural change, 71.4% were owners of MEL group cats ($n = 5$) and 1.4% were owners of ROB group cats ($n = 2$).

There was a weak positive correlation between owner-assigned pain score and surgical time ($r_s = 0.18$, $p = 0.03$) and pregnancy ($r_s = 0.17$, $p = 0.048$). However, there was no correlation between pain score and

age, bodyweight, the presence of pathology or surgeon experience.

Seven percent ($n = 10$) of owners would have given their cats additional analgesia in the 72-hour postoperative period. Significantly more owners of cats in the ROB group ($n = 9$, 14%) indicated that they would have done so compared with owners of cats in the MEL group ($n = 1$, 1.3%) ($p = 0.006$).

DISCUSSION

The results of this study corroborate previous reports[21,24] that suggest owners recognise changes in their cat's behaviour postoperatively. Clients registered at the practice receive veterinary care subsidised by a charity, and in the authors' experience, owners who are either unemployed or retired on a low income spend considerable time with their pets and are therefore likely to notice subtle behavioural changes. Behaviours identified included altered activity level, sleeping pattern, appetite, movement and interaction with people. One owner also detected a change in facial expression.

Both the Feline Grimace Scale (FGS) and the Glasgow Composite Measure Pain Scale-Feline are validated in cats[25,26] and include assessment of facial expression to discriminate between painful and non-painful animals. Good correlation is reported between pain scores assigned by clinicians and owners using the FGS.[27] However, it is unclear whether owners interpret behavioural changes as pain or attribute them to other causes.[21] In our study, most owners correlated changes in behaviour with pain, with just 7% ($n = 7$) suggesting otherwise.

It is therefore likely that the low number of painful animals is the result of few painful cats rather than a lack of recognition by owners. However, because owner assessment was not compared with veterinary staff scores, it is not possible to verify this. Nevertheless, as owners understand that pain impacts animals' quality of life and the need for analgesia,[28] their ability to detect subtle changes indicates that, with appropriate instruction, they could determine when to seek veterinary advice.

None of the cats enrolled in the study required rescue analgesia prior to discharge from the hospital, and in the 72-hour postoperative period, only 7% ($n = 10$) of owners believed their cat required additional pain relief. Owner-assigned NRS pain scores were significantly higher for the ROB group than for the MEL group ($p = 0.005$). This contrasts with the findings of Speranza et al.,[29] who reported non-significant but lower mean scores for cats receiving robenacoxib compared with meloxicam, and Kamata et al.,[15] who reported the superiority of robenacoxib. Further investigation is warranted to fully understand the significance of these findings.

Owners may be able to detect subtle changes in their cat's behaviour in response to drug-related behavioural modifications unrelated to pain. Sano et al.[24] found that owners were able to detect differences in their cat's behaviour following administration of either robenacoxib or ketoprofen for acute musculoskeletal disorders, but the difference did not correlate with pain scores assigned by clinicians. Although NSAIDs primarily inhibit the expression of peripheral COX-2, they also act centrally. The expression of COX-2 receptors in the central nervous system of rats[30] and dogs[31] has been demonstrated but has not been investigated in cats. Additionally, there is evidence that NSAIDs interact with endogenous opioids[32] and serotonergic receptors,[33] both of which affect behaviour in mammals.

An alternative explanation relates to the disparity between the relatively short plasma terminal half-life of robenacoxib (less than 2 hours) and its apparent duration of action in cats, hypothesised to result from its tendency to selectively distribute to and persist in inflamed tissue.[11,34,35] It is possible that the duration of efficacy is dependent upon the degree of inflammation. Speranza et al.[29] compared the NSAIDs in cats undergoing orthopaedic surgery, while Kamata et al.[15] included cats undergoing both elective and non-elective soft tissue and orthopaedic surgery. Cats in these studies are more likely to have pre-existing inflammation compared with the population in this study. Furthermore, the mean age of cats in these two studies was 3.5 (3.8) years. Mizorogi et al.[36] have reported a higher concentration of the inflammatory marker serum amyloid A in older cats, suggesting that, as in humans, background inflammation increases over time. It is possible, therefore, that demographic factors and disease status may affect the comparative efficacy of robenacoxib and meloxicam.

Demographic factors may also influence behavioural expression of pain. Although there was no correlation between age and owner-assigned pain score, it has previously been reported that cats aged less than 12 weeks score lower on postoperative assessment using a dynamic and interactive visual analogue scale than mature animals.[37] It is possible that the low median age of cats enrolled in this study contributed to the infrequent expression of pain-related behaviours. In contrast to the report by Polson et al., a very weak positive correlation between owner-assigned NRS pain score and pregnancy ($r_s = 0.17$, $p = 0.048$) was identified, but the significance of this is unclear given the low number of pregnant animals included.

Opioids are known to cause euphoria in cats, characterised by purring, rubbing, rolling and kneading.[5,38,39] This may explain the increased purring observed in two cats. Both cats were pregnant, and as purring increases around the time of parturition, hormonal changes resulting from the removal of reproductive tissue may provide an alternative explanation.

Surgeries were carried out by staff with varied skill levels but most were performed by an experienced surgeon. While there was no correlation between owner-assigned NRS pain score and surgeon experi-

ence, the median surgical time in this study was short, 13 minutes for the MEL group and 11 minutes for the ROB group. A weak positive correlation between surgical time and NRS pain score ($r_s = 0.18$, $p = 0.03$) was identified. Similar conditions may not be achievable in some veterinary practices due to relative surgeon inexperience. Surgical approach was via a ventral midline laparotomy and, although this approach has not been shown to influence pain score significantly,[40-42] wound tenderness is reduced when compared to flank celiotomy.[42] However, approximately 96% of veterinary surgeons in the UK elect to perform OVH via a flank approach.[43]

In the UK, most cats undergoing OVH are discharged the same day, and in two-thirds of cases, they are not provided with oral postoperative analgesia.[1] It is likely that this was historically lower.[44] In the authors' experience, this practice is increasingly commonplace and there are, at present, no studies assessing the requirement to do so.

In cats, the safety margin of NSAIDs is relatively narrow because of a reduced ability to undertake hepatic glucuronidation.[45-47] An oral formulation of robenacoxib is available (Onsior, Elanco) but is not currently licenced for the treatment of pain associated with soft tissue surgery in the UK. Meloxicam oral suspension for cats is licenced for the 'alleviation of mild to moderate postoperative pain and inflammation following surgical procedures' as a 0.5 mg/mL solution in bottles of 3, 5, 15 or 30 mL and is licenced for use at 0.05 mg/kg every 24 hours following a 0.2 mg/kg SC injection. For a 2.5 kg cat, at least four times the necessary amount for a 3-day course will be dispensed. There is, therefore, the potential for owners to administer significant overdoses to their cats or to retain unused medication for future use, which has possible safety implications.

Additionally, for many owners, there may be practical limitations associated with administering oral medication. Cats tend to eat several small meals, often preferring to do so at night,[49] and in the UK, an estimated 42% of cats live in multi-cat households.[48] This makes it harder for owners to ensure that the correct animal has received the medication and may necessitate administration directly into the mouth, which many owners find difficult.[50] Furthermore, 70% of cats in the UK have outdoor access.[48] Considerably fewer cats enrolled in this study were allowed outside preoperatively (21.5%, $n = 31$). However, given that the majority of owners of those who did have outside access did not follow advice to confine their cat postoperatively, poor compliance is likely.

The unnecessary dispensing of drugs has cost and environmental implications. In charity practice, unnecessary resources could be redistributed to extend the service to more animals or to fund other welfare initiatives. In private practice, ensuring the affordability of gonadectomy is important, with some owners citing cost as a consideration when deciding whether to neuter their animals.[51] Furthermore, all drugs have a carbon footprint resulting from their manufacture, packaging, transport and disposal and prescribing practices have been shown to have a significant impact on emissions in human hospitals.[52] In an era in which the environmental sustainability of the veterinary industry is an increasingly important consideration in clinical decision making, any means of reducing carbon footprint and waste is worthwhile.

CONCLUSIONS

Owners are able to recognise postoperative changes in feline behaviour and to attribute this to pain, which supports the findings of earlier publications,[21,24] and their assessment of pain can be utilised by veterinary surgeons in practice to determine the need for postoperative analgesia. The preoperative administration of both meloxicam and robenacoxib to cats at licenced doses is effective in controlling post-surgical pain in cats undergoing OVH using the protocol described in this study. This is likely to be the case for other protocols that use effective multimodal analgesia. The majority of cats do not demonstrate signs of pain in the 3-day postoperative period, and in those that do, it is mild. In this study, meloxicam appeared to have greater efficacy than robenacoxib, which may be associated with the patient demographics. Further work is required to determine whether this is indeed the case.

The findings of this study suggest that there may not be a requirement to dispense a course of oral NSAIDs to all cats undergoing midline OVH. Instead, prescribing practices may be based on individual patient assessment rather than a blanket approach. This is important, as NSAIDs have a narrow safety margin in cats, meaning that indiscriminate use poses a risk to patients. The findings also have implications in situations where cost is a concern and for environmental sustainability.

AUTHOR CONTRIBUTIONS

Florence Hillen, Sally Polson, David Yates, Rachel Watkinson and Kate White were responsible for all aspects of the planning and conduct of the study and collecting the data. Florence Hillen and Kate White analysed the results and wrote the manuscript. Florence Hillen, Sally Polson, David Yates, Rachel Watkinson and Kate White reviewed the mansucript. Florence Hillen, Sally Polson, David Yates, Rachel Watkinson and Kate White were responsible for content as guarantors.

CONFLICT OF INTEREST STATEMENT

The authors declare they have no conflicts of interest.

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DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

ETHICS STATEMENT

Ethical approval was granted by the University of Nottingham Ethics Committee (no. 3695 221019).

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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